Building a Resilient Power Sector Executive Summary

wbcsd electric utilities

From the CEOs

Electric utilities must adapt to climate change

The evidence of human-induced climate change grows stronger with every scientific report. While action to mitigate rising temperatures becomes increasingly urgent, it is also essential to consider how to adapt to the consequences of global warming. The long-term investment horizons in the electricity industry require an early risk assessment of our assets. We must prepare to maintain supplies in the face of different weather patterns and more frequent extreme weather events, as confirmed by the Intergovernmental Panel on Climate Change's Fifth Assessment Report. As members of the World Business Council on Sustainable Development (WBCSD) electric utilities project, we produced this report to share our learning and our understanding of best practice in increasing the resilience of the power sector.

This report analyzes climate impacts on power systems and recognizes that water is central to the industry and to the risks we face. The interdependencies between water and electricity are growing more complex because most electricity generation requires water, while pumping, moving and treating water requires electricity.

"We must prepare to maintain supplies in the face of different weather patterns and more frequent extreme weather events."

With ongoing climate change, the competition between the different water uses and users will increase.

We are convinced that all utilities need to develop adaptation strategies. The necessary measures depend on the local circumstances of each asset and utility. Assessing a risk-mitigating portfolio of options includes understanding the level of risk, the cost of adaptation measures and the internal and external benefits they provide.

The risks we face are complex – ranging from socioeconomic characteristics of the market to climatic and geographical conditions. While uncertainty is inescapable, a better understanding of the risks is essential if we are to improve risk management and identify the most efficient and cost-effective solutions.

Working together in this project demonstrates our belief that electric utilities and our stakeholders can benefit from pooling our learning, exchanging best practices, sharing resources and encouraging mutual aid. These will be key to developing new business models, climate modeling, technology developments and pricing and managing risk. It also applies to our cooperation with public authorities and other stakeholders, helping them to plan for improved resilience and adaptation in their businesses and communities. Pooling their technical expertise will also help to assess the risks, costs and benefits to our customers and communities.

"Electric utilities and our stakeholders can benefit from pooling our learning, exchanging best practices, sharing resources and encouraging mutual aid."

Cost efficient adaptation also requires a supportive regulatory framework. Better cooperation with public authorities would contribute to more functional frameworks. This is especially important to enhance external benefits across sectors as well as appropriate to local circumstances.

Our industry is vital to increasing resilience to devastating events, such as the recent storms in the U.S. and the Philippines. It is imperative that we learn the lessons and work together to develop the kind of robust responses and strategies outlined in this report.

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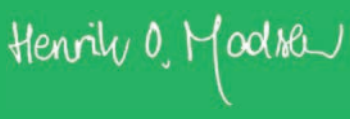

Henrik O. Madsen
President and Chief Executive Officer
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Executive summary

Climate change is creating substantial and varied risks for the electricity industry and for the customers who depend on the electricity utility companies provide. Although it becomes increasingly urgent for electric utilities to pursue mitigation actions, they also need to consider adaptation measures in anticipation of more frequent extreme events as well as long-term changes.

Already, climate change is bringing higher temperatures and rising sea levels and is seriously affecting water resources in many regions. Tensions between the energy and water sectors may increase as the power sector needs increasing supplies of water. Meanwhile, demand for water will also grow for agriculture, industry and domestic supply. Hydropower can play an important role at the nexus of energy and water management.

"Making investment decisions involves anticipating the long-term environment and the needs and constraints under which utilities will operate."

Along with global warming, the number of extreme weather events has risen sharply in the last 30 years. Heat waves and heavy rains are likely to continue becoming more common in many regions. The cost to the industry and the wider economy is enormous – Superstorm Sandy, which hit New York in 2012, created damage costing as much as $65 billion.[1]

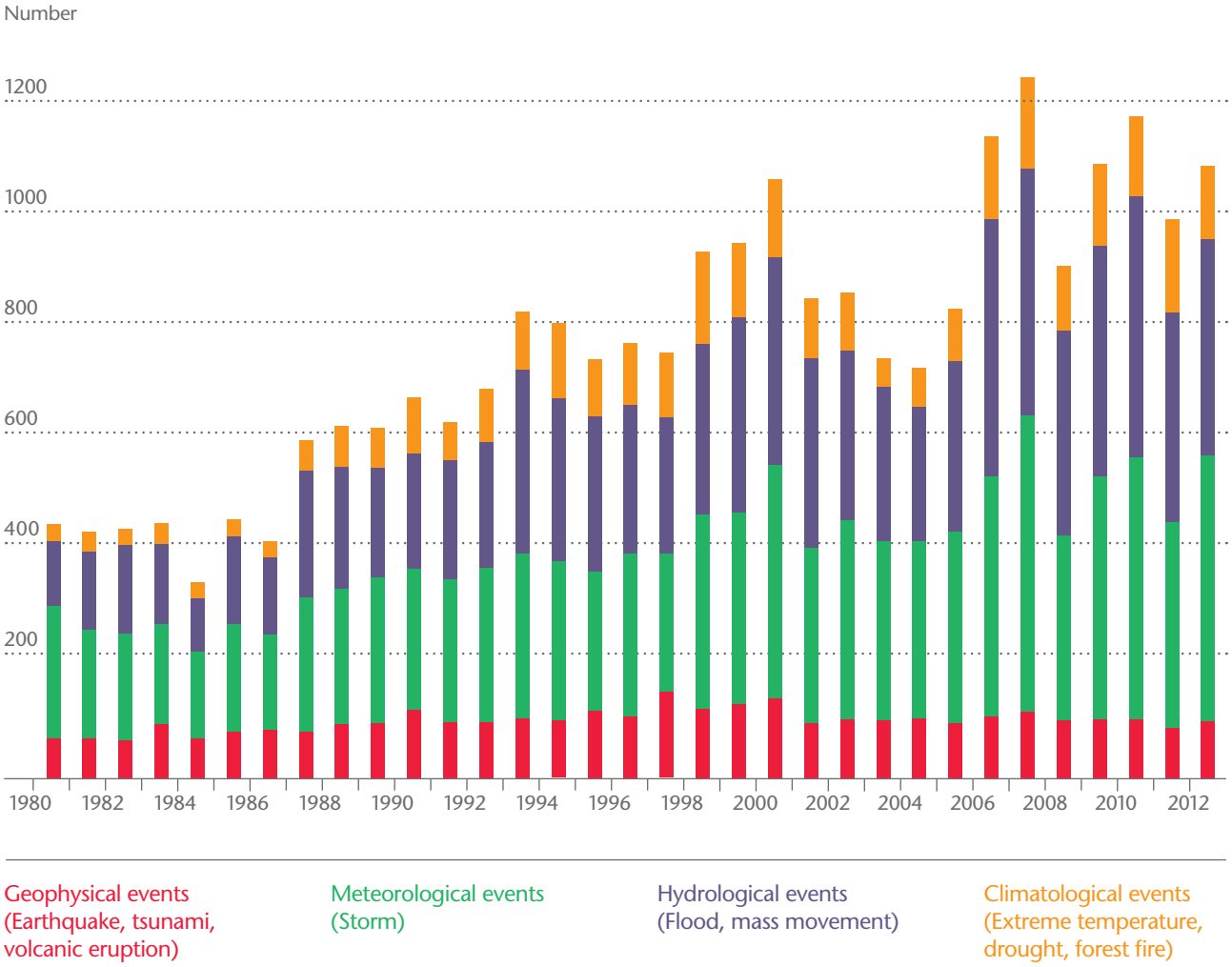
Investment decisions in the power sector have long timeframes as the lifetime of the assets varies between 20 to 100 years. Making investment decisions involves anticipating the long-term environment and the needs and constraints under which utilities will operate. When making decisions, utilities face several uncertainties: economic and policy uncertainty associated with technologies, political commitments and demographic and socioeconomic trends; scientific uncertainty around the impacts at regional levels and the reaction of affected systems; and natural variability of the climate system.

In addition to these uncertainties, rapid urbanization will exacerbate climate change impact. Indeed, some of the world's biggest and fastest growing cities are located on low-lying areas exposed to flooding and storm surges. Their growth is coupled with rising energy demand that increases pressures on capacity and reduces redundancies in power generation to riskier levels. An extreme weather event (or greater frequency of extreme events) will impact more people, and the resulting costs (through lost business, damage to homes, infrastructure and goods) will be higher.

This publication describes the risks and vulnerabilities for the power sector from more frequent extreme weather and progressive climate change, and the measures the sector can take to build resiliency in its operations.

[1] National Oceanic and Atmospheric Administration (2013).

Figure 1
Worldwide Natural Catastrophes 1980-2012



Source: Münchener Rückversicherungs-Gelleschaft (2013).

How can we forecast weather and climate risks?

The evolution of climate change substantially increases the complexity and risks involved in long-term investment decisions, requiring higher resolution meteorological modeling to support business decision-making. This may include reflecting systemic changes in climatic conditions in modeling data, for instance.

Weather forecasting is important for routine operations, optimizing production in response to demand. It is also essential to provide warning of an extreme event, such as a hurricane, making it possible to better manage demand and supply and to accelerate recovery times. Utilities need improved forecast quality and reliability, especially for air temperature, given its impact on demand, and rainfall, which influences hydropower production and water resources for cooling.

The huge development of observation networks in the last 20 years has provided vast amounts of information. To develop more reliable forecasts, utilities need access to climate data and hydrological information such as soil moisture, groundwater, runoff and evaporation. They also need enhanced skills to interpret the information and understand how the meteorological uncertainty affects their operations.

Improved climate projections and weather predictions are necessary to help utilities understand the climate impacts at local levels and adapt infrastructure to meet expected changes in climate and extreme weather events. Utilities need improved models that downscale global information to the local level and tools to understand how the meteorological uncertainty affects their current and future operations.

What are the climate risks we face?

While the general effects are global, the specific impacts of climate change and the greater frequency and intensity of extreme weather events will be local and specific to each technology and asset class. The impacts may also be unpredictable and will vary during the lifetime of assets.

The most significant threats are from rising sea levels, floods, storms and water shortages. But rising temperatures will also reduce the efficiency of thermal generation, and heat waves will significantly increase peak demand. In general, the industry needs to revise assumptions about weather risk and become more flexible and resilient to the changing environment.

Figure 2
Framework for climate change adaptation and resilience in the power sector

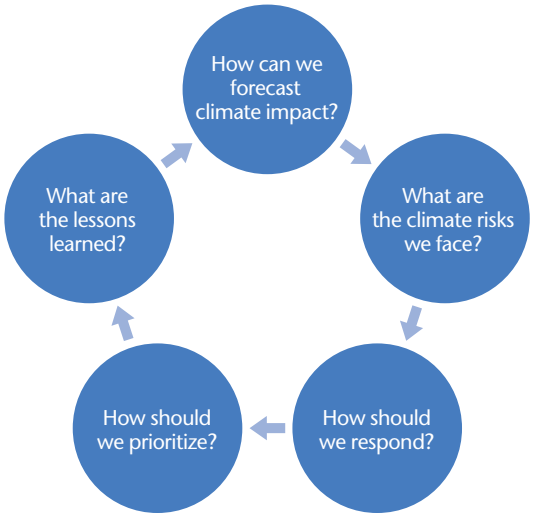


Table 1
Potential climate impacts per asset class

	Generation				T&D		Customers
	Thermal	Hydro	Wind/PV	Biomass	Lines	Stations	
Air temperature	●	●		●			●
Water temperature	●			●			
Water availability	●	●	●	●			
Wind speed			●		●		
Sea level	●	●	●	●	●	●	
Floods	●	●	●	●	●	●	
Heat waves	●		●			●	●
Drought	●	●		●			

Source: Adapted from Asian Development Bank (2012).

Appropriate adaptation measures include physical protection of assets, improving the designs of specific assets and of the electricity system as a whole. As technologies have different vulnerabilities, diversifying power supply and adequate back-up facilities are vital. The first line of defense will consist of low-cost, "no-regrets" measures, such as good vegetation management, waterproofing, servicing and maintenance.

How should we respond?

Utilities will have to adapt to gradual climate effects and become more resilient, which will involve the ability to anticipate, absorb, accommodate, and recover from the effects of an extreme event. Utilities need to change the way they design and manage power infrastructure.

Figure 3
Response to extreme events

Extreme events – Increasing resilience requires the ability to absorb, accommodate, and recover from the effects of an extreme event. It will involve anticipation and evaluation of events, planning response measures, discussion with stakeholders, implementing measures and recovery.

Longer-term climate impacts – Utilities need to adjust to gradual and progressive changes in climate and deal with greater uncertainty by being more flexible than the traditional hardening approach, considering infrastructure beyond individual utilities or even countries for maximum flexibility, and applying research and development to meet climate change vulnerabilities in new infrastructure. New weather patterns will result in greater demand volatility, increasing peak loads and capacity requirements, and changing demand locations.

How should we prioritize?

When selecting adaptation measures, improvements must be considered in light of the costs, benefits and risks. The costs and benefits are often not distributed symmetrically – utilities may carry the costs, while several stakeholders may reap the benefits. Incurring heavy costs will only be justifiable if the risks and benefits are commensurate, measurable and accessible.

Risk-cost benefit (RCB) analysis produces a cost-benefit curve based on:

> Quantitative estimates of risk, expressed as potential losses;

> Costs of adaptation measures, including capital and operating expenses;

> Benefits, which may include potential additional revenues as well as losses averted from direct consequences of an adverse event and possibly indirect consequences, such as losses experienced by customers.

But a quantitative RCB analysis cannot provide definitive answers. Customer service, the regulatory environment, capital availability and technical and institutional capacity are important criteria to be considered in addition to quantitative analysis.

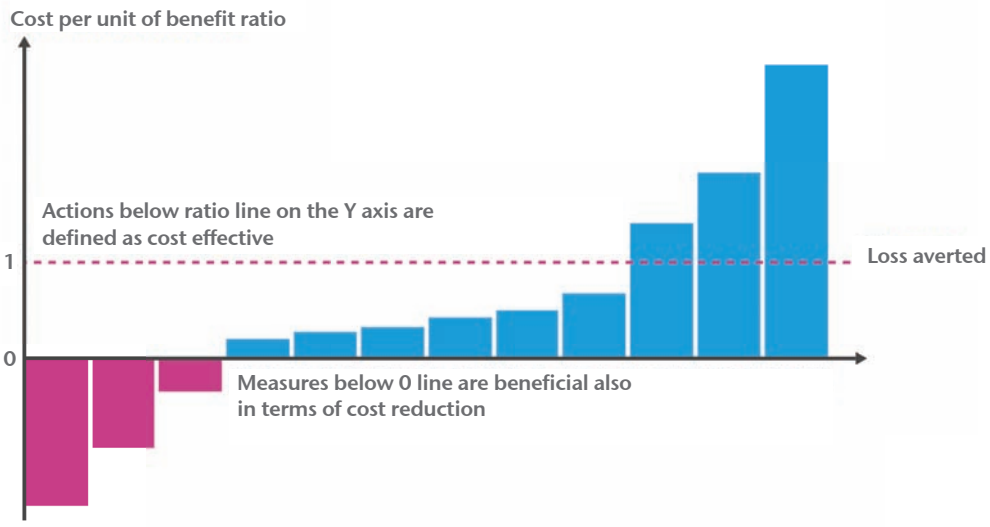
Collective, community-wide action is necessary to build resilient communities and identify the cost-effective measures that will best manage the community risks. It is necessary to engage communities about how climate change will affect their demand for electricity, the implications for supply and the trade-offs that may be necessary. Local authorities, customers and others must be involved in establishing a risk management framework and identifying the cost-effective measures that will best manage the risks and address their vulnerabilities.

Growing urbanization involves massive infrastructure investments, which will be affected by climate change. Electric utilities will also have to manage climate related risks associated with public infrastructure that they depend on, underscoring the need to work with the public sector to map and model risk at the national level and understand the links with critical infrastructure, such as sewage, information and communications technologies (ICT), and coastal and inland flood management. Public investments will be needed to cover wider landscape management issues, such as dams and flood plain management, or keeping critical transport arteries open at times of emergency.

The private sector should work with public authorities to establish a more comprehensive view of the risk, response and resilience strategies that governments at the national and local levels have in place – and to improve them if possible.

Figure 4
Global adaptation and resilience actions by the project members

Figure 5
Risk-cost benefit curves



Conclusion

Strengthening electricity infrastructure is fundamental to energy security, a key concern for governments all over the world and central to the power sector's social responsibilities.

Regulatory frameworks may need to be redesigned in the most vulnerable areas to support system upgrade plans, system design and equipment standards that respond to the threats from climate change. Financing adaptation measures will be constrained if benefits do not accrue to the companies making the investment.

The nature of the different risks and the variation across locations and timeframes during the lifetime of assets increases the importance of fully understanding the risks and potential adaptation measures. Assessing and managing these risks requires electric utilities to embrace uncertainty. It is necessary to strengthen infrastructure but also to build-in flexibility to enable more effective responses to unexpected events.

Risk-cost benefit analysis is a useful tool for quantifying the impact and cost of potential adaptation measures. But it is necessary to engage with communities and consider risks beyond utilities' own assets to identify cost-effective measures that will best manage the risks and build resilient communities.

The lessons learned from the companies involved in this study show that climate change is leading to the emergence of new business models in the power sector that incorporate new ways of approaching risks and uncertainty. Utilities will face additional pressure from insurance and the financial sector to improve their understanding and management of climate risks and to build, design or retrofit their assets accordingly. In some countries, regulations (such as property rights, insurance and planning) currently block the emergence of these new business models. Policies and regulations need to be adjusted or created to incentivize investments that increase resilience in operations, in power systems and in local communities.

Recommendations

Recommendations for the industry

> Build expertise in analyzing climate information to better understand risks, especially downscaling global climate models to a more local level.

> Use risk management and risk-cost benefit analysis when developing adaptation strategies to determine which solutions are efficient and cost-effective.

> Continue investing in R&D to develop effective upgrades to major infrastructure elements, broadening the range of options and reducing costs over time.

> Pool learning, exchange best practice and share resources to respond more effectively to extreme events.

Recommendations for policymakers

> Consider market signals and regional regulatory structures appropriate to local circumstances that can mitigate some of the risks.

> Support a business model that is viable in the context of climate change, including incentives for utilities to invest in adaptation.

> Adjust regulations to recognize the high-impact risks faced today and the likelihood of increasing frequency in future.

> Reflect climate risks in system specification and equipment standards.

Recommendations for public-private collaboration

> Organize cross-sector collaboration for long-term infrastructure planning and organize mutual aid for crisis response.

> Organize effective pooling of technical expertise, risk assessment and understanding of socioeconomic costs and develop new business models to price and manage risk.

> Develop more useful, local forecasts over time periods short enough to be relevant to business decision-making by giving utilities access to climate data and hydrological information.

> Improve public-private collaboration to share information, especially on a local scale, to improve community resilience.

About the World Business Council for Sustainable Development (WBCSD)

The World Business Council for Sustainable Development (WBCSD) is a CEO-led organization of forward-thinking companies that galvanizes the global business community to create a sustainable future for business, society and the environment. Together with its members, the council applies its respected thought leadership and effective advocacy to generate constructive solutions and take shared action. Leveraging its strong relationships with stakeholders as the leading advocate for business, the council helps drive debate and policy change in favor of sustainable development solutions.

The WBCSD provides a forum for its 200 member companies – which represent all business sectors, all continents and a combined revenue of more than $7 trillion – to share best practices on sustainable development issues and to develop innovative tools that change the status quo. The Council also benefits from a network of 60 national and regional business councils and partner organizations, a majority of which are based in developing countries.

WBCSD electricity utilities project members

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Disclaimer

This report is a result of collaborative work among executives from eleven member companies of the WBCSD Electricity Utilities Project. This work was convened and supported by the WBCSD Secretariat. All member companies of the project have thoroughly reviewed drafts of the report. However, this does not mean that every member company necessarily agrees with every statement in the report.

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