

# Adaptation to Climate Change for Infrastructure Development

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Climate change is one of the all-encompassing global environmental changes likely to have deleterious effects on natural and human systems, economies and infrastructure. Mitigation and adaptation are the two fundamental response strategies. While mitigation seeks to limit climate change by reducing the emissions of greenhouse gases and by enhancing sink opportunities, adaptation aims to alleviate the adverse impacts through a wide-range of system-specific actions. Climate change impacts do not happen in isolation; impacts in one sector can adversely or positively affect another. Incorporation of initiatives, measures and strategies to reduce vulnerability to climate into existing policies, processes and structures regarding environmental datasets, disaster management plans, food security, water resource management, health issues, sustainable livelihoods, institutional structures, project design and implementation is the prime focus nowadays.

Adaptation issues and considerations need to be integrated into the centre of decision-making and policy formation and the planning processes at the local, regional, national and global level. This leads to an economically efficient solution. There are difficulties in integrating adaptation concerns into national policy due to low staff capacity for planning, monitoring and evaluation; poor data on adaptation options and lack of mechanisms for information sharing and management across sectors; and limited awareness of adaptation among stakeholders and the population. There are a number of actions that can help facilitate adaptation and integration of adaptation into policy, including actions at the local level (e.g. strengthening coping strategies and feedback to national policies), the national level (e.g. inter-agency coordination in the sector and legal provisions for mainstreaming) and the regional level (e.g. incorporating climate change risks in projects of regional development agencies and the creation of inter-sectoral committees to be engaged in the formulation of adaptation plans). As climate change increases the potential for climate related risk, it is also important that risk management and risk reduction is incorporated into adaptation planning at all levels, and that climate change is incorporated into disaster and risk management activities as well.

Public infrastructure is a major current and future investment for a nation's development. Many of these resources face a new risk in sea level rise, temperature and precipitation changes, and extreme events associated with climate change. A framework should be established for

infrastructure planning that optimizes service provision while recognizing that climate change, and policy responses to mitigate greenhouse gases, will alter both the need for and the performance of public infrastructure. High level policies tend to have a significant impact on spatial planning and land management activities in an area.

Regulatory changes are needed to develop and implement necessary adaptation plans. In particular, regulations must be developed to deal with probabilistic rather than absolute scenarios. When revising existing or building new structures, technical standards are used in every phase during the lifetime cycle of an infrastructure. Standards can apply during the planning phase (e.g. risk assessments, environmental standards), the design phase, the construction phase and the maintenance phase (e.g. environmental standards, safety standards). Thus standards have an important impact on the resilience of products, processes and construction. New climate ready guidance documents, new or revised policies, dedicated adaptation action plans, new or revised building codes, or the implementation of changes in land management practices or physical infrastructure are required. Adaptation to climate change requires a long term perspective and the suitability of the periods of regulatory reviews focused on driving current efficiency should be reconsidered. While our economic regulators might not be directly responsible for technical standards, they play a major role in developing effective standards. The interaction with National and International regulation should also be recognised. Innovation in architectural and building practices, materials science, engineering, and construction trades through a continuously updated standard setting process that considers forecasts of climate change and variability to improve the resilience of structures built or rebuilt in high risk areas is required.

Instruments like Environmental Impact Assessment and the Strategic Environmental Assessment help in incorporating considerations of climate change impacts and adaptation within existing modalities for project design, approval, and implementation. They identify, describe and assess the direct and indirect effects of a project on the human beings, fauna and flora, soil, water, air, climate, the landscape, material assets and cultural heritage and the interactions between these factors. This helps in mainstreaming adaptation and improving the climate resilience of infrastructure.

Modelling infrastructure systems and scenario planning is essential to ensure that vulnerabilities in one sector do not compromise others. Regulation also needs to accommodate the potential failures that might arise from innovation. It may be better to allow failure in systems, which can then be restored, rather than demand investment in a completely resilient system. Standards should be adapted to allow resumption of a partial service or services at a lower performance level after an emergency, where a full service is still unavailable. There must be greater preparedness for emergencies and disasters, with attention to resuming limited services as quickly as possible. Engineers need to develop skills in crisis management to deal with failures swiftly and effectively.

Sharing information about the condition of infrastructure assets and plans for adaptation both within and across sectors is necessary to plan adaptation effectively. Rethinking of regulation is needed where business regulation prevents such openness.

Developing high level policy statements referring to climate change adaptation with the use of green and blue infrastructure can set a context for local scale action. If the policy framework does not provide this, adaptation can be integrated within other strategies related to environmental improvements, e.g. biodiversity strategies. In some countries, adaptation-related regulations at the city or regional level have been developed. Regulations may only apply to specific zones in the city, where the adaptation actions are needed the most.

Incentives for adaptation such as subsidies, expedited permit process, waving of fee can also be used in conjunction with regulation. Investigating the possibility of generating funds from environmental compensation programs, for example from developers seeking to obtain planning permission in environmentally sensitive areas, can provide funding for adaptation responses. These can also be supported by sources of funding available for different departments in the organization, from different levels of government, and from international sources. Some proportion of the cost of retrofitting buildings and publishing the energy use of buildings also has an impact on the behaviour of occupants (e.g. more lights turned off).

Establishing a clear and transparent process that guides residents and developers through programs of subsidies, incentives, or regulations can improve their implementation. Setting up a dedicated team to deal with this process and to answer enquiries, and providing information about the initiatives avoiding jargon, can also support the adaptation process.

Employing an external party to evaluate the process leading to development of the adaptation initiative can provide valuable information. Investigating which of the adaptation initiative's outcomes are measurable, and setting up the mechanisms to measure them, can also be helpful. Similarly, when developing policies, setting clear targets against which the progress can be measured will support monitoring. Action plans should specify time frames for

completion of tasks and identify organizations accountable for delivery of the tasks. All interested parties should be involved in the development of the action plan.

Meeting the adaptation challenge is essential for economic growth. It is, however, an opportunity that should be tackled alongside delivering mitigation measures, serving a growing and changing population and contributing to the infrastructure development in a sustainable manner.

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