Global Methodology for **Infrastructure Resilience** Review

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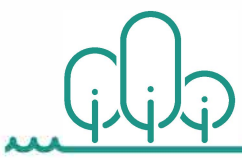
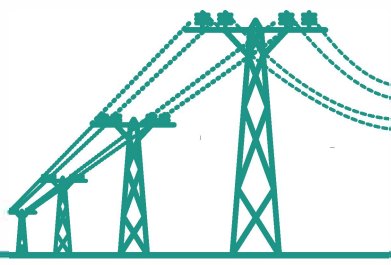




Executive summary

Taking proactive measures to make infrastructure systems capable of withstanding disruptions from a wide range of hazards will minimize both economic and human losses, in addition to yielding significant economic benefits. To achieve this goal, countries need to establish effective legal and policy frameworks and strengthen institutional arrangements.

This methodology, developed by the United Nations Office for Disaster Risk Reduction (UNDRR) and the Coalition for Disaster Resilient Infrastructure (CDRI), aims to support countries in assessing the current state of infrastructure resilience, so that areas of improvement are identified, and actions taken.

The methodology comprises the following five steps:

Step 1: Map institutional governance and identify key stakeholders

The first step consists of mapping the stakeholders involved in infrastructure development, such as ministries, regulators and operators, as they play an important role in building infrastructure resiliency. In addition to identifying stakeholders responsible for disaster risk reduction (DRR) and overall infrastructure development, users of this methodology also need to engage stakeholders active in each critical infrastructure sector, such as energy, transport, information and communication technologies (ICT), and water.

Step 2: Review existing policies and regulations

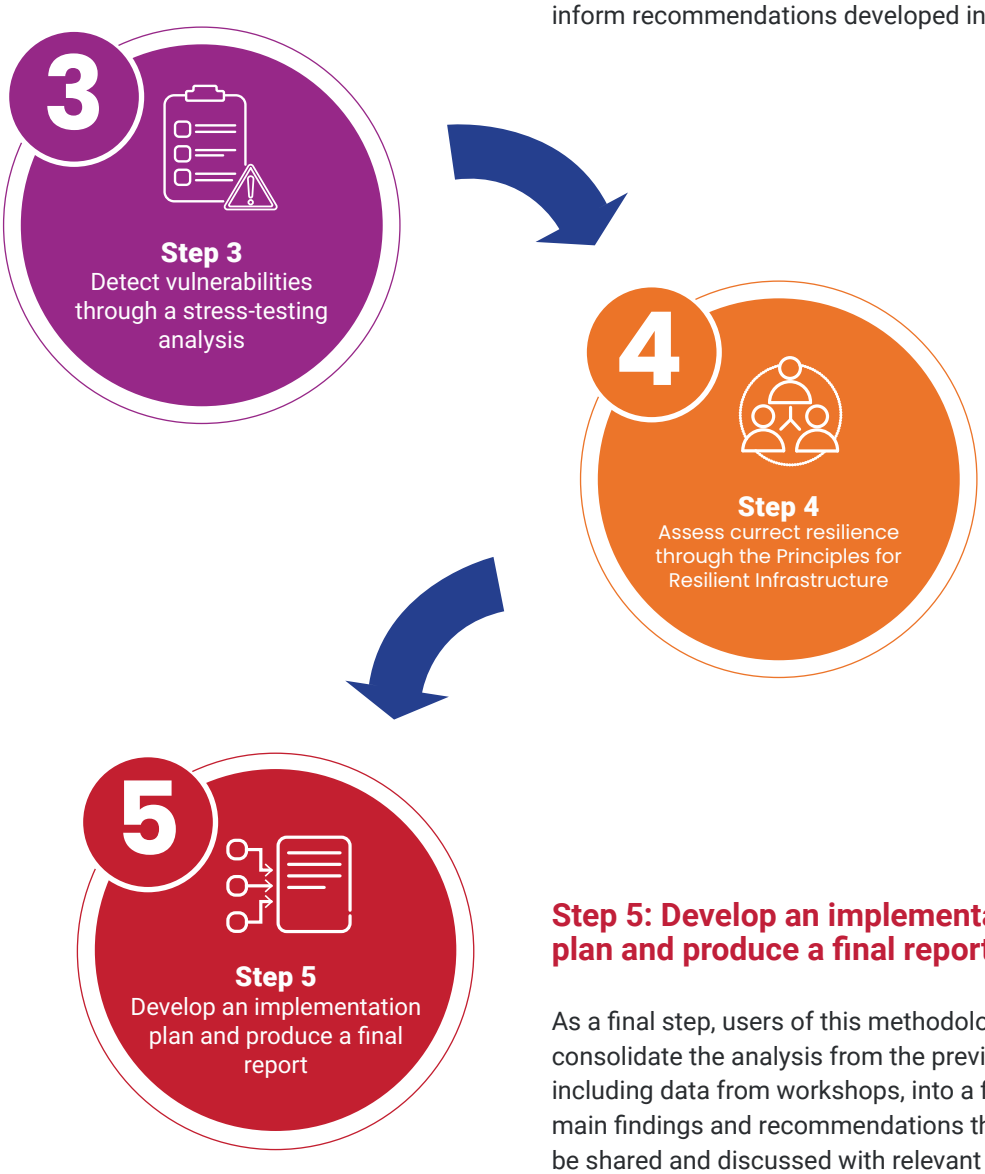
Policy and regulatory frameworks directly impact the resiliency of infrastructure assets and the continuity of services. Cross-cutting policies and intersectoral regulatory mechanisms are necessary as disasters often have cascading effects that impact multiple sectors. Similarly, it is crucial to assess whether sectoral policies and strategies properly capture DRR considerations. In this step, users of this methodology thus identify the relevant policies and regulations that can influence the resilience of infrastructure systems, as well as their key DRR components.

Step 3: Detect vulnerabilities through a stress-testing analysis

The third step guides users of the methodology in performing a multi-hazard stress testing of the infrastructure system. The objective is to assist countries in better understanding infrastructure vulnerabilities and system interdependencies. This allows countries to prioritize actions and resources while assessing the state of critical infrastructure at the national level. To inform the stress testing, this methodology suggests different ways for collecting data.

Step 4: Assess current resilience through the Principles for Resilient Infrastructure

In this step, users of the methodology consider whether current infrastructure practices are adequate for achieving infrastructure resilience. This assessment is done through a workshop with relevant stakeholders identified in step 2, and enables the participants to familiarize themselves with the Principles for Resilient Infrastructure.[1]The assessment is based on a scorecard tool developed by UNDRR, and requires interactive discussions with workshop participants. The results, along with analysis from the preceding steps, are then used to prioritize key interventions and inform recommendations developed in step 5.



Step 5: Develop an implementation plan and produce a final report

As a final step, users of this methodology need to consolidate the analysis from the previous steps, including data from workshops, into a final report. The main findings and recommendations then need to be shared and discussed with relevant stakeholders during a final workshop to validate the results and establish an implementation plan.

1 See https://www.undrr.org/publication/principles-resilient-infrastructure.

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Step 1: Map institutional governance and identify key stakeholders

Stakeholders play an important role in building infrastructure resilience. Several different categories of stakeholders can add value, for example:

- **Governments** can initiate changes to national policy for infrastructure resilience, allocate the necessary funding to resilience-building activities, and require that the tendering process for infrastructure projects gives appropriate weighting to resilience-related considerations.
- **Regulators** can monitor disruptions to critical services, ensure adherence to codes and standards, require operators to improve their resilience, and introduce obligations on infrastructure operators to develop and maintain long-term resilience strategies.
- **Operators** can monitor their capacity to absorb disruptions caused by different types of hazards, and realize retrofit improvements that improve their ability to absorb future ones.
- **Owners** can raise infrastructure resilience standards, invest in skills and capacity to achieve infrastructure resilience, and require operators to assess potential hazards.

To conduct an infrastructure resilience review, it is thus important to identify the key actors in each infrastructure sector, as well as those playing a cross-cutting role (e.g. intersectoral coordination, budget allocation). In addition, it is important to identify and engage stakeholders that can support the implementation of resilience measures, such as major financiers and lenders active in the country.

1. Cross-cutting institutional arrangements

Disaster resilience efforts have often been fragmented, with different sectors focusing solely on their specific responsibilities without fully considering the broader implications or a whole-of-government approach to resilience.

A systems approach with improved coordination and cooperation considers the interconnectedness and interdependencies of critical infrastructure sectors. It also helps address potential intersectoral conflicts, make optimized use of resources and reduce overlap of responsibilities (e.g. responsibilities related to climate change impacts, parallel reporting systems).

Depending on a country's specific arrangements, national, subnational and local governments may all play distinct roles in shaping the infrastructure landscape. Recognizing these varying roles and their impacts is essential for developing effective strategies to enhance the resilience of infrastructure systems, as it allows for tailored approaches that consider the unique governance structures and responsibilities at each level.

To assess the existing arrangement in the country, the methodology recommends answering the following questions and summarizing the findings in a short document entitled "**institutional mapping**", which should eventually become a chapter of the final report mentioned in step 5.

Cross-cutting institutional arrangement

DRR and CCA responsibilities	**Is there a dedicated institution to address DRR at the national level? Are there institutions accountable for DRR at regional/subnational level?** *Note: The Sendai Framework for Disaster Risk Reduction 2015-2030[2] requests governments to establish a designated national focal point, which is the entry point in a government for the implementation, review and reporting of the Sendai Framework. While the specific structures of these institutions may vary from country to country, they generally serve as focal points for DRR activities and provide a platform for collaboration among various stakeholders. For example, the focal point could be located in the national disaster management authority, which is typically responsible for DRR strategy formulation, planning and implementation.* **Is the institution (if present) empowered to decide the roles and responsibilities of various institutions for DRR at the national, subnational and local levels?** *Note: The clarity of roles and responsibilities at each level, to prevent overlapping mandates and ensure accountability of each institution is of paramount importance. The apex body for DRR should lay out clear roles and responsibilities, as well as reporting mechanisms for institutions at each level of governance and sectoral institutions.* **Does the institution regulate the DRR component of critical infrastructure sectors?** *Note: Although there might be regulators for each of the critical infrastructure sectors, the apex body responsible for DRR might also be an approver of (or be consulted on) sectoral plans, to ensure synergy and consistency with DRR mandates.* **Is there a dedicated institution to address climate change adaptation (CCA) at the national level?** *Note: In many countries, CCA is dealt with by the ministry of environment, while DRR is handled by an independent authority sometimes affiliated to the ministry of defence or of home affairs. This may lead to overlapping mandates and, in some cases, incoherent policies.* **If yes, is the institution empowered to decide the roles and responsibilities of various institutions for CCA at the national, subnational and local levels?** **Does the institution regulate the CCA component of critical infrastructure sectors?** *Note: Multiple sector ministries or levels of government may be involved. For example, in India, the sector ministries, including the Ministry of Power, Ministry of Urban Development, Ministry of New and Renewable Energy, Ministry of Jal Shakti, Ministry of Agriculture, Department of Science and Technology, etc., are designated as the key nodal ministries for the delivery of each of the respective eight national missions (e.g. the Solar Mission, Mission on Enhanced Energy Efficiency, Water Mission, Mission for Green India) under the National Action Plan for Climate Change of the Ministry of Environment, Forests and Climate Change.*

2 See https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030RR.

Cross-cutting institutional arrangement

Cross-sectoral coordination for infrastructure systems	**Who ensures cross-sectoral coordination and cooperation among key infrastructure actors?** *Note: Cross-sectoral coordination can take different shapes. For example, countries have established interministerial committees and independent infrastructure advisers for this purpose (e.g. the National Infrastructure Commission in the United Kingdom of Great Britain and Northern Ireland). Many have also created a national platform for DRR, a multisectoral platform that coordinates DRR-related actions in a country and aims at mainstreaming DRR considerations into the functioning of all relevant institutions.* **Who is responsible for ensuring consistent and coherent infrastructure planning?** *Note: Typically, an interministerial apex body (e.g. a planning commission, development planning authority) is responsible for this function at the national level. However, it is frequently observed that different sectors work in silos and lack synergy in planning, leading to overlap and incongruous efforts.* **Who is responsible for dispute resolution in conflicting situations in sector interests?** *Note: In many countries, disputes related to sector interests among two or more sectors may be resolved through the judicial system. In cases where sectoral regulators are present, it is often the role of the regulator to resolve conflicts. However, in their absence, the responsibility lies with the government, which typically has dispute resolution mechanisms and procedures put in place.*
Planning	**Who is responsible for land-use planning?** *Note: Typically, ministries related to urban, rural and regional planning are responsible for the overall planning. However, key inputs from ministries responsible for forests, water resources, agriculture, minority or tribal affairs, etc., are sought to ensure holistic development and system-level resilience. Land-use planning is carried out by assistance from local authorities which may or may not have the capacity to integrate disaster risk information. It is necessary to assess whether disaster management agencies are building these capacities at the local level. In other cases where evidence-based land-use planning and zoning regulations exist, the capacity to enforce them may sometimes be lacking. Land-use plans must also recognize the need for cross-sectoral coordination for system-level resilience.* **Who is designing and updating building codes and standards?** *Note: Building codes and standards are typically developed by government agencies/ professional organizations or associations in their respective area of expertise, for example the American Society of Civil Engineers. These may be inventoried by a national agency for a central repository. The responsibility to enforce these codes and standards relies on local governments, in most cases.* **Who is responsible for master planning?** *Note: Master plans are developed by planning departments at the local level, and typically feature zoning and land-use plans, along with critical infrastructure networks for roads, drainage system, buffer zones, etc. Often, private consulting firms are involved in the master planning of cities. These plans must align with the national DRR strategies for development.*

Country example

In India, the apex body for DRR is the National Disaster Management Authority. It decides the roles of all other agencies that assist the National Disaster Management Authority in its functions, such as:

- The National Executive Committee, which prepares disaster plans and monitors the implementation of guidelines
- The State Disaster Management Authority, which helps design state disaster policy and disaster management plans, fund recommendations, and ensure implementation
- The District Disaster Management Authority, which is involved in planning, coordination and implementation
- The National Institute of Disaster Management, which is responsible for capacity-building
- The National Disaster Response Force and Post-Disaster Response
- The National Crisis Management Committee, which deals with major crises of national importance

Source: India, Ministry of Home Affairs (2019). *National Disaster Management Plan*. New Delhi: National Disaster Management Authority.

2. Governance of key infrastructure sectors

Each infrastructure sector has a responsibility to implement measures to enhance resilience, mitigate disaster risks and ensure the continuity of critical services. Reviewing the organization of each sector is thus a necessary step in order to understand who can help enhance the resilience of infrastructure systems. Implementing the methodology necessitates answering the following questions in order to identify major institutions involved in each sector, which could be important stakeholders to consult with later on.

The following guidance is provided for the key main economic infrastructure systems of energy, transport, water, wastewater and digital communications. These serve as an essential backbone for the effective functioning of socioeconomic infrastructure services such as health, education, business, the food industry, etc.

To adapt the methodology to the local context, other infrastructure sectors could be included if deemed necessary. In this case, questions equivalent to the ones presented can be used for the analysis in any additional sector.

a) Energy

The energy sector is inherently complex, with traditional energy sources including oil, gas, thermal and hydropower; and new sources such as solar, wind, geothermal and hydrogen. The sector is also divided in terms of function, i.e. generation, transmission and distribution. As such, there is a wide range of actors which affects the resiliency of the sector.

Energy

Policymakers	**Who sets the vision, policy, and planning for the sector?** *Note: The government ministry responsible for energy or power, such as the Ministry of Energy or Ministry of Power, often plays a central role in formulating the vision and policy for the sector. Some countries also have dedicated agencies for developing long-term energy plans with focus on demand management, resource conservation, renewables, etc.*
Regulators	**Who is regulating the sector in the country?** *Note: The energy sector is typically supervised by regulator(s), in charge of setting technical and operational standards, issuing licences for operators, issuing health and safety regulations, regulating tariffs, and monitoring the sector's performance, among other tasks. The economic and safety regulations typically fall under a common roof.*
Owners	**Who owns the infrastructure assets of the sector?** *Note: The ownership of energy infrastructure can be public (state-owned enterprises) or private (e.g. independent power producers), and may vary depending on the different functions (e.g. power generation, transmission, distribution).*

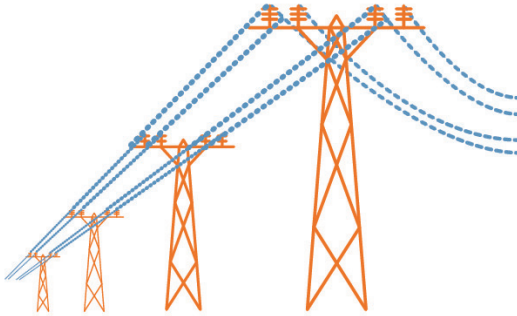
Energy

Operators	**Who are the main operators in the country?** *Note: Different operators are typically involved in the power sector, including:* • *Utility companies, typically private or publicly traded companies, that generate, distribute, and supply electricity and natural gas to consumers. They often operate power plants, transmission lines, and distribution networks.* • *Transmission system operators, responsible for the high-voltage transmission lines linking power plants to distribution networks.* • *Distribution companies, in charge of distributing electricity to consumers.* • *Oil, gas and petroleum companies involved in the exploration, extraction, production and distribution of oil and natural gas resources.* • *Coal mines operated by the public sector or licenced private operators.*

Country example

The Ministry of Economy, Trade and Industry (METI) is primarily responsible for energy policy in Japan. Within METI, the Agency for Natural Resources and Energy ensures strategic energy security and energy efficiency, and implements renewable energy initiatives. The Electricity and Gas Market Surveillance Commission serves as the regulatory authority for electricity, gas and heat power markets, although, it is not fully independent of METI. The Organization for Cross-regional Coordination of Transmission Operators supervises electricity transmission and distribution companies, focusing on nationwide electricity supply-demand balance and enhancing interconnections between local markets, ensures coordination between various regions during a disruption to maintain stable supply. After the Great East Japan Earthquake in 2011, Nuclear Regulation Authority was established as a fully independent body in charge of regulations on nuclear energy, nuclear security, safeguards. There are also various agencies for research and development for technological innovations and for addressing environmental challenges.

Source: International Energy Agency (2021). Japan 2021: *Energy Policy Review*. Paris.



b) Transport

The transport sector, being spread over various modes including road, freight and rail, airways, and shipping, usually has varied institutions handling each mode, and thus intrasectoral and cross-sectoral coordination become key.

Transport

Policymakers	**Who sets the vision, policy, and planning for each of the modes of transport in the country? And who manages intrasectoral coordination?** *Note: Many countries have an overall vision for the sector, typically developed by a central agency such as a ministry of transport. However, each mode of transport shall ideally have its own vision and policy that integrates with and contributes to the overall vision.* *For example, the Federal Highway Administration in the United States of America provides guidance and resources to assist states and localities in incorporating disaster and climate change considerations into infrastructure planning, design and maintenance. The agency also supports research and provides technical assistance to road and highway transportation agencies. This includes the development of guidelines, tools and training programmes to help professionals assess risks, implement resilience measures and improve emergency response capabilities.*[3]
Regulators	**Who regulates the sector in the country?** *Note: Various modes of transport may have their own independent regulatory agencies, or in some cases they may be regulated by a national government authority. This includes regulations, rules and standards for safety, performance, licences, emissions, traffic control, etc.* *For example, the Research Designs and Standards Organisation is a technical adviser to Indian Railways for the design and standardization of railway equipment and problems related to railway construction, operations and maintenance. It ensures enforcement of standards and identifies vulnerable assets (e.g. bridges, waterways, embankments), based on which strengthening work can be undertaken.*[4]
Owners	**Who owns the infrastructure assets of the sector?** *Note: The ownership of transport infrastructure can be public (state-owned) or private, for instance through public-private partnerships. It is typically observed that railways, roads and public transport in a country are owned by the government; airports and ports, on the other hand, are typically under private ownership.*
Operators	**Who are the main operators in the country?** *Note: Different operators are involved in the transport sector, including:* • *Railway and freight operators and railway station operators* • *Airports and airline operators* • *Public transport buses operators* • *Port terminal operators*

3 See https://highways.dot.gov/.

4 See https://rdso.indianrailways.gov.in/index.jsp.

Country example

In Viet Nam, organization and policy changes have occurred to ensure that policy, regulatory and operator roles are segregating among all transport institutions. However, comprehensive multimodal integration is still challenging. The overall administrative responsibility of the sector lies with the Central Ministry of Transport which houses all critical agencies under its umbrella. At the subnational level, there are Provincial Transport Authorities (PTAs) for planning and sector investment management. Under these PTAs, there are state-owned enterprises for modal administrations, including ports, roads and shipping, and there are state corporations for airlines, shipping, shipbuilding, inland waterways, etc.

Source: Asian Development Bank (2012). *Viet Nam: Transport Sector Assessment, Strategy, and Roadmap*. Manila.

c) ICT

With the development of Internet technologies, services including telephony and computer connections, have become inseparable, and large private companies have been substantially taking over the sector. Since the sector is central to the functioning of economies, governments need to ensure that national and international ICT assets and services are safeguarded from disasters and climate-related impacts. Many countries have also developed designated bodies for dealing with cybersecurity threats.

ICT

Policymakers	**Who sets the vision, policy and planning for the sector in the country?** *Note: Many countries have a national agency/ministry that plays a central role in setting goals, and creating policies that govern the deployment, regulation and development of ICT. Industry associations and/or advisory committees can also play an instrumental role to help shape policy frameworks.*
Regulators	**Who is regulating the sector in the country?** *Note: Some countries may have a regulatory authority that grants licences, ensures compliance, manages spectrum allocation, promotes fair competition, and protects consumer interests (e.g. data privacy) within the ICT sector.* *For example, the Federal Communications Commission is the regulatory body responsible for overseeing the telecommunication sector in the United States of America. The Federal Communications Commission has implemented regulations that require telecommunication service providers to develop and maintain emergency communication plans.*[5]

5 See https://www.fcc.gov/about/overview.

ICT

Owners	**Who owns the infrastructure assets of the sector?** *Note: The ownership of telecom infrastructure can be public (state-owned enterprises) or private (independent telecom companies). Cellular towers, for instance, are usually owned by private telecom companies, while fibre networks and international connections are typically owned by a consortium of telecom companies, Internet service providers, etc. Satellite systems are typically government-owned for scientific purposes. However, they can also be privately owned; for instance, Intelsat provides satellite capacity to the United States of America.*
Operators	**Who are the main operators in the country?** *Note: Although ICT/telecom may be operated by government agencies, private telecom and IT companies have substantially taken over the sector in most countries.*

Country examples

Telecom: In Sweden, the telecommunications industry has many private telecommunication companies, as well as telecom industry associations, regulated by the Swedish Post and Telecom Authority, a government agency responsible for overseeing and regulating the sector. It grants licences, ensures compliance with regulations, promotes competition, and manages the allocation of radio frequencies. The telecommunication companies provide mobile and landline telephony, broadband Internet, and television services, while the industry associations represent the interests of these companies. The National Broadband Forum is an initiative that brings together stakeholders from the public and private sectors.[6]

Source: European Commission (2023). Broadband in Sweden. 9 February. Available at https://digital-strategy.ec.europa.eu/en/policies/broadband-sweden. Accessed on 20 October 2023.

Cybersecurity: The National Infrastructure Advisory Council advises the United States of America regarding cybersecurity and plays a key role in addressing cyberthreats to critical infrastructure. Its recommendations include forming a convening group to develop cross-sector drills to enhance coordinated responses to physical attacks or cyberattacks on critical infrastructure, harmonizing standards that govern common activities of the private sector and enhancing coordination among local, state and federal government entities.

Source: United States of America, National Infrastructure Advisory Council (2017). *Securing Cyber Assets: Addressing Urgent Cyber Threats to Critical Infrastructure*. Washington, D.C.

6 See https://www.government.se/government-agencies/swedish-post-and-telecom-authority/.

d) Water supply and wastewater management

The water supply and wastewater management services vary from country to country; however, it is usually a central ministry that governs the water sector, water being a basic human right. This ministry is typically responsible for policy formulation, planning, allocation, protection measures and overall regulation.

Water

Policymakers	**Who sets the vision, policy, guidelines and planning in the sector?** *Note: Typically, a central ministry formulates the vision for the sector. Nonetheless, the service levels and quality standards may differ for rural and urban areas, and may be governed by separate entities. In India, for example, water is a state subject; however, the vision, guidelines and overarching sector goals are set at the central level, by the Ministry of Jal Shakti and the Ministry of Urban Affairs for the urban areas.*
Regulators	**Who is regulating the sector in the country?** *Note: The sector may or may not have an independent authority that regulates the sector in terms of tariff setting, allocation for various uses, resolution of interstate/province and transboundary water disputes, etc. In addition, pollution control or environmental protection agency might regulate parameters for effluent quality, groundwater extraction, environmental flow, aquatic biodiversity protection, etc.*
Owners	**Who owns the infrastructure assets of the sector?** *Note: Water and wastewater infrastructure, such as water treatment plants, can be public (state-owned) or private (independent companies). Large assets like dams, reservoirs and interstate bulk infrastructure may be centrally owned. However, other supply and treatment infrastructure in most cases is decentralized to local governments, who then may outsource it to private companies.*
Operators	**Who are the main operators in the country?** *Note: Different operators are typically involved in the sector, including:* • *Operators of water and sewage treatment plants, also responsible for cost recovery from consumers* • *Bulk water supply operators* • *Operators managing the distribution networks* *These may also be responsible for continuous monitoring of large infrastructure assets to ensure continuity of service, leak detection, quality control and cost recovery through user charges.*

Country example

In Singapore, the Public Utilities Board is a statutory body under the Ministry of Environment and Water resources, responsible for water supply, water catchment and sewerage in an integrated way. The board, apart from ensuring these key functions and services, also leads and coordinates the holistic management of inland and coastal flood risks to ensure protection from disaster incidents occurring due to rising sea levels. Efforts for long-term sustainability of water supply and wastewater management include rainwater harvesting, proper stormwater management, and alternative sources of water such as recycled wastewater treated for reuse and desalination. To manage the demand side of water, mechanisms have been used such as labelling schemes for water-efficient plumbing fixtures for domestic use and water efficiency management plans for commercial and industrial use.[7]

3. Institutional mapping document

Based on this review of institutional arrangement, it should be possible to draw a list of the main infrastructure actors in the country that can have an impact on DRR and CCA. The user of this methodology should compile this list in a short document that could also outline the structure of the different sectors. This information can be used later for engaging the relevant stakeholders on disaster resilience, in particular in steps 3 and 4.

7 See https://www.pub.gov.sg/AboutUs.

Step 2: Review existing policies and regulations

The adequacy of policy and regulations for DRR within sectoral as well as cross-cutting themes, directly determine the quality of assets and services, the effectiveness of public spending, and the incorporation of resilience measures. This step thus identifies the relevant policies and regulations that can influence the resilience of infrastructure systems in a country, as well as their key DRR components.

As the Principles of Resilient Infrastructure developed by UNDRR provide an international reference in this area,[8] users must keep in mind, while reviewing various policies and regulations, the alignment of these to the Principles.

To check this alignment, users should consider the following questions:

P1 – Continuously learning: Does the document contain policies on the call for multi-hazard assessment, including requirements for stress testing, and for using this information for formulating improvements in the sector?

P2 – Proactively protected: Does the document contain policies on raising safety requirements, promoting regular safety updates, and/or call for having a backup system (redundancy) in case of disruption in the sector?

P3 – Environmentally integrated: Does the document contain policies aimed at minimizing environmental impact, and encouraging the use of environmental solutions to deliver infrastructure services in the sector?

P4 – Socially engaged: Does the document contain policies on fostering communication among operators in the sector and engagement with users, for example for demand management purposes?

P5 – Shared responsibility: Does the document contain policies which clarify the roles and responsibilities of each actor in the sector, require intra-/intersectoral collaboration, and facilitate the sharing of information?

P6 – Adaptively transforming: Does the document contain requirements for the sector operators to have plans and strategies for adapting to changing needs?

1. Cross-cutting policies

Cross-cutting policies and intersectoral regulatory mechanisms for DRR are necessary, as disasters often have cascading effects that impact multiple sectors simultaneously. Integrating disaster risk components in cross-cutting policies facilitates collaboration, cooperation and coordination among different sectors and stakeholders. It encourages joint planning, information-sharing and resource allocation to address common vulnerabilities and enhance overall resilience.

By answering the following questions, users of this methodology will be able to list relevant cross-cutting policies that a country has put in place, which could later be further analysed and enhanced if necessary. Going through this questionnaire will also help users to identify possible gaps in the current policy and regulatory frameworks.

8 Previous guidance, such as the UN Common Guidance on Helping Build Resilient Societies, were considered when developing the UNDRR Principles for Resilient Infrastructure. United Nations (2020). *UN Common Guidance on Helping Build Resilient Societies*. New York.

Cross-cutting policies

DRR strategy/ CCA plans	**Is there a national disaster management policy? Does it include a DRR strategy at the national level, and guidance for strategies to be developed at subnational and local levels, if applicable?** *Note: Many countries have a remedial or reactive approach to disaster management rather than a preventative one that focuses on building resilience, reducing impact of disasters on human health and infrastructure.* **Does the DRR strategy (or national disaster management policy) include specific provisions in relation to resilient infrastructure?** *Note: Some countries have developed specific strategies focused on resilient critical infrastructure, such as Germany's National Strategy for Critical Infrastructure Protection, which identifies main threats, risks and vulnerabilities, and develops guidelines in the prevention, response and sustainability areas based on three pillars: (i) preventing and mitigating loss of services; (ii) promoting backup systems (redundancies) and emergency capacity; and (iii) enhancing self-protection capabilities. The idea is to reduce vulnerability by building partnerships, sharing and protecting information, and implementing an all-hazards risk management approach.* *Source*: Germany, Federal Ministry of the Interior (2009). *National Strategy for Critical Infrastructure Protection (CIP Strategy)*. Berlin. **Has the country developed a national adaptation plan (NAP) in relation to Climate Change at the national, subnational and local levels, if applicable? Does the NAP include specific actions in relation to resilient infrastructure?** *Note: NAPs typically include an infrastructure component. For example, Bangladesh's NAP targets developing climate-smart cities, which include robust drainage networks and water management infrastructure as well as the expansion of green infrastructure. It also highlights setting adaptation standards for critical infrastructure and mainstreaming these into relevant guidelines or policies.* *Source*: Bangladesh, Ministry of Environment, Forest and Climate Change (2022). *National Adaptation Plan of Bangladesh (2023–2050)*. Dhaka. **Is the DRR/CCA plan periodically reviewed and revised based on evolving scientific evidence on hazards and risks?** *Note: Due to climate change, risk scenarios are constantly evolving and need to be taken into consideration. Some countries use the latest Intergovernmental Panel on Climate Change climate scenario predictions to update their DRR/CCA strategies; however, many may not have reviewed their plans for years.*

Cross-cutting policies

Is there a regulation requiring regular risk assessment of critical infrastructure sectors and the identification of critical entities?

Note: Often, there is a lack of a clear understanding of what critical infrastructure resilience entails among both public bodies and private companies. Public authorities can engage with private companies to create a common understanding of critical infrastructure and its resilience and raise awareness of the benefits of investing in resilience. For example, according to the Critical Entities Resilience Directive, European Union member states need to adopt a national strategy and carry out regular risk assessments to identify entities that are considered critical for the society and economy. In turn, these critical entities need to carry out risk assessments of their own and take technical, security and organizational measures to enhance their resilience and notify incidents.

Do existing policies and regulations account for interdependencies of infrastructure systems, and do they adequately address potential risks and vulnerabilities?

Note: It is important to consider the complex interdependencies of connected networks, as a change in one area can have ripple effects on others. It is also beneficial to evaluate how the policies and regulations outline the process for maintaining the safety and sustainability of critical infrastructure assets in the country, and to identify any provisions of redundancy or alternatives.

Are gender equality, disability and social inclusion embedded in the DRR strategies and CCA plans, and the diverse needs of all individuals considered for achieving infrastructure resilience?

Note: Vulnerable populations are affected by disasters in particular ways that should be examined and considered, for instance having shelters equipped to support people with disabilities, or ensuring that warning systems are accessible to those with visual impairments. The following references may be used to better understand social inclusions in DRR and CCA:

UNDRR (2022). Gender-responsive disaster risk reduction. Policy Brief No. 3. Geneva.

UNDRR (2023). *A Review of Gender and the Sendai Framework*. Geneva.

CDRI (2021). Pre-COP26 webinar: Building infrastructure resilience inclusively – integrating gender in recovery and reconstruction. Available at https://www.cdri.world/events/pre-cop26-webinar-building-infrastructure-resilience-inclusively-integrating-gender-recovery. Accessed on 20 October 2023.

What are limitations to implementing DRR and CCA plans, and how do these limitations impact resilience?

Note: Once a policy is put in place, a country might face challenges in its implementation, such as limited capacities or resources, which would impact the effectiveness of the policy in building resilience.

Cross-cutting policies

National development plan	**Is there a national development plan, and does it have DRR and CCA considerations?** *For example, the Philippines has a robust national development plan which aims at increasing the resilience of communities, institutions, and the natural and built environment to natural hazards and climate change. To realize this goal, the Government will implement a comprehensive risk management approach to reduce vulnerabilities and address the compounding and cascading risks posed by climate change across different sectors. Rehabilitation and protection of natural resources will be accelerated to sustain the provision of ecosystem goods and services. Lastly, improved governance will underpin the country's collective effort to ensure long-term climate and disaster resilience.* *Source:* Philippines (2023). *Philippine Development Plan 2023–2038*. Manila. **Has the country had a voluntary national review process and what is the assessment for Sustainable Development Goal (SDG) 9 and SDG 13? How is DRR being addressed in this process?** *Note: SDG 9 is about developing quality, reliable, sustainable and resilient infrastructure. SDG 13 speaks of climate action, which also targets strengthening of resilience and building adaptive capacity to climate-related disasters. When countries report on their progress on SDG 9 and 13, they may provide useful information on their approach to resilience.* *Indonesia in its voluntary national review, for instance, discusses its national DRR strategies in line with the Sendai Framework under SDG 13. Similarly Norway, while reporting on SDG 9, states its aim for an efficient, sustainable and safe transport system by implementing its National Transport Plan 2022–2033.* *Source:* Indonesia (2021). *Indonesia's Voluntary National Review (VNR): Sustainable and Resilient Recovery from the COVID-19 Pandemic for the Achievement of the 2030 Agenda*. Jakarta. Norway, Ministry of Local Government and Modernisation, and Ministry of Foreign Affairs (2021). *Voluntary National Review 2021 Norway: Report on the Implementation of the 2030 Agenda for Sustainable Development*. Oslo. **Has the country reported its Sendai Framework progress through the Sendai Framework Monitor, and has there been an assessment for Sendai Framework Target D?** *Note: Sendai Framework Target D is about substantially reducing disaster damage to critical infrastructure and disruption of basic services. United Nations Member States voluntarily report their progress through the Sendai Framework Monitor. The online platform also provides a tool to guide risk-informed policy decisions and to allocate resources accordingly towards reducing risk.*

Cross-cutting policies

Public finance/ investment management	**Is there a strategy for infrastructure pipeline development? Does the strategy incorporate DRR elements and/or prioritize investing in resilient infrastructure?** *Note: Governments can include DRR considerations in their infrastructure pipeline development, either for deciding which projects to prioritize and/or for addressing resilience priorities. For example, the Tuvalu Priority Infrastructure Investment Plan gives 30 per cent weightage to the climate change and environment criterion, which includes the subcategories of resilience, disaster management, climate adaptivity and environmental impact. Meanwhile, the 2021 Australian Infrastructure plan includes among its recommendations to ensure that infrastructure decisions consider resilience through clear and harmonized guidance on how projects can address risks and value resilience.* *Source:* Australia, Infrastructure Australia (2021). *Reforms to Meet Australia's Future Infrastructure needs: 2021 Australian Infrastructure Plan*. Canberra. Tuvalu, Ministry of Finance and Pacific Region Infrastructure Facility (2020). *Tuvalu Priority Infrastructure Investment Plan 2020–2025*. Funafuti and Sydney. **Is there a ring-fenced budget for DRR-related initiatives? Can this budget be used for infrastructure-related investment, such as structural and non-structural measures?** *Note: Some countries ensure that budget allocated for the resilience of new and existing infrastructure, as well as budget specifically for resilience infrastructure, is kept aside. This will ensure adequate financing for implementation of DRR strategies. For example, the Government of India assigns 20 per cent of its disaster-related budget to DRR activities, leaving the rest for disaster response (40 per cent), recovery and reconstruction (30 per cent), and preparedness and capacity-building (10 per cent).* *Source*: India, National Disaster Management Authority (2022). *Recovery and Reconstruction Guidelines*. New Delhi. **Are there safeguards to protect infrastructure maintenance budgets?** *Note: Budgets for long-term investment in maintenance, safety and security, risk coverage and transfer also ensure resilience. Public finance management systems must ensure that this funding is protected.*

Cross-cutting policies

Private sector regulation	**Are infrastructure owners/operators required to disclose risk-related data to investors and other stakeholders, for instance through corporate sustainability disclosure (e.g. Task Force on Climate-Related Financial Disclosures [TCFD]-like requirements)?** *Note: Typically, governments and regulators include risk disclosure in mandatory financial reporting for asset owners and operators. Some have even made it mandatory to ensure disclosure against TCFD-like recommendations. For example, Engie, a French electric utility company, produced in 2023 a TCFD report that sheds light on the topic of resilience. Acknowledging that power asset integrity may be affected by the increasing number of extreme events, Engie has boosted its resilience against four major risks: heatwaves, drought, floods and extreme wind. Mud slides, forest fires and extreme rainfall (for hydraulic activities), and the temperature of rivers, will also be studied. The principal focus for increasing asset resilience for Engie is the integration of physical risks into their enterprise risk management process, and the integration of the impact of climate change in the management of investments.* *Source*: Engie (2023). *2023 Climate Notebook/TCFD Report*. Paris. **Are banks active in the country following voluntary/mandatory standards for assessing the resilience of projects they finance?** *Note: Banks and other finance institutions could stop funding infrastructure projects that fail to consider disaster resilience. For example, 139 financial institutions in 39 countries are currently members of the Equator Principles. These Principles require the signatory financial institutions to conduct a climate change risk assessment, considering physical risks, for all the projects they finance with potential significant adverse environmental and social impacts. For example, HSBC's procedures for applying the Equator Principles are included in its credit risk policies. Projects run through Reputational & Sustainability Risk team for guidance and approval and projects that are high risk under the Equator Principles are not approved.*[9]

9 See https://www.hsbc.com/who-we-are/esg-and-responsible-business/managing-risk/sustainability-risk/equator-principles.

Cross-cutting policies

DRR/CCA considerations in regulations of land-use plans and building codes	**Do the building codes and standards, geographic zoning and land-use plans consider evidence-based scientific criteria and tolerance of risks?** *Note: Most countries develop codes or standards based on historical evidence of disasters. However, in this constantly evolving landscape, it is essential that these are updated from time to time, based on scientific advancements and futuristic scenarios of climate change. Review and audit process for the codes should be institutionalized so that it is not discretionary. The data used for updating the codes and standards should also be made available in the public domain. Enactment and enforcement of these codes and standards are challenging and must be regulated.* **Do the regulations consider the periodic update of the scientific criteria for risk zoning due to natural hazards?** *Note: Scientific understanding of natural hazards, such as earthquakes, floods, hurricanes and landslides, evolves over time as new research is conducted and data are collected. The Geological Survey of India, for instance, conducts geological and geophysical surveys across India to understand seismicity, landslides and other geological hazards. They periodically update hazard maps and seismic zoning criteria based on new data and research findings. These maps and criteria inform land-use planning, building regulations and infrastructure development.*[10] *Source*: Mohapatra, A.K., and W.K. Mohanty (2010). An overview of seismic zonation studies in India. In *India Geotechnical Conference – 2010. GEOtrendz*. 16–18 December, Mumbai.
DRR considerations in international agreements for cross-border infrastructure	**Are there any arrangements/agreements in place with neighbouring countries for the protection of cross-border infrastructure? Do these include resilience measures?** *Note: Historically, countries often establish agreements and arrangements with neighbouring nations to address various aspects of cross-border cooperation, including the protection of infrastructure. These agreements can cover issues such as security, emergency response and mutual assistance in case of threats or disruptions to critical infrastructure.*
Interaction between various actors	**In what ways does the government provide recommendations to the regulators?** *Note: A government can issue policy statements or guidelines that outline its recommendations on specific regulatory matters. These statements may provide regulators with a framework or principles to consider when making decisions. They can issue notices from time to time to update those recommendations.* **Are there policies or requirements around open data and sharing and exchange of infrastructure information? If so, what type of data is shared and how?** *Note: Often data from third-party providers are not shared with governments and operators, and therefore this information cannot be used for improving infrastructure resilience.* **Are there mechanisms to measure users/consumers' level of satisfaction from the services?** *Note: Typically, all infrastructure services have a grievance redressal mechanism and a consumer helpline to ensure feedback is received for continuous improvement of services, including the availability of services.*

10 See https://www.gsi.gov.in/webcenter/portal/OCBIS.

2. Sector policies

In addition to cross-cutting policies, sectoral policies may include specific components for DRR, or for disaster management broadly, as well as policies addressing issues of security, safety, sustainability and environmental integration. Certain countries might also have gone beyond this and created a sectoral strategy for DRR.

The following table offers guidance for users of this methodology to assess and gain insights into the actions taken by countries to achieve infrastructure resilience through policies, plans, strategies and regulations at the sector level. Each country may have a tailored approach according to their unique circumstances, and hence the country examples from around the world give an overview of how DRR and climate resilience can be incorporated in sectoral policies to guide the assessment process.

Sector policies

Energy	*Resilience in the energy sector requires a comprehensive approach that policymakers may achieve through regulatory measures and/or a dedicated strategy. For instance, as many components of the sector, such as power supply, are privatized, accountability and integration across stakeholders is key to strengthening disaster resilience, and sector policies could promote collaboration and coordination among stakeholders. Energy policies can also include specific resilience-building measures, such as hazard assessment of critical installations (e.g. nuclear power plants). Resilience strategies in the energy sector also need to consider the resource side, which may differ depending on the energy source, such as coal, petroleum, oil, gas or renewables. Furthermore, demand-side management can play a crucial role in achieving efficiency and resilience. Measures such as implementing differential pricing for power consumption during different times of the day and consumption-based tariffs can help smooth out the power demand curve and reduce strain on the system.* *Country example: Japan has an Energy Supply Resilience Act that mandates electricity network operators to create a joint action plan to guarantee reliable power supply during disasters. The Act requires power transmission and distribution companies to develop disaster cooperation plans in advance, to facilitate collaboration with relevant organizations in times of emergencies.* *Source:* International Energy Agency (2022). Japan electricity security policy, 18 August. Available at https://www.iea.org/articles/japan-electricity-security-policy. Accessed on 23 October 2023.

Sector policies

Transport	*Various modes of transport have their own policies and initiatives of which some focus on resilience. For example, the Federal Highway Administration in the United States of America promotes hazard mitigation strategies under its hazard mitigation programme to reduce the vulnerability of transportation infrastructure to natural hazards. This includes conducting risk assessments, developing mitigation plans, and implementing measures to minimize the impact of hazards on the road transportation system.* *Source: Jorge E. Pagán-Ortiz (2020). Guest editorial: Introducing a series on hazard mitigation R&D. Public Roads, vol. 73, No. 6.* *Countries may also have sector-specific review processes. For example, the Bureau of Infrastructure and Transport Research Economics is leading a review into the resilience of Australia's road and rail supply chains. This review aims to identify the supply chains that are most critical to Australian communities and businesses, and the risks they face, and to conduct a stocktake of any work under way to mitigate risks.* *Source*: Australia, Bureau of Infrastructure and Trasport Research Economics (2023). *Road and Rail Supply Chain Resilience Review – Phase 1: Building an Evidence Base of Road and Rail Supply Chain Resilience.* Canberra: Department of Infrastructure, Transport, Regional Development, Communications and the Arts.
ICT/ telecoms	*DRR strategies or DRR-related policies for ICT typically consider natural hazards, technological failures and cyberattacks. Policies can target redundancy measures to ensure that critical ICT components have backup systems or alternative infrastructures available. Cybersecurity for all other critical sectors is also impacted by policies in this sector.* *Country example: The Bangladesh Telecom Regulatory Commission has issued guidelines that require telecommunications service providers to develop and maintain business continuity plans, including backup power systems, redundancy measures, and coordination with emergency response agencies.* *Source*: Bangladesh, Posts and Telecommunications Division (2015). *Bangladesh National Telecommunications Policy (Draft)*. Dhaka.

Sector policies

Water and wastewater	*Water policies can include mechanisms for long-term sustainability such as regulation on groundwater extraction, or the quality of treated wastewater that can be discharged into natural water bodies or underground aquifers. These policies can also include backup arrangements for water supply to reduce the vulnerability of population impacted by disasters. Nature-based solutions/blue-green infrastructure are also promoted in some countries.* *Country example: In the Netherlands, the Delta Programme is a long-term strategy that addresses flood risk management, water availability, and spatial adaptation to climate change. In the same vein, the Room for the River programme is a major initiative to create additional space for rivers to safely handle high water levels and involves measures such as the widening and deepening of river channels, the construction of floodplains and overflow areas, and the relocation of dikes and infrastructure.*[11] *The Netherlands has also established stringent flood protection standards to ensure the resilience of its water infrastructure. These standards consider the probability of flooding and the potential consequences. Infrastructure, including dikes, flood barriers and pumping stations, are designed and maintained to meet these standards.* *Source*: Dutch Water Sector (2016). Dutch parliament adopts unique risk standards for flood protection, 8 July. Available at https://www.dutchwatersector.com/news/dutch-parliament-adopts-unique-risk-standards-for-flood-protection. Accessed on 23 October 2023. Netherlands (2020). *Staying on Track in Climate-Proofing the Netherlands: National Delta Programme 2021.* Amsterdam: Ministry of Infrastructure and Water Management, Ministry of Agriculture, Nature and Food Quality, and Ministry of the Interior and Kingdom Relations. Available from https://english.deltaprogramma.nl/binaries/delta-commissioner/documenten/publications/2020/09/15/dp2021-eng-printversie/DP2021+ENG+printversie.pdf.

11 See https://www.dutchwatersector.com/news/room-for-the-river-programme.

3. Policy and regulatory review document

Based on the review of cross-cutting and sectoral policies, users of this methodology should compile a short policy and regulatory document, including the relevant policies a country has already put in place that reinforce the resilience of its infrastructure systems.

However, this document should go beyond simply listing the relevant policy documents, and should explain why they are relevant for DRR and infrastructure resilience, and whether they are aligned with the Principles of Resilient Infrastructure developed by UNDRR. To this end, users of this methodology should refer to the questions highlighted in the introduction of step 2.

For example, Principle 2 states *Does the document contain policies on raising safety requirements, promoting regular safety updates, and/or call for having a backup system (redundancy) in case of disruption in the sector?* The Government of Cambodia's Strategic National Action Plan (SNAP) for Disaster Risk Reduction (2008–2013) provides evidence for the key actions in Principle 2, "proactively protected". The SNAP aimed to mainstream DRR into the national, sector, and local development policies and plans, national and local risk assessments, improve flood forecasting and early warning capabilities, education and awareness-raising, and promote structural and non-structural measures to enhance resilience. Under component 5 (mainstreaming), the SNAP aimed to "enhance existing and launch new initiatives related to the integration of disaster risks into land-use planning, building code, design of new infrastructure, and environmental impact assessments of development projects". These initiatives are relevant to Principle 2 as they align with the key actions of raising safety requirements, designing infrastructure to fail safely, and embedding emergency management (early warning) in infrastructure development.[12]

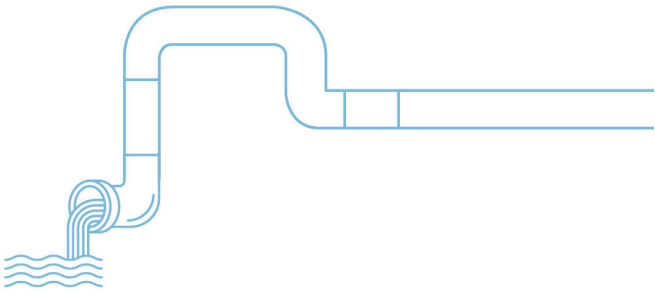
The user of this methodology could then summarize the findings of the policy and regulatory review in a table such as this one:

Document title	Relevance for DRR/resilience	Link to the Principles					
		P1	P2	P3	P4	P5	P6
Cross-cutting							
Energy							
Transport							

12 Cambodia, National Committee for Disaster Management and Ministry of Planning (2008). *Strategic National Action Plan for Disaster Risk Reduction* (2008–2013). Phnom Penh.

Document title	Relevance for DRR/resilience	Link to the Principles					
		P1	P2	P3	P4	P5	P6
ICT							
Water and wastewater							

The policy and regulatory review document will provide a solid foundation for identifying gaps and opportunities for improvements to achieve greater infrastructure resilience. It will also inform the next steps of this methodology and provide insight into how policies can be redesigned. It should ultimately form a chapter of the final report mentioned in step 5.



Step 3: Identify infrastructure vulnerabilities through a stress-testing analysis

Stress-testing analysis complements traditional risk analysis by assisting countries to better understand infrastructure vulnerabilities at the national level, identify system interdependencies and prioritize actions. To perform the stress-testing analysis, the methodology recommends first collecting available data on the vulnerability and exposure of infrastructure systems, and then convening stakeholders and experts in a workshop to consider the impact of various stressors.

1. Collect data on vulnerability/exposure

Users of this methodology should try to collect existing data on vulnerability or exposure, to inform inputs for the stress test tool and the Principles scorecard, as well as to support the formulation of recommendations. This data can be grouped into two broad categories: geographic information system (GIS) data and infrastructure performance data.

a) GIS data on infrastructure exposure

GIS data are valuable in assessing infrastructure exposure by integrating and overlaying various infrastructure data layers, such as roads, power lines and water networks, with other relevant data, such as earthquake zones or flood-prone areas, as well as socioeconomic factors such as population.

By combining data, GIS-based models can simulate the potential exposure to hazards of infrastructure systems based on different scenarios. Users will have to define the criteria of the disaster hazard scenarios. The challenge is not that assets are exposed to hazards, but that these assets may stop providing the services they are expected to.

A practical application of GIS data for this methodology is to calculate the percentage of infrastructure assets in disaster-prone areas. This approach can easily be applied to the percentage of power plants (number or generation capacity); transmission/distribution lines (kilometres); road (kilometres); rail (kilometres); airports (number); ports (number); health facilities (number if included in the scope); and so on. For infrastructure services where infrastructure layers are not available or practical (water, ICT, etc.), population data can be used as a proxy for infrastructure assets location (i.e., percentage of the population in disaster-prone areas).

The following are a few examples of scenarios that could be considered:

- **River and coastal flooding:** Percentage of infrastructure assets in river/coastal flood-prone areas (a once-in-a-100-year event), today, in 2050 and in 2080, using different climate scenarios). If relevant, the analysis could differentiate by flood depths (e.g. 0–1 metres, 1–2 metres, and >2 metres).

- **Tropical cyclone:** Percentage of infrastructure assets in a tropical cyclone zone (once-in-a-10-year event and once-in-a-100-year event), today and in 2050. The analysis should differentiate by maximum wind speed, for example using the Saffir-Simpson Hurricane Wind Scale to differentiate between possible exposure to different categories of hurricanes.

- **Earthquake:** Percentage of infrastructure assets in earthquake-prone areas, using the Global Earthquake Model to distinguish exposure to different ranges of peak ground acceleration with a 10 per cent probability of being exceeded in 50 years.

- **Drought:** Percentage of infrastructure assets (or population as a proxy) in zones that have an annual probability of a "drought event" over a certain threshold or within different brackets of probability. Drought is particularly relevant for assessing water infrastructure exposure.

Open data sources can be used to compute this type of information. A key one is the **Global Infrastructure Resilience Index** (GIRI), a core initiative of CDRI, which is a publicly available and fully probabilistic risk model that estimates risk for infrastructure assets with respect to major geological and climate-related hazards such as earthquakes, floods, landslides, tsunamis, tropical cyclones and droughts. GIRI covers major sectors such as power and energy, transportation, telecommunications and water, as well as social infrastructure such as education and health. Hazard data are obtained through comprehensive sets of simulated events accounting for all the possible manifestations of each hazard considering their geographical location, frequency and intensity. Hydrometeorological hazards account for two future scenarios, reflecting a lower and upper bound of climate change.

One of the outputs from the GIRI model is a set of loss function metrics, probable maximum loss (PML) curve and the average annual loss (AAL). These outputs help identify contingent liabilities for each infrastructure sector and the implications for social and economic development. The Map Viewer on the GIRI Data Platform allows a user to see a range of hazard layers across different return periods and climate scenarios. The data sets can be freely downloaded and used for further analysis.[13]

Another open data source is the **Global Resilience Index Initiative** which also provides filters for different hazards, return periods and infrastructure layers (roads, rail and power).[14]

Additional information might be found in the national-level databases that some countries have. For example, Canada's Design Value Explorer provides 19 climatic design values in map or table formats, providing useful information for infrastructure resilience to climate hazards.[15] As models and data are evolving, other hazards could be added, such as wildfires and landslides.[16] Also, countries usually prefer to rely on national data rather than global models, so it is worth checking with the country focal points whether additional GIS data can be accessed for implementing this methodology.

Nonetheless, some hazards remain non-modellable, while vulnerability does not only depend on exposure to hazards but also on asset characteristics such as material and age. Users will need to consider these factors and hazards when conducting a vulnerability assessment.

b) Infrastructure systems performance

It is useful to complement the GIS information with data on the current performance of the infrastructure systems. This could be realized with key performance indicators, such as the following.

- **Outage frequency:** The duration and frequency of electricity/water outages, and the reliability of Internet access, supply provide useful information about the current resilience of infrastructure systems and existing vulnerabilities. Ideally, utilities should publish information online on the frequency and duration of outages. If not, surveys have been conducted to estimate the reliability of infrastructure services supply, such as the World Bank's Doing Business surveys.[17]

13 See https://giri.unepgrid.ch.

14 See www.cgfi.ac.uk/global-resilience-index-initiative/try-grii-now/.

15 Canada, National Research Council (2023). Improving access to historical and projected climatic design variables, 27 February. Available at https://nrc.canada.ca/en/stories/improving-access-historical-projected-climatic-design-variables. Accessed on 23 October 2023.

16 For example, landslides risk requires combining exposure to possible triggering events (e.g. earthquake and heavy precipitation) with data capturing the susceptibility of the terrain to landslides (e.g. topography).

17 See https://archive.doingbusiness.org/en/doingbusiness.

- **Infrastructure age:** Gathering information about the approximate construction years of main infrastructure assets can help the identification of bridges, tunnels and other structures that may have experienced wear and tear and become less robust over time. Where data is available, it can also shed light on infrastructure that may have been built in accordance with outdated design standards. Interviews with experts could be conducted if public information on this topic is limited. At this stage, the idea is only to have a rough idea of the construction dates of main infrastructure systems, not to gather precise data on individual infrastructure assets.

- **Demographic changes:** These should be considered for the analysis. Ageing populations and fast-growing populations will have different infrastructure needs and demands, putting additional stress on infrastructure and services (growing populations require more built infrastructure, increased energy, water and wastewater supply, etc.).

- **Growth and energy transition:** Economic growth is associated with growing demand for infrastructure assets and additional pressure on existing systems. Meanwhile, the energy transition requires the adaptation of infrastructure systems, and could add additional pressure on existing networks, making them more vulnerable. For instance, electricity consumption might increase more rapidly than generation, due to a shift to electric vehicles.

- **Coverage:** If the coverage is partial and access to infrastructure services such as electricity and water supply is limited, infrastructure systems do not yet meet the needs of the population, and are likely to be under pressure. This can exacerbate the vulnerability to shocks due to lack of backup services and interconnectedness of infrastructure networks.

- **Redundancy:** Alternative ways to provide critical infrastructure services could avoid disruptions in case of partial failures. These alternatives also offer more options for management of infrastructure without affecting its service. For this reason, identifying and assessing alternative routes to providing critical infrastructure services to guarantee an adequate level of redundancy should be considered as part of the overall evaluation.

In addition, users could look at post-disaster assessments to better understand the extent of damages caused by various events to infrastructure systems and inform future decisions.

c) Data summary document

Ideally, the consultant should summarize the findings from these data analysis in a short document that could serve as background or a reference point for the workshop and stress-testing analysis described in the next step.

However, it is important to bear in mind that it is not possible to use data for calculating the vulnerability or exposure of infrastructure systems to all types of hazards, and the lack of data should not limit the range of hazards considered in the stress-testing analysis. When data is lacking, experts' opinions can be used as an alternative.

2. Convene stakeholders and run the stress test analysis

The stress-testing analysis requires experts to score the vulnerability and exposure of the critical infrastructure functions to selected hazards. It thus requires conducting a workshop to collect experts' knowledge and judgment, complementing this with targeted interviews when needed. It is recommended to engage the same group of stakeholders throughout the whole process described in the methodology. This group should ideally be representative of the main actors identified in step 1.

To run the stress test analysis, during the workshop, users will have to provide the following inputs in the user-friendly tool developed by UNDRR:

a) Identify critical infrastructure functions

As a first input, the consultant and the government counterpart must define the 10 critical infrastructure functions to be assessed, among a long list of possible functions.

The global methodology typically targets the main infrastructure sectors, such as energy, transport, ICT, and water and wastewater, so the functions are usually linked to these sectors.

The list below provides an example of what these functions could be, although the actual list should be based on the country context and need, and could also cover a wider range of sectors, for instance including health.

1. Generation of electricity
2. Transmission/distribution of electricity
3. Transportation of people/goods by road
4. Transportation of people/goods by rail
5. Transportation of people/goods by air
6. Transportation of people/goods by water
7. Transportation of materials by pipeline
8. Provision of telecommunication services
9. Supply of water and management of wastewater
10. Management of solid waste

It is important that the critical infrastructure functions and sectors are used consistently throughout the study, ensuring coherence between the different steps of the methodology so that results from each step can be connected.

b) Identify key economic industries and score their relative importance

The second input required for the stress-testing analysis is the selection of the 10 industries most important to the country's economy. This selection should be based on research, and made in consultation with the government counterpart ahead of the workshop.

The selected industries will vary from one country to another, but will typically cover agriculture, manufacturing and services. For the purpose of the stress-testing analysis, these broad categories should be further broken down into 10 selected industries most relevant to the country context, such as construction, automotive, textiles, financial services and tourism.

By understanding the economic structure of a country, including key industries, supply chains, and dependencies, one can better analyse how disruptions in critical infrastructure might propagate through the economy. Similarly, policymakers can prioritize investments and develop strategies to enhance the resilience of critical infrastructure in the areas that are most critical for the functioning of the economy.

To facilitate the industry section, the stress-testing tool provides a list of suggested industries, based on the International Standard Industrial Classification of All Economic Activities developed by the United Nations.

Once the selection is made, the stress-testing analysis requires the use of data such as the contribution of different industries to the gross domestic product and employment, in order to assess their relative importance in the country. This type of data can be found in national statistics and international databases (e.g. World Bank). If the data are not readily available, expert judgment should be used to assign a score to each industry.

c) Select and assess relevant hazards

The third input for the stress-testing tool is a selection of the 10 most relevant hazards. A "hazard" is understood as a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, and/or environmental degradation.

The stress-testing exercise emphasizes the need to consider exposure and vulnerability in multi-hazard environments. Multi-hazard (or multi-risk) approaches are crucial to define successful DRR measures. Traditionally, DRR measures are implemented to decrease the risk of a single hazard type, despite their potential of having unwanted effects on other hazard typologies. The tool provides the opportunity to consider the behaviours of infrastructure functions against multiple hazards.

To select the hazards most relevant to the country, users should consider their probability and expected impacts, while also considering how climate change is projected to exacerbate hazards and risks. The data collected earlier in step 3 should guide the hazard selection.

To keep an approach that is both manageable and sufficiently broad, the methodology suggests the selection of a list of 10 hazards from the following categories.[18]

1. Meteorological and hydrological hazards (e.g. tropical cyclones, river floods, heatwaves)
2. Extraterrestrial hazards (e.g. asteroid and meteorite impacts, solar flares)
3. Geohazards (e.g. earthquakes, volcanic eruptions, tsunamis)
4. Environmental hazards (e.g. biodiversity loss, land salination, loss of mangroves)
5. Chemical hazards (e.g. heavy metals, hazardous pesticide contamination in soils)
6. Biological hazards (e.g. waterborne diseases, invasive weeds)
7. Technological hazards (e.g. cyberhazards, dam failures, leaks and spills)
8. Societal hazards (e.g. civil unrest, financial shocks)

The selected hazards are then scored based on the exposure and vulnerability of infrastructure systems to them, using available data as well as expert judgment.

d) Stress testing the critical functions

Once the infrastructure critical functions, economic sectors and hazards have been defined, the core of the stress testing is conducted, to score the links between them. That is, the exercise further continues by requesting these considerations:

- The level of dependency of each economic industry to each critical infrastructure functions
- The level of impact the selected hazards would have on the critical infrastructure functions
- The level of interdependencies between critical functions, or in other words, the cascading impact if a function fails

A preliminary assessment is conducted on the stress test tool based on the data collected and interviews with infrastructure sector representatives. This information is then validated and discussed with representatives of the infrastructure sectors in a workshop setting, with at least two objectives. The first objective is to promote consensus and validate the relations between hazards, economic sectors and the different infrastructure functions and sectors. The second objective is to highlight the links between infrastructure sectors, and their challenges in terms of disaster risks. The goal of this exercise is to enable a systems approach and break down silos between infrastructure sectors. The assessments are based on a combination of information extracted from the data collection and analysis, interviews with stakeholders, and desk research.

3. Analyse and interpret the outcomes/ results

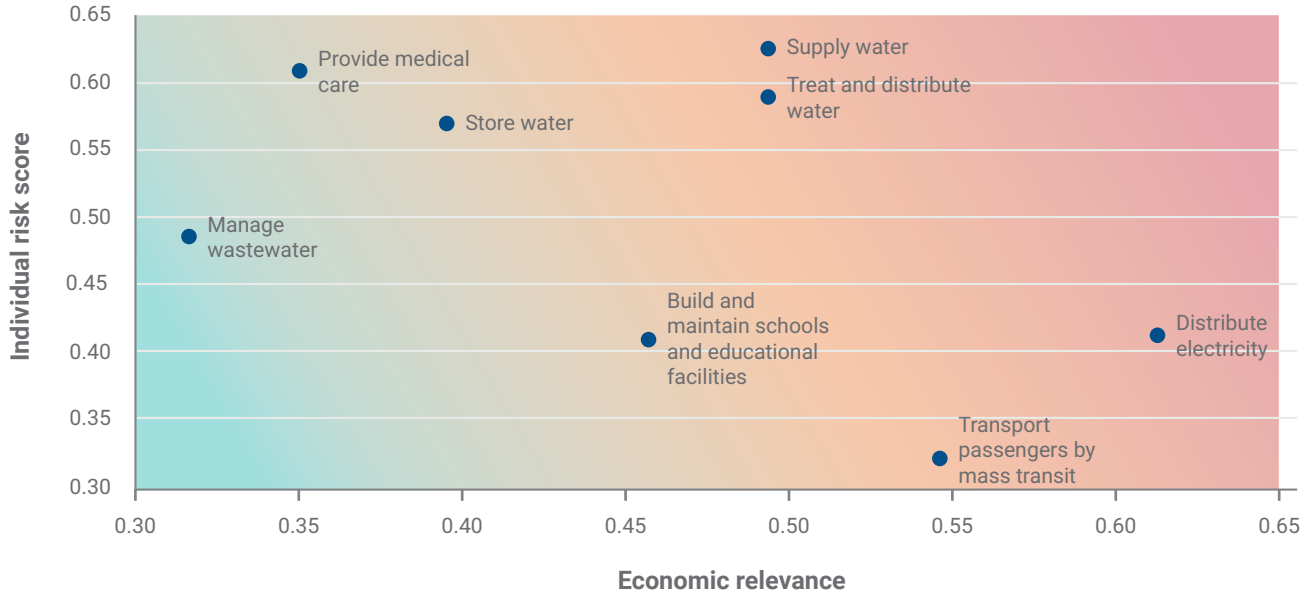
Following the different inputs, the tool provides a series of results and visuals useful for understanding the vulnerability, as well as the potential cascading impact of disasters.

a) Infrastructure systems

At the level of the infrastructure systems, the tool provides an overview of the critical functions in terms of their importance to the economy and the level of risks they are facing. Figure 1 illustrates how this relationship can be visualized in the tool.

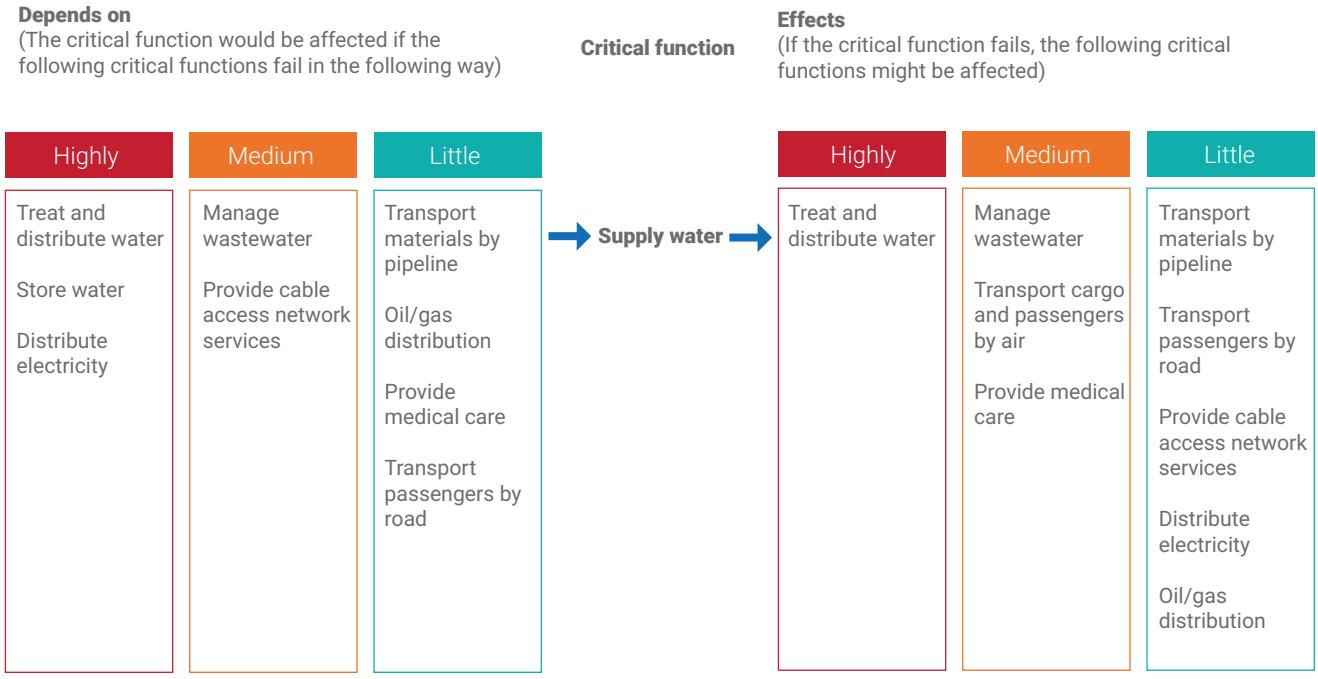
18 For more detailed description of the list of hazards, see Murray, Virginia, and others (2021). *Hazard Information Profiles: Supplement to UNDRR-ISC Hazard Definition & Classification Review – Technical Report*. Geneva and Paris: UNDRR and International Science Council.

Figure 1: Infrastructure critical functions: Risk and economic relevance



The tool also allows for a deeper analysis of each of the critical functions of the infrastructure systems while highlighting the interdependencies among them. In particular, the tool helps understand whether a critical function depends on other functions, and if so, to what degree (high, medium, low). Figure 2 illustrates how this interdependency could look in the hypothetical case of "supply water".

Figure 2: Critical infrastructure interdependencies



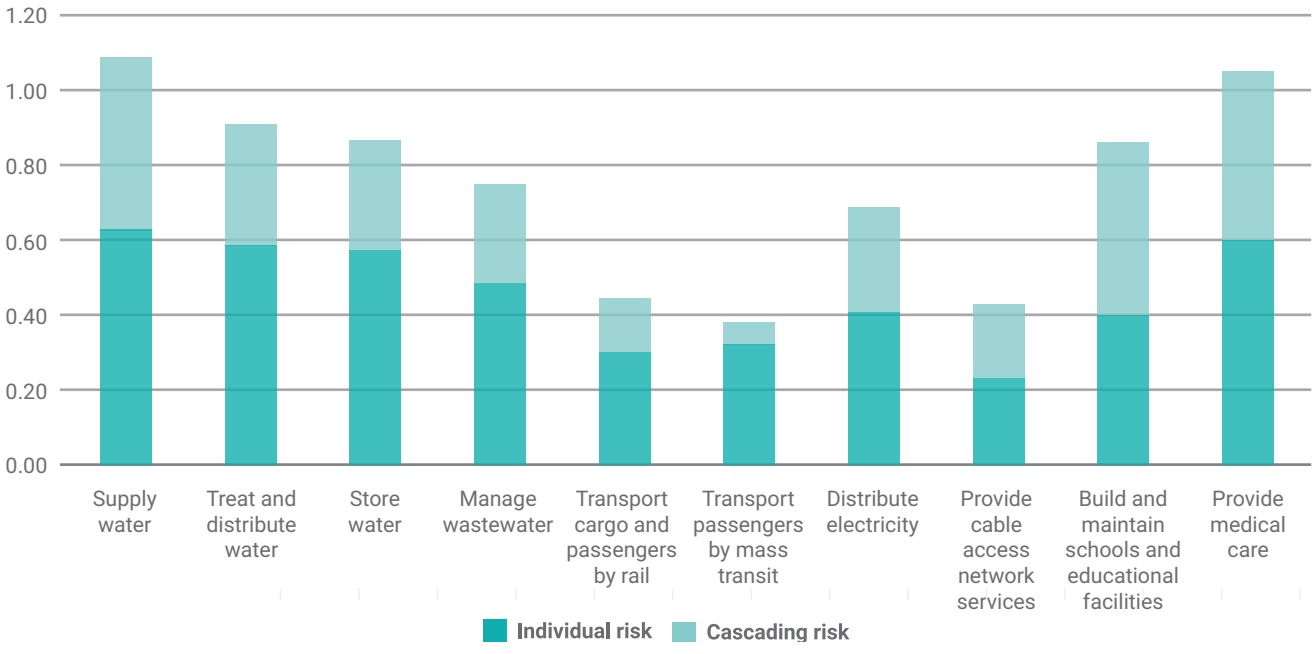
Ideally, in the final report, the consultant should provide the rationale and explanation of why the interdependency is considered as high, medium or low. The following figure provides an example of how this could be done.

Figure 3: Water supply dependencies to other critical functions with rationale

High	Medium	Low
Power Water supply depends on pumps that require electricity. Resilience could thus depend on backup generators or alternate power sources, as well as on the duration of the outage. **Water** Reliable water supply depends on water storage and treatment.	**Telecommunications** Water supply operation and monitoring may require telecom services, but these could potentially be bypassed. **Airports and seaports** Depend on water supply for passengers' drinking water, firefighting purposes, cooling systems, cleaning, etc.	**Road and rail** Water supply is usually not directly linked to transport networks. **Health** Water supply does not directly depend on the functioning of health services, but any disruption of water supply will impact health services delivery. **Oil/gas pipelines** No direct dependence on the functioning of pipelines.

Based on these interdependencies, the level of cascading risk can be computed as illustrated in figure 4. High cascading risk means that the critical function is vulnerable to disruptions from other functions, as it depends on them.

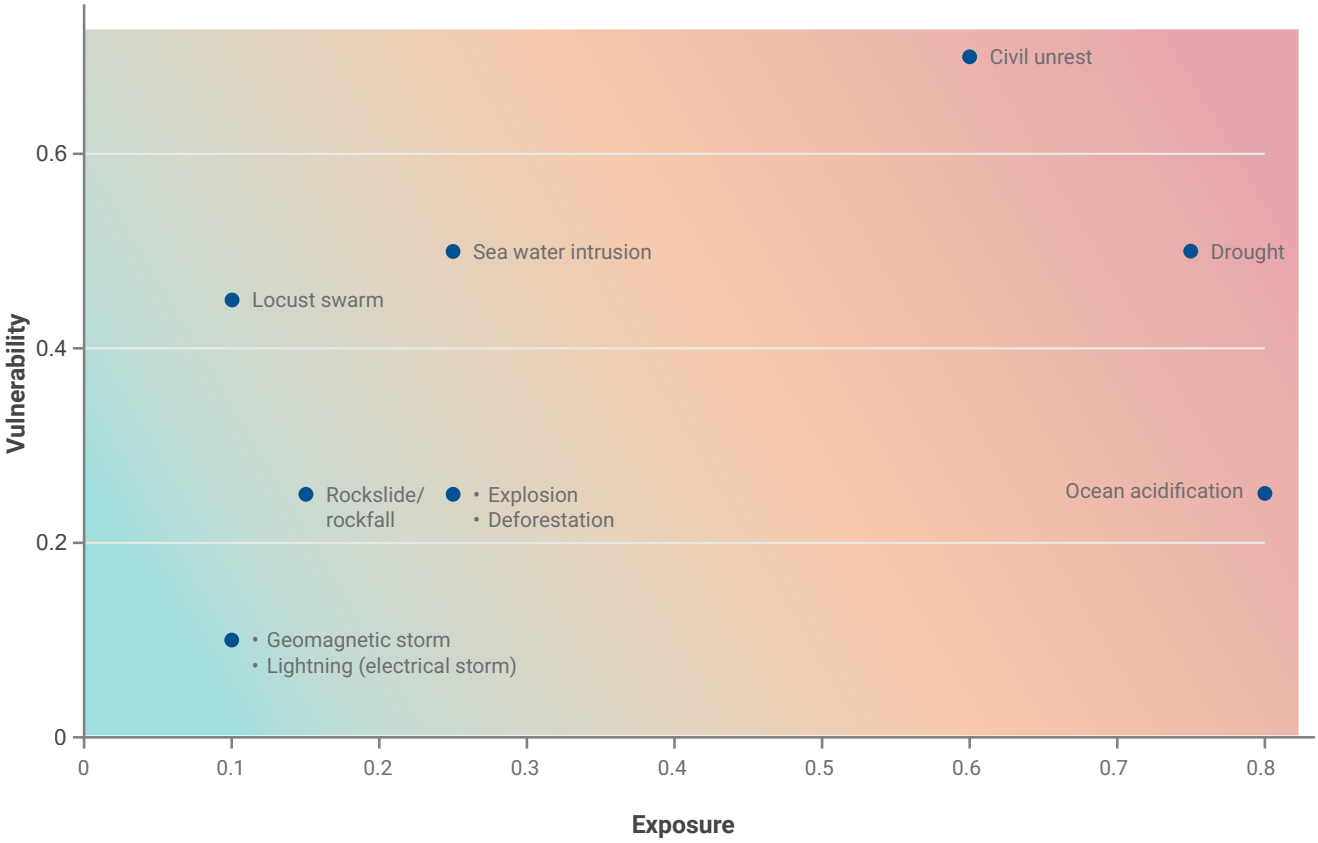
Figure 4: Disaster risks for each infrastructure function (with and without cascading effect)



b) Hazards

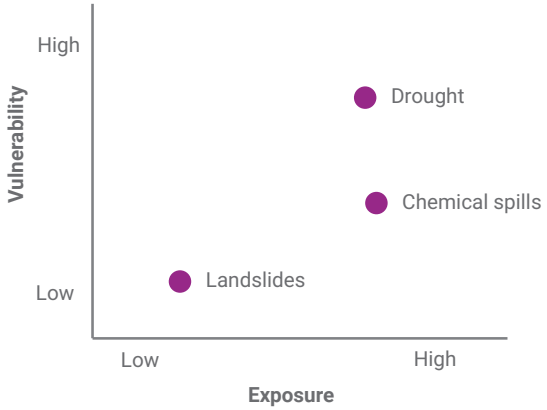
The stress test tool helps users prioritize the hazards that need special attention, based on the exposure (likelihood) and vulnerability (potential impacts). If the exposure and vulnerability impact of a hazard are too high (or in other words, both the likelihood of a hazard occurring and its potential impact on the economic sector and/or critical functions are high), immediate action to prepare and reduce its risk is recommended. Hazards with low vulnerability can often be managed.

Figure 5: Exposure and vulnerability of infrastructure systems to hazards



Based on the input provided, the tool can also highlight the exposure and vulnerability of each critical function to different hazards, which could look like figure 6.

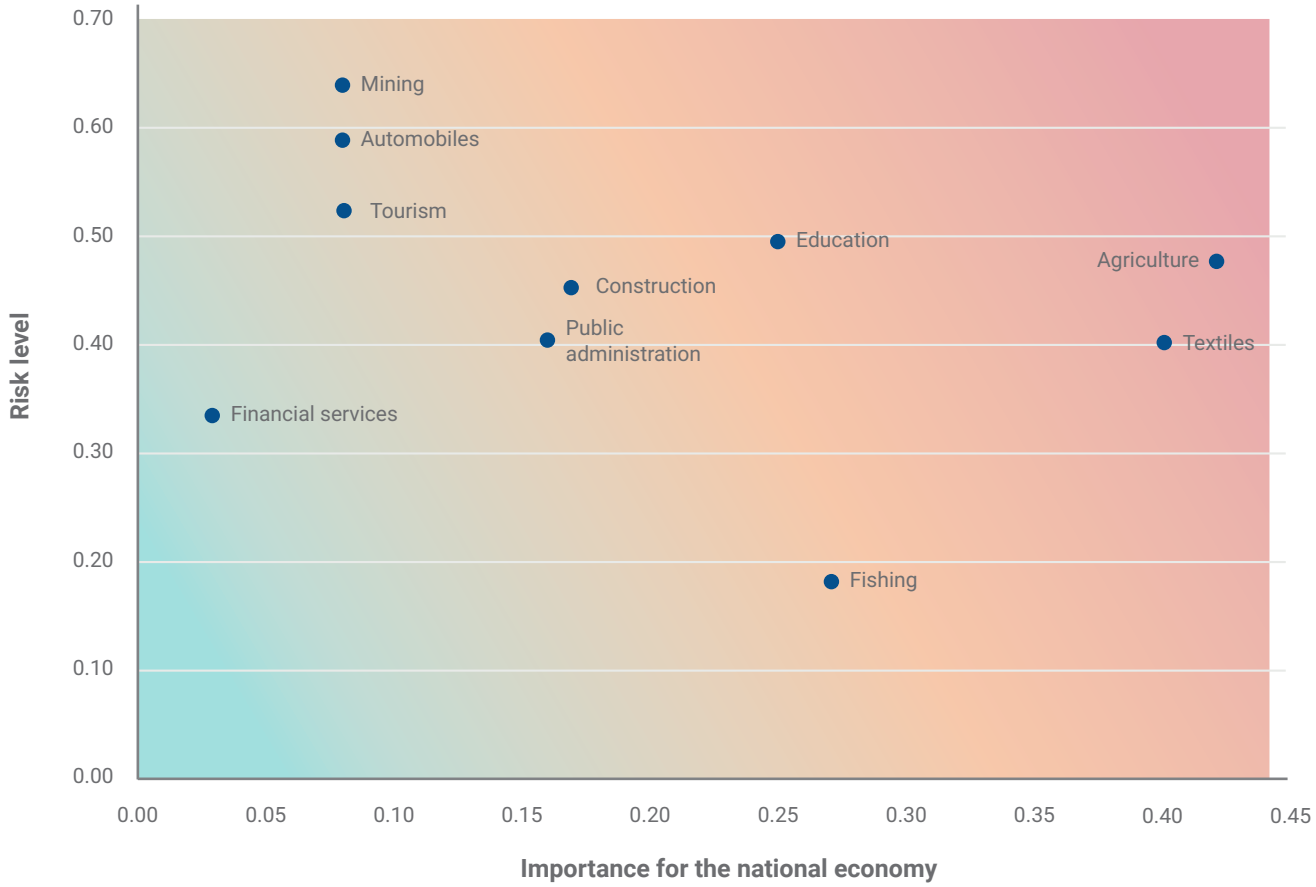
Figure 6: Risk matrix for water supply



c) Economic sectors

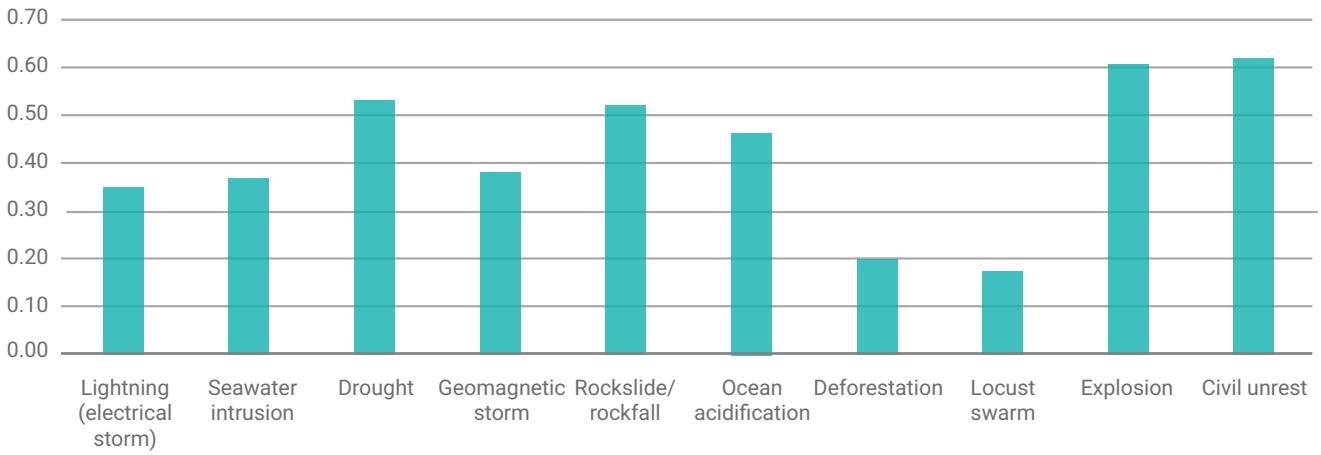
The tool enables prioritization of actions in economic sectors, based on the risk they face due to their dependency on infrastructure services to function, and their importance to the overall economy (i.e. the sector's contribution to the gross domestic product and jobs creation).

Figure 7: Prioritization of economic sectors based on their importance to the economy and the risk posed to them



In addition, the tool provides a snapshot of the level of impact of hazards to the overall economy, as shown in figure 8.

Figure 8: Impacts of hazards to the economic sectors



4. Produce a summary document

A coherent document that contains both data-based and perception-based analysis should be developed linking the findings from the desk research and GIS modelling, the results of the stress testing and the additional qualitative data received through indvidual interviews and workshops. This analysis should outline specific areas for prioritization, and should provide recommendations on specific measures and actions to be considered and included in the final implementation plan.

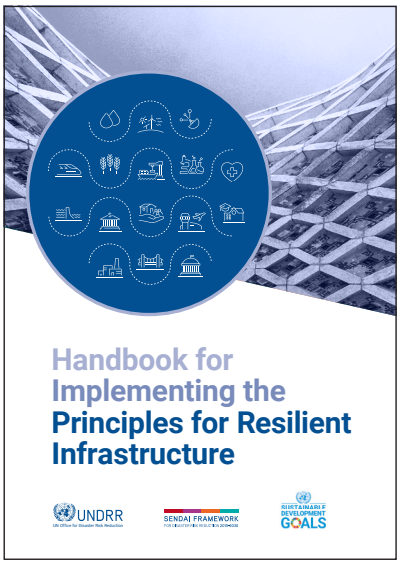
Step 4: Assess current practices through the Principles for Resilient Infrastructure

Once the infrastructure vulnerabilities have been tested in step 3, the methodology aims at assessing the current practices of infrastructure resilience. To this end, the methodology builds on the Principles for Resilient Infrastructure, which is the international reference on this matter.

Similarly to step 3, the assessment requires conducting a workshop with the relevant stakeholders representing all sectors. The workshop should combine both steps 3 and 4, in most cases.

1. Introduce the Principles for Resilient Infrastructure

To familiarize the stakeholders with the Principles for Resilient Infrastructure, the workshop can start with a presentation of these Principles.



Building on the related *Handbook for Implementing the Principles for Resilient Infrastructure*, it is suggested for the workshop organizers to introduce the key actions under each Principle and the possible interventions of the stakeholder groups.[19]

Case studies and examples could also be presented to share experiences and lessons learned from other countries.

2. Conduct surveys/group exercises around the principles

During the workshop, stakeholders should use a scorecard system developed by UNDRR to evaluate the level of implementation in the country of each of the Principles (if need be, the Principles scorecard can also be shared with sector specialists and stakeholders online).

The scorecard features a set of questions and responses based on the key performance indicators for each of the key actions, as identified in the *Handbook for Implementing the Principles for Resilient Infrastructure*.

This allows users to gain a quick assessment of the level of implementation of the Principles in the country, as illustrated in the hypothetical example below, which uses a traffic light system to visualize areas of strengths as well as potential weaknesses. The numbers in figure 9 are based on the responses from the scorecard, which include for each key action a scoring system from 0 to 5 (5 indicating the most resilient practices and 0 for the least resilient practices).

19 UNDRR (2023). *Handbook for Implementing the Principles for Resilient Infrastructure: How to Make Infrastructure Resilient*. Geneva.

Figure 9: Level of implementation of the actions under each Principle

Principle 1: Continuously learning
Develop and update understanding and insight into infrastructure resilience

P1.1 Expose and validate assumptions	2
P1.2 Monitor and intervene appropriately	2
P1.3 Analyse, learn and formulate improvements	2
P1.4 Conduct stress tests	1

Principle 2: Proactively protected
Determine and increase the level of hazard/threat preparedness and response

P2.1 Raise essential safety requirements	2
P2.2 Exceed basic requirements for critical components	2
P2.3 Consider complex interdependencies of connected networks	3
P2.4 Embed emergency management	2
P2.5 Design infrastructure to fail safely	5
P2.6 Design for multiple scales	3
P2.7 Commit to maintenance	3
P2.8 Devise long-term investments	3

Principle 3: Environmentally integrated
Integrate natural environment implications into infrastructure planning and management

P3.1 Minimize environmental impact	4
P3.2 Use environmental solutions	5
P3.3 Integrate ecosystem information	3
P3.4 Maintain the natural environment	4
P3.5 Use local sustainable resources	4

Principle 4: Socially engaged
Empower communities to participate in infrastructure resilience and disaster prevention

P4.1 Inform people about disruptions	3
P4.2 Raise resilience literacy	2
P4.3 Incentivize demand behaviour	2
P4.4 Encourage community participation	2

Principle 5: Shared responsibility
Ensure shared accountability by sharing information and expertise for coordinated benefits

P5.1 Harmonize open standards	0
P5.2 Cultivate collaborative management	2
P5.3 Establish shared responsibilities	2
P5.4 Enhance connectivity for information-sharing	2
P5.5 Assure data safety to develop trust	3
P5.6 Share risk and return information	1

Principle 6: Adaptively transforming
Critical assets are designed to operate comfortably in hazardous conditions and during extreme disruption events

P6.1 Choose manageable solutions	3
P6.2 Create adaptive capacity	3
P6.3 Develop flexible management	4
P6.4 Enable capacity for transformation	2
P6.5 Allow for human discretion	2

The Principles scorecard also enables users to decide on the nation's ambitions for infrastructure resiliency by selecting the priority level of improvement for each key action as illustrated in figure 10. This prioritization will help frame the key interventions for the implementation plan described in step 5.

Figure 10: Priority actions for improving the resilience of infrastructure

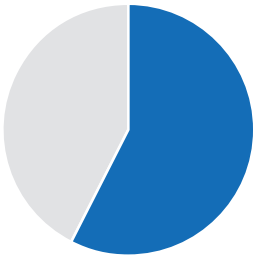
High priority	Medium priority	Low priority	No priority
P2.3 Consider complex interdependencies of connected networks	P1.3 Analyse, learn and formulate improvements	P1.1 Expose and validate assumptions	P1.4 Conduct stress tests
P3.4 Maintain the natural environment	P2.2 Exceed basic requirements for critical components	P1.2 Monitor and intervene appropriately	P2.4 Embed emergency management
P5.1 Harmonize open standards	P2.7 Commit to maintenance	P2.1 Raise essential safety requirements	P2.5 Design infrastructure to fail safely
P6.4 Enable capacity for transformation	P3.2 Use environmental solutions	P2.6 Design for multiple scales	P3.1 Minimize environmental impact
P6.5 Allow for human discretion	P4.3 Incentivize demand behaviour	P2.8 Devise long-term investments	P3.5 Use local sustainable resources
	P5.2 Cultivate collaborative management	P3.3 Integrate ecosystem information	P4.1 Inform people about disruptions
	P5.5 Assure data safety to develop trust	P4.2 Raise resilience literacy	P4.4 Encourage community participation
	P6.1 Choose manageable solutions	P5.3 Establish shared responsibilities	P5.4 Enhance connectivity for information-sharing
		P6.2 Create adaptive capacity	P5.6 Share risk and return information
			P6.3 Develop flexible management

An average for each principle is also calculated based on the responses to provide a more synthetic view of the degree of resilience in the country as shown in figure 11.

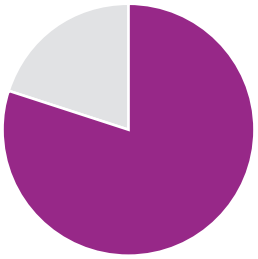
Figure 11: Current state of implementation of each of the Principles

Principle 1: Continuously learning

Principle 2: Proactively protected



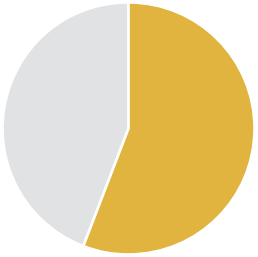
Principle 3: Environmentally integrated



Principle 4: Socially engaged

Principle 5: Shared responsibility

Principle 6: Adaptively transforming



The scorecard can be completed at the overall infrastructure system or for each sector. In the latter case, additional tailored questions for each sector can be added, and the sectoral level of resilience can be computed.

3. Discuss results from the Principles scorecard exercise

The scorecard should ideally be completed in breakout groups. Once each group has completed the scorecard, the workshop moderator should facilitate the sharing of the results and lead a discussion to collect inputs from participants. This should allow the group to identify the general areas that are stronger and those that might need further attention.

Within each principle, the key strengths and weaknesses identified during the analysis should be highlighted and discussed. Suggestions for general recommendations and interventions by each of the stakeholder groups should be put forward by participants and consolidated by the workshop organizer.

The examples and guidance from the Principles for Resilience Infrastructure and its associated *Handbook* can spark a reflection process on potential interventions that could be feasible for increasing net resilience, given the context of each country.

4. Compile the results

The user of this methodology should compile the workshop results and its analysis in a brief document, which will become a chapter of the final report.

This document should be developed using the results from the scorecard exercise and inputs from workshop participants, and be complemented with desktop research of documents. The results from the principles scorecard provide a snapshot and overview of the resilience level of infrastructure practices, but these results should be further analysed by building on the policy documents identified in step 2 for each of the principles.

Additional stakeholder interviews and consultations may be needed as supplementary information in order to have the most comprehensive assessment possible.

The analysis of policy gaps and the future needs/ ambition emerging from the scorecard exercise also help inform the formulation of recommendations and the implementation plan in step 5.

Step 5: Develop an implementation plan and final report

The results and analysis from all the previous steps need to be consolidated for developing an implementation plan that lays out the foundations for strengthening infrastructure resilience in the country.

1. Develop a draft implementation plan

The implementation plan should present the actions that a country could take to address the challenges and gaps identified through the different steps.

- Steps 1 and 2 help identify the appropriate stakeholders and policies that should be considered when proposing interventions.
- Steps 1 and 2 also help ascertain if the intervention concerns a specific stakeholder or policy, or whether the problem lies in the interaction between stakeholders and/or the implementation of the current policies and regulations.
- Step 3 on stress testing highlights the infrastructure functions and hazards that are more relevant and should be addressed in more detail.
- Step 4 provides the analysis of the gaps in infrastructure resilience practices and identifies prioritization of actions.

As an overarching framework for formulating the implementation plan, users of this methodology should use the key actions under the Principles for Resilient Infrastructure. To this end, they can build on the *Handbook for Implementing the Principles for Resilient Infrastructure* to formulate recommended interventions, as the Handbook provides an understanding of the different roles and responsibilities of each stakeholder group for each of the key actions.

The implementation plan should consider short-, medium- and long-term interventions for each sector, as well as for cross-sectoral interventions.

The following is an example of how the actions in the implementation plan could be organized.

Water implementation plan

Actor responsible for intervention	Short term	Medium term	Long term
Principle 1			
…			
Principle 2			
…			

Energy implementation plan

Actor responsible for intervention	Short term	Medium term	Long term
Principle 1			
…			
Principle 2			
…			

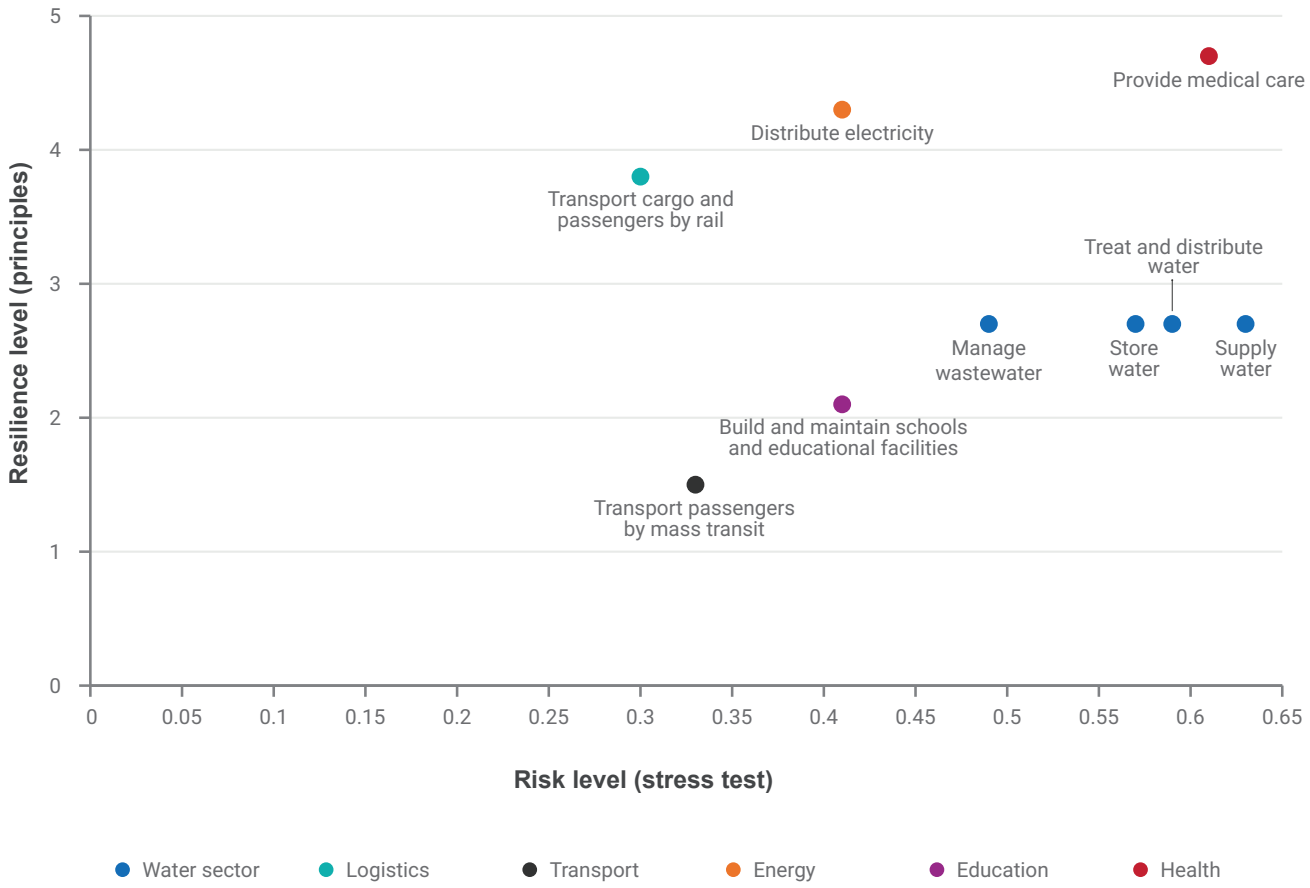
Cross-sectoral implementation plan

Actor responsible for intervention	Short term	Medium term	Long term
Principle 1			
…			
Principle 2			
…			

The recommendations and implementation plan should also consider the relationship between risk and resilience levels, by integrating the results from the stress-testing analysis (step 3) and principles assessment (step 4). This will help to identify the highest priorities to consider in the implementation plan.

To support this analysis, a graph connecting the risk level identified in the stress test with the resilience level assessed in the Principles would be useful. An example is given in figure 12. Mismatches between the level of resilience of an infrastructure sector (as calculated in the scorecard – step 4) and the level of risk of their functions (as calculated in the stress test – step 3) should be further analysed to make sure resilience efforts are used in the critical infrastructure services most at risk. Please note that these charts can only be developed if the scorecard exercise has been disaggregated in step 4 by infrastructure sectors (e.g. energy, transport).

Figure 12: Risk level versus resilience level



The chart in figure 12 can then be analysed by quadrant as follows.

- **Imminent risks (high risk, low resilience):** These functions should take priority in the implementation plan and be addressed in the short term.
- **Contained risks (high risk, high resilience):** The high resilience level limits the impact of hazards on infrastructure functions; however, the implementation plan would benefit from finding further opportunities to reduce the risk.
- **Well-managed risks (low risk, high resilience):** Lessons can be taken from these infrastructure sectors/functions to expand the management of risks to other areas.
- **Monitored risks (low risk, low resilience):** While not calling for immediate action, these risks should be monitored in case of changes in the future.

In addition to the recommended actions, the implementation plan should suggest well-established government processes that could be used for the periodic monitoring and revision of the plan and related actions. This would avoid duplication of efforts and increase the chance of successful follow-up while ensuring accountability and progress tracking.

Capacity development would often be a recommended first step towards implementation to make sure common concepts are properly understood. Other arrangements around the implementation of the recommended actions and policy/governance interventions (monitoring processes, sources of funding, etc.) could also be included in the implementation plan.

The implementation plan can be turned into a road map for the implementation of infrastructure resilience that can be shared publicly.

2. Validate recommendations through a final workshop

The main findings, recommendations and draft implementation plan should be shared and discussed with relevant stakeholders during a workshop.

The aim of the workshop is to validate findings and recommendations and obtain buy-in from stakeholders to support the implementation plan. The overall goal is to formulate a coherent implementation plan that simultaneously addresses resilience at a national level and concrete sectoral needs.

Bringing all stakeholders together to discuss the findings and recommendations will help identify synergies and enhance coordination among the different infrastructure sectors. The multisectoral approach to agreeing on interventions will guarantee consistency across sectors. At the same time, the interactive participatory process will build up ownership and commitment to the recommendations and interventions, increasing the rate of success for implementation.

Additional stakeholders, such as potential donors and multilateral development banks, should also be invited to this workshop to discuss and encourage financing of the implementation plan.

Feedback collected during the workshop should be used to finalize the implementation plan and recommended actions.

3. Disseminate findings through a final report

The analysis from all the previous steps, including all data from workshops, need to be consolidated into a final report to facilitate knowledge sharing and support evidence-based decision-making.

The final report should outline the process that was involved, all the analysis from the steps identified in this methodology, and the recommendations and implementation plan.

The final report should include at least the following sections:

1. Executive summary
2. Background and risk profile of country (building on step 3 data analysis)
3. Methodology and limitations
4. Infrastructure stakeholders and institutions (building on step 1 findings)
5. Current state of play – policies and regulatory landscape (building on step 2)
6. Risks and vulnerabilities through stress testing (building on step 3)
7. Assessment using the Principles for Resilient Infrastructure (building on step 4)
8. Recommendations and implementation plan (building on step 5)
9. Annex with workshop results, stakeholder interviews, GIS visualizations, etc.

The user of this methodology should then share the report with the country focal point and obtain a formal acknowledgement from the country authorities (for example, explaining how they intend to use this work and whether it was beneficial to them). The receipt of this letter can formally close the process described in this methodology and open the door to the implementation process.

To facilitate peer-to-peer learning, it could also be beneficial to bring together countries that have gone through the process outlined in this methodology. Similarly, countries could be invited to present their experiences and showcase their work at regional and global platforms. Countries effectively implementing this global methodology are well-positioned to offer support and facilitate capacity development for others.

Conclusion

DRR in a country has likely undergone a gradual evolution over time, but the methods used may not always be sufficient to address the challenges posed by changing circumstances.

To establish a common understanding of DRR policies, regulations and processes, UNDRR and CDRI have endeavoured to develop a global structured methodology to (i) assist countries assess the current level of resilience; (ii) identify gaps that need to be addressed for optimal resilience; and (iii) formulate an implementation plan. This facilitates the implementation of the Principles for Resilient Infrastructure and assists countries in building infrastructure resilience.

The focus is on mainstreaming DRR in infrastructure by actively incorporating it into regulations and policies, and for the design and planning of new infrastructure, as well as retrofitting of existing infrastructure.

The strength of this methodology lies in its cross-sectoral approach that allows a holistic view of the wide spectrum of factors relevant to DRR, and accounts for the cascading impact of various sectors on one another. To illustrate these concepts effectively, numerous examples from various countries have been provided. However, it is important to recognize that each country's journey and interventions in DRR will be unique, and thus these examples must only be used as illustrations. Furthermore, the analysis and recommendations conducted through this methodology are limited by the available information and the methods used; there may be uncertainties due to the lack of data and limitation of responses/input from available sources.

By learning from both their own experiences and those of other countries, nations can accelerate the process of enhancing global safety and disaster resilience. The ultimate goal is to create a safer world by collectively sharing knowledge and implementing effective strategies to reduce the impact of disasters.

Insights from the experiences of countries implementing this global methodology will provide a feedback loop to further improve this methodology over time.

UNDRR
UN Office for Disaster Risk Reduction

CDRI
Coalition for Disaster Resilient Infrastructure