ADB

Sector Briefing on Climate Change Impacts and Adaptation

ENERGY

Climate change could affect the supply of, and demand for, energy in a number of different ways.

Potential Impacts of Climate Change on Energy Supply

Changes in water availability affect hydropower generation.

- Changes in precipitation patterns affect the hydrological cycle and river runoff, resulting in changing outputs from hydropower projects.
- The retreat of glaciers may increase water discharge and consequent power generation in the short term, followed later by significant reductions in summer flows and power generation as glaciers disappear.
- Climate change-induced changes in water use patterns and increases in water demand for other uses, such as irrigation, may lead to reduced water availability for power generation.
- Increased sediment load may result in more rapid siltation of reservoirs and deterioration of turbines leading to lower power output.

Changes to air and water temperature affect thermal power generation efficiency.

- Higher air temperatures reduce the generation efficiency of thermal power plants; this reduces power generation, which may occasionally coincide with peak demands during heat waves.
- An increase in water temperature may adversely affect the operation of the cooling systems of thermal and nuclear power plants and violate ambient water quality standards.
- Advanced cooling systems for thermal power such as dry cooling can reduce or eliminate freshwater dependency in areas forecasted to be water-scarce; however, these technologies are expensive and may lead to efficiency losses.

Sea-level rise and changes in wind speed and cloud cover as well as in the frequency and intensity of extreme weather events have direct impacts on energy infrastructure.

- Changes in wind speed and patterns, and cloud cover and atmospheric turbidity can affect the output of wind and solar photovoltaic projects, respectively.
- Severe weather events including extreme precipitation and glacial lake outburst flooding can compromise dam safety and lead to unplanned large-scale release of water, which can cause floods downstream.
- Energy infrastructure such as oil and gas refineries, storage tanks, and transmission lines in low-lying coastal locations are increasingly at risk of damage, disruption, and higher maintenance costs. This higher risk may result in increased insurance premiums for offshore and coastal facilities and increase production costs.
- Saltwater intrusion may corrode materials used in energy production and distribution.
- The structural integrity of energy infrastructure may deteriorate due to intense heat waves and unseasonal cold snaps.

ADB Support for Operational Risk Management and Climate Resilience Strategies in the Energy Sector

Through the Glacial Melt and Downstream Impacts on Indus Basin-Dependent Water Resources and Energy project, ADB is providing added climate adaptation knowledge and tools benefiting the governments of Pakistan (Pakistan Meteorological Department) and Afghanistan (Ministry Water and Energy), and Indus Basin risk management stakeholders. A Mountain Glacier and Downstream Water Risk Management Adaptation Screening Methodology has been developed by ADB in partnership with the International Centre for Integrated Mountain Development (ICIMOD) Kathmandu. This climate risk screening methodology includes operational risk management and climate impact resiliency strategies for the energy sector. The risk screening was carried out on seven ADB water and hydropower projects in the Indus Basin, encompassing $1.5 billion in ongoing projects and $700 million in planned new projects.

Source: ADB. 2011. *Islamic Republic of Pakistan: Glacial Melt and Downstream Impacts on Indus-Dependent Water Resources and Energy.* Consultant's Report. Manila.

Asian Development Bank

Potential Impacts of Climate Change on Energy Demand

- Warmer temperatures increase the demand for air conditioning, particularly during heat waves.
- In higher latitudes, unseasonal increases in surface temperatures may reduce overall demand for domestic heating and commercial energy consumption.
- Lowered water tables will increase energy demands for groundwater pumping. Increased pumping will, in turn, amplify vulnerability to water shortages and possibly lead to land subsidence.
- While desalination may emerge as a response to regional surface or groundwater shortages, the process requires a large quantity of energy.

Adaptation Options

Energy investment decisions have long lead times and "locked-in" effects as power plants and transmission grids can last for 40 years or more. A wide range of adaptation measures could be considered to address the impacts of climate change in the energy sector.

- Construct sea dikes or introduce mangrove plantations to protect energy infrastructure located at low elevations from sea-level rise and storm surges.
- Modify design of infrastructure to withstand changing conditions, such as increased wind strength or sediment loads, to protect energy generation and distribution systems.
- Increase water intake and/or adjust/redesign air cooling processes to cope with rising air and water temperatures.
- Improve watershed management to regulate the hydrologic cycle and reduce sediment loads, thereby maintaining hydropower production levels.
- Improve planning in the technology chosen and sites selected for energy facilities using information on the likely nature and spatial distribution of climate change impacts and natural disasters.
- Promote wind and solar energy as alternative energy sources, in appropriate locations.
- Prepare disaster response strategies for energy service disruptions, paying attention to critical services such as health care and emergency medical services.
- Improve supply interruption management by including standby power sources or distributed power generation capacity near demand centers.
- Improve demand-side management based on changes to energy needs resulting from climate changes.
- Provide sufficient and up-to-date information and technical expertise for energy authorities and stakeholders to respond to climate impacts and disasters.

Further Assessment and Research Needs

Assessments and further research are needed to enhance the understanding of climate risks and inform adaptation responses in the energy sector. These include

- Assess observed climate change, its impacts, and current and future vulnerabilities to assist in prioritizing adaptation options.

Rising Air Temperature Will Reduce Annual Power Output at a Natural Gas Combined-Cycle Power Station in Viet Nam

O Mon IV is a combined-cycle gas turbine thermal power station with a designed capacity of 750 megawatts. Under normal conditions, the plant has a net efficiency of 56.4% and is expected to generate 4,500 gigawatt hours of electricity per year. It is designed for an ambient air temperature of 30^{0}C. A once-through cooling water system is employed, abstracting and discharging water from the Hau River. A study conducted by ADB showed that the O Mon IV power plant may experience a loss in power output corresponding to approximately 0.8% of its total power output over the period 2015–2040. The reduction in net efficiency will also result in a small increase in fuel consumption. In present value terms, the loss of power output and increased fuel consumption is estimated to cost approximately $11.0 million. In this case, the projected losses are relatively small and may not merit any action. The study helped develop an approach that can be used to screen future large-scale investments.

Source: ADB. Forthcoming. *Adaptation to Climate Change: The O Mon IV Combined Cycle Power Plant.* Manila.

Installation of local monitoring stations can improve the understanding of the relationship between climate change impacts on energy supply and demand. This can contribute to improved management and planning.
- Conduct impact assessments combining energy models and sector impact models with downscaled climate information through integrated assessment modeling.
- Evaluate how climate change might affect energy installations to inform energy sector planners, designers, and practitioners.
- Develop national and regional climate risk atlases based on geographic information systems to determine vulnerable energy assets and develop adaptive responses.
- Assess the costs and benefits of various adaptation options and energy strategies.

There is no universal single-best adaptation measure. Possible options need to be appraised against a set of predefined criteria, which may include technical feasibility, costs and benefits, and/or cost effectiveness of proposed actions and inaction.

For further information, please contact:
N. J. Ahmad
Director, Environment and Safeguards
concurrently Practice Leader (Environment)
E-mail njahmad@adb.org or call +63 2 632 4444

C. Rodgers
Senior Environment Specialist (Climate Change Adaptation)
E-mail crodgers@adb.org or call +63 2 632 4444

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