

Power Sector Resilience

AECOM has been engaged by the World Bank's Energy Sector Management Assistance Program (ESMAP) to collate information and analyse current and emerging practices to manage risks associated with natural hazards in the electricity sector.

The objective of this work is to document experience and facilitate future dialogue between utilities and stakeholders with the ultimate aim of assisting to increase the resilience of the sector to natural disasters.

We are seeking your participation in answering a short survey which seeks to identify the risk management practices which your organisation is using to manage risks from natural hazards.

Throughout this survey our focus is to discover practices that you believe are relatively new or novel that may assist organisations to improve power sector resilience.

1. What aspects of the power sector is your organisation responsible for? (tick all that apply)

- Generation – conventional fossil fuels
- Generation – renewable sources (excluding hydro)
- Generation – hydro
- Generation – nuclear
- Transmission
- Distribution
- System Operations
- Retail
- Other (please specify)

2. How would you describe the structure of the electricity market in your primary country of operation?

- Vertically integrated monopoly providers
- Vertically integrated providers operating in competitive market
- Non-integrated providers operating in a non-competitive market (i.e. sole provider for that function)
- Other (please specify)

Power Sector Resilience

3. What is the ownership structure of your organisation?

- State, National or Local Government utility
- Privately owned company
- Publically listed company with multiple shareholders
- Other (please specify)

4. Is your organisation part of a larger corporate grouping?

- Sole entity in corporate group
- Joint venture or other special purpose company
- Parent company with subsidiary/ies
- Subsidiary of a larger corporate grouping
- Other (please specify)

Region

5. In which region is your organisation based?

- North Africa
- Central or Southern Africa
- Western Europe
- Central Europe
- Middle East
- Central Asia
- East Asia
- South Asia
- Australia or New Zealand
- Pacific
- Latin America and Caribbean
- North America

The following information is provided to assist with you answering the rema...

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We are considering the effects of natural hazards in this study.

The Centre for Research on the Epidemiology of Disaster uses the following definitions when considering natural hazards and disasters.

Geophysical

Events originating from geological processes

Meteorological

Events caused by short lived weather events ranging from minutes to days

Hydrological

Events caused by the inundation, flooding and/or overflow of surface water bodies.

Climatological

Events caused by long lived climate events ranging (seasons to long term)

6. What are the main geophysical hazards which affect the provision of energy services for your organisation? (tick all that apply)

- Earthquake
- Volcanic Eruption
- Rock Fall
- Tsunami
- Snow / Ice Avalanche
- Other (please specify)

7. What are the main meteorological hazards which affect the provision of energy services for your organisation? (tick all that apply)

- Tropical or Extra-tropical cyclone, including Hurricanes and Typhoons
- Tornado
- Extreme Winter Conditions (Winter Storm, Extreme Cold Periods)
- Hail Storm
- Lightning Storm
- Dust Storms
- Extreme Heat Event, including Heat Waves
- Other (please specify)

Power Sector Resilience

8. What are the main hydrological hazards which affect the provision of energy services for your organisation? (tick all that apply)

- Coastal Erosion
- Debris Flow/Mudslide
- River Flood
- Flash Flood
- Pluvial/Urban flood
- Coastal Inundation
- Other (please specify)

9. What are the main climatological hazards which affect the provision of energy services for your organisation? (tick all that apply)

- Drought
- Wildfire (forest/bush and land fires)
- Other (please specify)

Risk Management Processes

The following questions relate to your organisations risk management approach, particularly in relation to natural hazards and disasters

10. Does your organisation have a formal or documented risk management approach which is used to identify, assess and treat risks as they relate to natural hazards?

- No – no risk management approaches are used
- No – only informal risk management approaches are used
- Yes – aligned to ISO31001 Risk Management or other risk standard (please specify)
- Yes – internal risk management policy / procedure or similar which are organisation specific
- Yes – Other (please specify)

Risk Management Approaches - Power Sector

We would appreciate understanding more about the risk management approaches used in your organisation.

When answering these questions, please consider both “hard” and “soft” measures.

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Hard measures include practices centred on engineering or technological solutions such as risk proofing infrastructure, asset redundancy, risk protection assets such as flood levees, early warning systems, etc.

Soft measures involve solutions focusing on governance, institutional and non-physical interventions such as planning, coordination, social considerations, etc.

11. What risk identification approaches (recognizing, assessing, and understanding risks from natural hazards) are used by your organisation to manage risks associated with the natural hazards you identified previously? (tick all that apply)

- None
- Review of historical records, such as meteorological, geological and/or operational data
- Online monitoring to develop long term meteorological and/or geological databases
- Probabilistic modelling of hazards and risks
- Conduct internal risk identification and risk review studies and maintain risk register considering natural hazards (including at the operational and board level)
- Engaging specialist services to analyse or model hazard(s), identify and assess risks, etc.
- Other (please specify)

12. What risk reduction approaches are used by your organisation or in the power sector in your country to manage risks associated with natural hazards? (tick all that apply)

- Mandatory information transparency enforced on market participants, such as energy availability for generation plant.
- Regular electricity industry consultation of electricity supply risks.
- Public education on electricity supply risks
- Penalties/ incentives regimes for service providers
- Auditing of Service Providers to ensure appropriate risk management practices
- None
- Risk proofing infrastructure through design and material selection, including for the development of New assets and retrofitting existing assets
- Improved maintenance practices
- Change site selection of new assets or considered relocation of existing assets
- Organisational capacity building (training)
- Diversification or identification of alternate fuel suppliers
- Alternative energy supply/distribution arrangements
- Encourage distributed generation and microgrids capable of separating and operating temporarily isolated from the Grid
- Economic valuation of the energy supply that is lost during a power system event is used in cost benefit analyses for potential power supply system improvements rather than the price of the energy lost (value of lost load).
- Other (please specify)

13. What methods does your organisation use to increase its risk preparedness? (tick all that apply)

- None
- Forecasting and early warning systems
- Contingency plan
- Emergency management plan (including governance arrangements)
- Business continuity plan
- Communications plan
- Review of interdependent infrastructure to avoid recovery delays due to impaired third party supporting infrastructure such as communications, roads, water supplies etc.
- Have you evaluated in any way (e.g. scorecard, participative survey, internal audit) your institutional preparedness for disaster?
- Drills and response training
- Other (please specify)

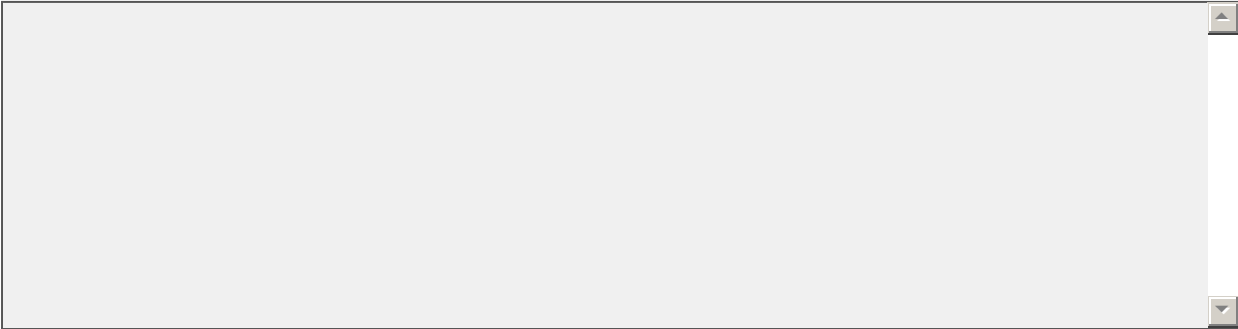
14. What financial approaches are used by your organisation to manage risks associated with the natural hazards/disasters you identified previously? (tick all that apply)

Risk financing and insurance can help to relieve financial pressures from loss and damages associated with natural hazards.

- No financial protection approaches are used
- Risk financing
- Increased depreciation of assets (reduced asset lifetime)
- Asset insurance
- Parametric (defined event) insurance
- Direct pass through of costs to customers
- Other (please specify)

Power Sector Resilience

15. Please describe any other approaches used by your organisation to manage risks associated with the natural hazards/disasters which have not previously been discussed.



Recovery and Restoration - Power Sector

Recovery and reconstruction includes actions to improve the quality and timeliness of recovery and reconstruction in disaster-affected areas (including skills and resources to conduct post-disaster assessments, planning and implementation of large and long term reconstruction programs).

16. What PLANNING approaches used in your power supply system/s to improve the recovery and reconstruction in disaster-affected areas associated with the natural hazards you identified previously? (tick all that apply)

- Response planning
- Recovery planning
- Plan for damage assessment post disasters
- Other (please specify)



Power Sector Resilience

17. What are **TECHNICAL** approaches used in your power supply system/s to improve the recovery and reconstruction in disaster-affected areas associated with the natural hazards you identified previously? (tick all that apply)

- Dynamic live retail pricing at consumer level to discourage high loading of the power system during critical times (live retail pricing changes during the day)
- Smart meters at consumer level to enable better load visibility during supply disruptions.
- Merging of live SCADA data with GIS asset condition data to create live geographical view of asset utilisation, condition and restoration activities
- Demand side management or other automated reduction of demand in order to maintain the power system within its capability in order to avoid wider loss of supply than would otherwise occur
- Centralised rapid response or other 'on call' maintenance and construction crews
- Decentralised on call maintenance and construction crews
- Built in redundancy in systems and supply
- Portable and/or other forms of temporary supply / transmission infrastructure (i.e. generator sets)
- Permanently installed bulk energy storage (batteries) as an alternative supply during power system constraints
- Stocking of spare parts, especially commonly damaged equipment
- Other (please specify)

18. What are **FINANCIAL** approaches used in your power supply system/s to improve the recovery and reconstruction in disaster-affected areas associated with the natural hazards you identified previously? (tick all that apply)

- Regulatory requirement for monetary bonds and/or financial assurance required to meet the costs associated with restoration
- Regulatory requirement for monetary bonds and/or financial assurance to meet the costs associated with recovery
- On call financial reserves and/or contingency allowances within the organisation's operating budget
- Parametric insurance which pays out upon the occurrence of a defined event
- Other mechanisms and funding for recovery operations
- Other mechanisms and funding for reconstruction programs
- Other (please specify)

Power Sector Resilience

19. What INFORMATION and/or COMMUNICATION approaches used in your power supply system/s to improve the recovery and reconstruction in disaster-affected areas associated with the natural hazards you identified previously? (tick all that apply)

- Rapid visualisation and sharing of asset information through the use of GIS (Geographical Information Systems) e.g. asset field data and recovery information entered directly into GIS database to enable rapid management visualisation and response to asset outages.
- Automatic messaging to consumers to request load reduction e.g. SMS (mobile/cell phone text message service)
- Engagement with equipment manufacturers and/or resellers to identify opportunities for long lead time equipment to be replaced quickly
- Other (please specify)

Relationships and Interactions

We are also interested in understanding the relationships which exist between organisations as they relate to natural hazard preparation and recovery.

20. How would you describe the relationship you have with the power sector regulator in your country? (tick all that apply)

- Partners relationship with frequent discussions initiated by both partners
- Reactive relationship with discussions only in response to issue raised by one party
- Highly structured around regulatory reporting requirements
- Limited relationship with infrequent or ad-hoc discussions
- No regulator

Other (please specify)

Power Sector Resilience

21. Does your organisation have relationships with third parties in regards to identifying and managing risks associated with natural hazards?

If yes, please indicate what organisations your organisations has interactions with.

- Not Applicable
- Local meteorological agency, research organisation or university
- Regional or national disaster agencies
- Regional or national recovery agencies
- Other power sector organisations in your country
- Other power sector organisations outside of your country
- Private sector financial institutions
- World Bank
- Development Bank or similar non profit lending agency
- Insurance companies (including brokers)
- Regulators
- Other regional or national government agencies
- Other United Nations organisation
- Other (please specify)

22. Does your organisation work with other members of the power sector to balance load in the network before, during or after disaster events? (tick all that apply)

- No collaboration - vertically integrated monopoly
- No collaboration between members of the supply chain
- Collaboration between competitors delivering the same function in the supply chain to maintain load
- Collaboration between organisations who provide different supply chain functions to maintain load
- Other (please specify)

Power Sector Resilience

23. During restoration of supply and recovery operations, what organisations do you interact with? (tick all that apply)

- Manufacturers and suppliers of spare parts
- Private insurance companies who underwrite repair/replacement costs
- Government insurance agencies who underwrite repair/replacement costs
- Private lending organisations which provide funding soon after a disaster to assist paying for restoration and recovery
- Government lending organisations which provide funding soon after a disaster to assist paying for restoration and recovery
- Public authorities involved in recovery and reconstruction activities

Other (please specify)

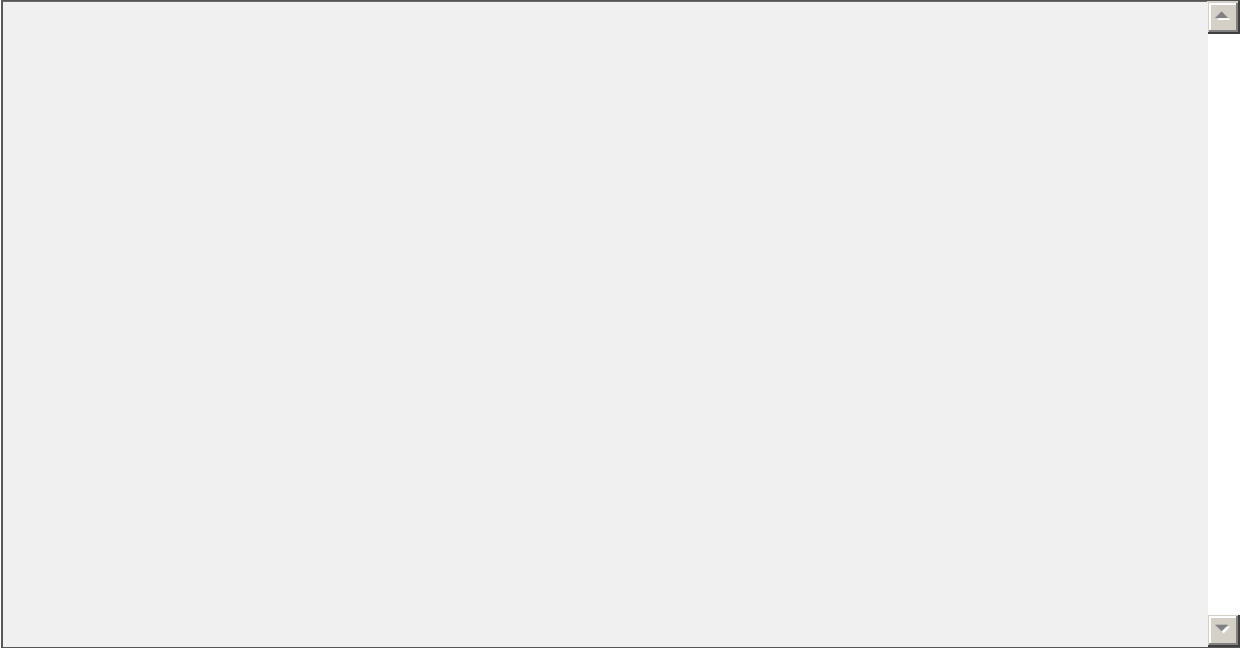
24. What are the main constraints that may prevent your organisation from implementing natural disaster planning, risk reduction or recovery? (tick all that apply)

- The organisation has not considered the need previously
- The organisation does not have the necessary skills and experience to undertake risk preparedness activities
- no budget available within the organisation to support planning and risk reduction activities
- The organisation is not able to enforce other aspects of the power sector supply chain to ensure that planning, reduction and recovery are coordinated
- The regulatory framework does not support planning and risk reduction activities
- There is no incentive for the organisation either because costs are passed through to customers or there are no penalties for disruption to supply
- There is no established supply chain to assist recovery and reconstruction efforts

Other (please specify)

Power Sector Resilience

25. What do you believe are useful emerging practices to develop resilience in the electricity supply sector?



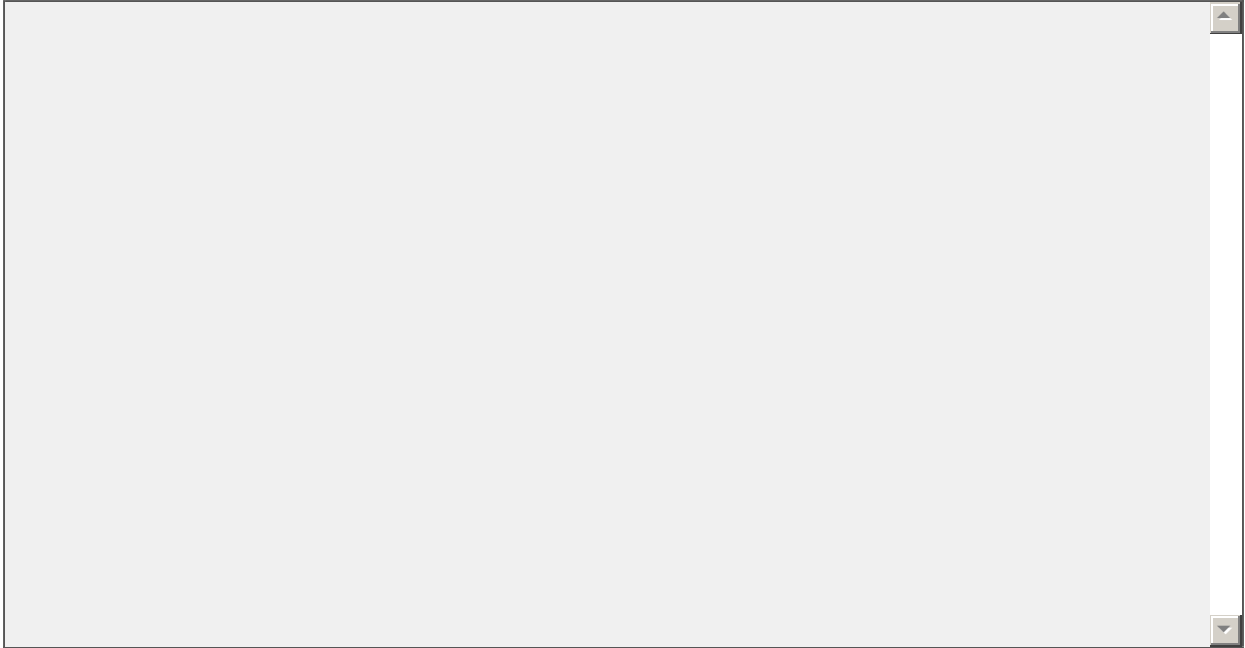
Participation

The World Bank is seeking to develop case studies and to facilitate future discussions by working with the power sector to aid in developing resilience to natural hazards.

Power Sector Resilience

26. If you wish to participate in future discussions, or provide more details, please select the appropriate option(s) below and provide your contact details in the following question.

- I am available to discuss my organisation's risk management approaches to assist with developing case studies
- I wish to participate in future discussions and events organized by the World Bank on the topic of developing resilience in the power sector to natural hazards.
- I'd like to recommend my colleague is invited to participate in future events. (Please provide their details in the space provided below)



***27. To assist in understanding what organisations have responded and to ensure that we have geographical coverage we kindly ask that you provide the organisation name and country.**

We would appreciate if you could provide all of your contact details, but respect that you may prefer to remain anonymous.

Name:	<input type="text"/>
Company:	<input type="text"/>
Address 1:	<input type="text"/>
Address 2:	<input type="text"/>
City/Town:	<input type="text"/>
State/Province:	<input type="text"/>
ZIP/Postal Code:	<input type="text"/>
Country:	<input type="text"/>
Email Address:	<input type="text"/>
Phone Number:	<input type="text"/>