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CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

World Energy Perspective

The road to resilience − managing and financing extreme weather risks

Project Partners Marsh & McLennan Companies and
Swiss Re Corporate Solutions

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The road to resilience – managing and financing extreme weather risks (Executive Summary)
World Energy Council

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Executive summary

Lights out in Manhattan after Hurricane Sandy, nuclear and thermal power plants being shut down due to long-lasting heat waves in Europe, years of rebuilding needed after Typhoon Haiyan hit in the Philippines, droughts in Brazil and changing rainfall patterns in Kenya impacting hydropower: the list could go on. The common denominator in all of these events is extreme weather – a deviation from typical weather patterns that current energy infrastructure was not designed to handle.

The frequency, severity and exposure of energy systems to extreme weather events are increasing. The number of extreme weather events increased more than 4 times from 38 in 1980 to 174 events in 2014.[1] Severe convective storms' contribution to overall insured losses (last 5 years compared to last 20 years) alone has increased to over 40%.[2] Many more events are expected in the future, driven by the increase in global average temperature.[3] Extreme hot and cold temperatures will raise overall energy demand and strain peak capacity. The energy supply also faces reduced efficiency of thermal plants, cooling constraints on thermal and nuclear plants and increased stress on transmission and distribution (T&D) systems. More extreme events such as tropical storms, droughts or floods may not only impact energy production and revenue streams, but also the equipment itself.

While in the past impact-resistant – 'fail-safe' – structures were built, today's system complexity and increased incidence of extreme weather require a shift towards having energy infrastructures operating under a 'safe-fail' approach. The solution appears to be 'smarter not stronger'. This soft resilience approach can make energy supplies more secure, more reliable and can contribute to the quicker restoration of services in case of disruptions. Soft adaptation measures are increasingly complementing traditional hard resilience measures.

Taking a systemic approach to identify technical risk naturally enables the development of innovative financing for the energy sector. Shifting from historical mind-sets towards future-focused planning can incentivise private investors, who have otherwise considered energy too high-risk for traditional sources of financing.

Financing resilient energy infrastructure

Protecting energy infrastructure assets from extreme weather will add significantly to the estimated US$48–$53trn in cumulative global investment needed in energy infrastructure by 2035.[4] This figure does not include estimates for investment needed

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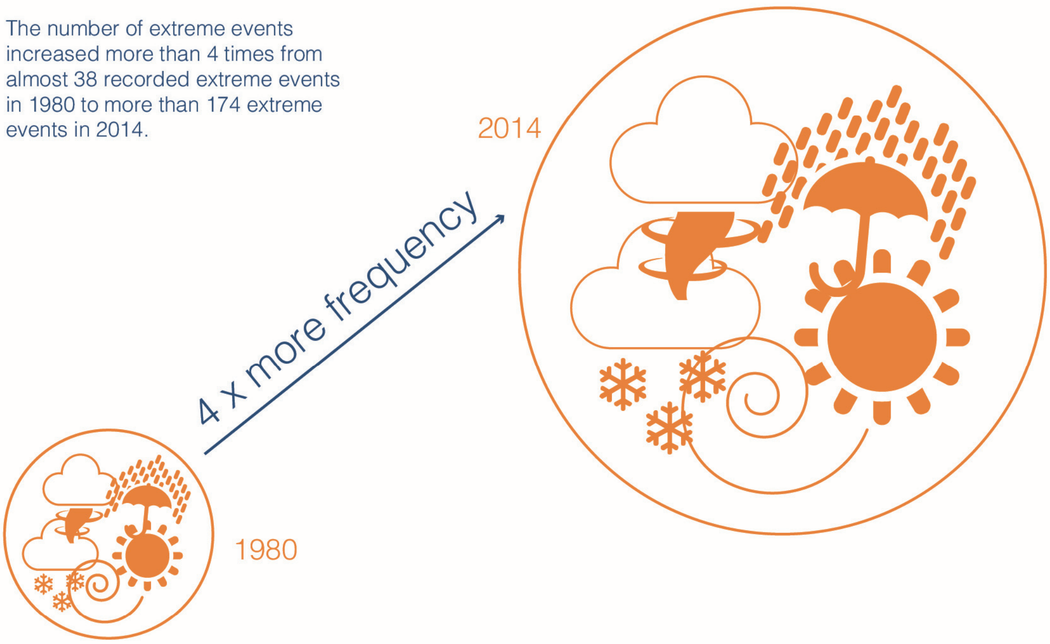
[1] Swiss Re Economic Research and Consulting, 2015: Sigma world insurance database (last accessed 10 September 2015)
[2] Swiss Re, 2015: Sigma Report No. 2/2015 – Natural catastrophes and man-made disasters in 2014: Convective and winter storms generate most losses
[3] Pachauri, R K, Allen M R, Barros V R et al, 2014: Climate Change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)
[4] International Energy Agency (IEA), 2014: World Energy Investment Outlook; The 2°C scenario would require double the investments in low-carbon technologies and energy efficiency.

The road to resilience – managing and financing extreme weather risks

The global energy sector is exposed to unprecedented uncertainty and faces a number of emerging risks. Extreme weather events pose a real threat to existing energy infrastructures and affect the security of supply. Building resilient energy systems is critical for meeting future Energy Trilemma goals.

The number of extreme events increased more than 4 times from almost 38 recorded extreme events in 1980 to more than 174 extreme events in 2014.



Extreme weather risks

These events pose direct risks to infrastructure, and their consequences can further stress the energy system.

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Impact on energy infrastructure

Oil & gas assets

Tropical cyclones and hurricanes can damage assets and reduce production rates.

Oil & gas pipelines

Thawing permafrost, floods and landslides can affect the asset itself, pipeline flow and associated revenue.

Transmission and distribution

Strong winds and ice-storms can damage above ground T&D lines and affect associated revenue streams.

Renewables

Strong winds, storms but also increased cloud conditions can result in equipment damage, erratic output and lost revenue.

Thermal electricity generation

Floods, storms and cyclones can damage equipment and restrict generation. Rising air and water temperatures affect thermal efficiency, with impacts on cost and revenue.

Hydropower

Hydropower plants are highly vulnerable to changes in the hydrologic cycle, including water stress, drought, floods, cyclones and higher temperatures. Equipment can be damaged and output reduced.

Nuclear

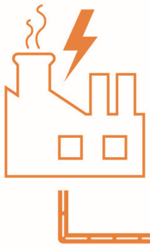
Storms, cyclones, water stress, floods or increasing water temperatures may damage or disrupt critical equipment and processes and affect generation output.

Smarter not stronger

Resilience for energy infrastructure refers to its robustness and ability to recover operations to minimise interruptions to service. Resilience also implies the ability to withstand extraordinary events, secure the safety of equipment and people, and ensure the reliability of the energy system as a whole.

Hard resilience

Focus on resistance. 'Fail-safe' – building single infrastructures to withstand sudden impact. Looks to strengthen individual Infrastructures and single assets.



Soft resilience

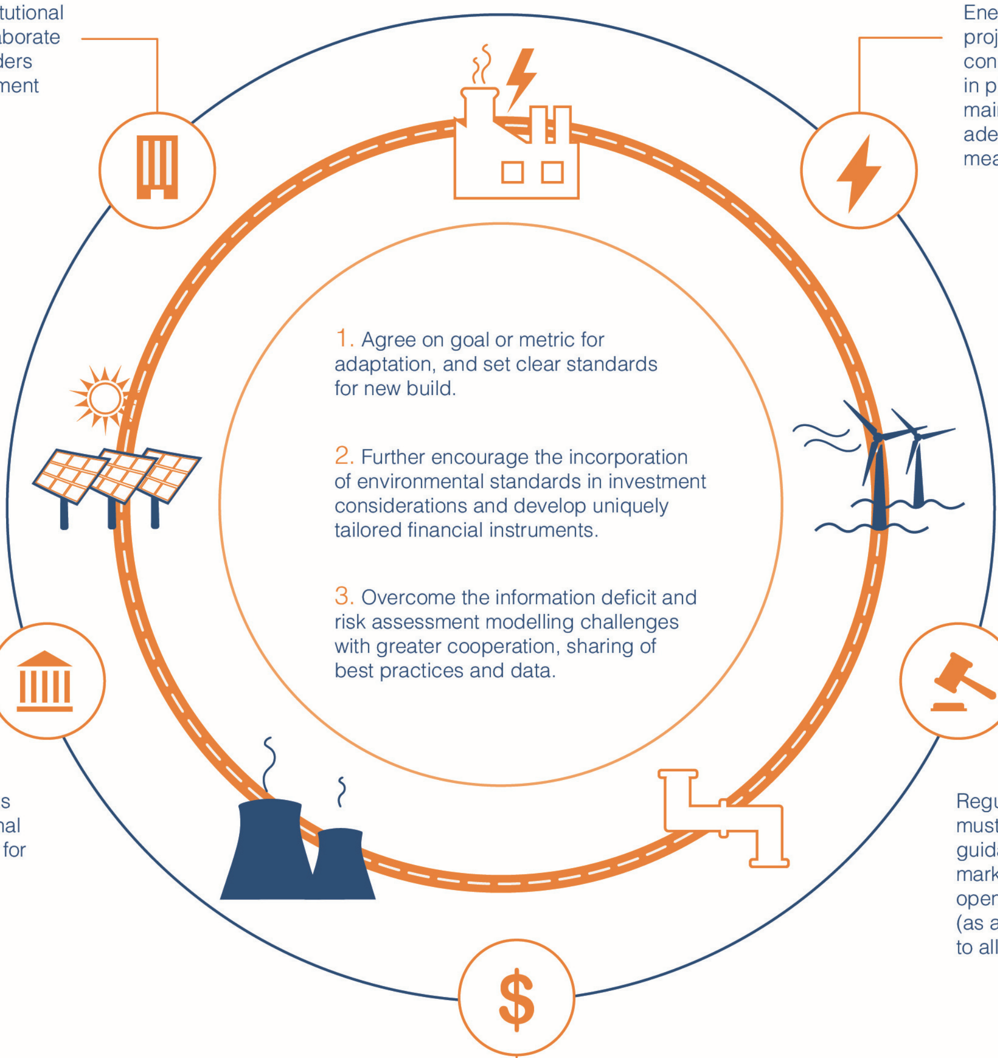
Focus on absorption. 'Safe-fail' – building infrastructures that recover quickly from sudden impacts. Looks to reduce impact of disruption by taking a systemic view.

Call to action: creating systemic resilience

Increasing the resilience of energy infrastructure to extreme weather events is not an option but a must. Resilience can only be achieved by moving from individual to joint efforts to build systemic energy systems that will support the growth of the global economy.

Long-term and institutional investors must collaborate with other stakeholders to overcome investment barriers.

Energy companies and project developers must consider extreme weather in planning, operation and maintenance, and implement adequate soft/hard resilience measures.



Insurance and banks must create additional risk transfer options for residual risks.

Regulators (governments) must provide regulatory guidance for resilience and market regulation, but also by opening energy infrastructures (as an asset class) to all investors.

The financial services industry must develop models that fully reflect extreme weather risks and include soft/hard resilience in cost-benefit analysis.

in energy infrastructure adaptation. The impact on developed economies with highly interdependent energy systems is likely to add significantly to this already large figure.

It is clear that governments alone cannot cover the costs of ensuring secure and reliable energy systems that meet our current and future energy demand and at the same time are able to withstand the impact of extreme weather events. Private investors must join in the funding. To attract private sector investors, energy investments must receive adequate and stable returns over an asset's lifetime. To get private money flowing into energy infrastructures and resilience measures, it is critical for all stakeholders involved in developing new or operating existing energy infrastructure projects to communicate and have the tools necessary to compare the costs with the benefits of investing in resilience.

However, limited data and a lack of best practice sharing is creating an information vacuum which is reducing the ability of both the energy and finance sector to properly price the investment risk presented by increased extreme weather. All stakeholders must cooperate and share best practices and data to overcome the information deficit. Similarly energy companies and project developers must move on from simply using historical operational data, to embrace dynamic modelling for the planning, operation and maintenance of their energy investments. Fully reflecting extreme weather risks in the cost benefit analysis of project financing can greatly enhance the project risk profile. These measures, aligned with risk transfer options for residual risks, will reduce exposure, unlock capital and ultimately reduce cost.

Setting a framework for financing resilience

Adaptation measures often lack regulatory guidance regarding what is necessary to increase resilience. There is currently no agreed goal or metric for adaptation, or specific responses to extreme weather. Nor is there agreement on how much resilience is sufficient and how increased resilience can be related to an additional revenue stream and so become attractive for investors. Government and regulators should implement regulatory frameworks to clearly define the levels of resilience required for energy infrastructure. This could enable the finance sector to create suitable financial vehicles which would help the private sector to carry their responsibility in resilience.

Currently institutional investors like pension and insurance companies cannot invest substantially in energy infrastructure because of solvency regulations. Introducing a new asset class that includes long-term investments in infrastructure can make large funds available for future energy supplies. With greater transparency, insurance companies and banks could take advantage of extreme weather risks to create unique financial vehicles that help fill project financing gaps. Long-term and institutional investors could use this approach to overcome regulatory restraints by incorporating extreme weather and climate in investment planning, by using responsible investment standards, to help de-risk energy investments.

Call to action

Increasing the resilience of energy infrastructure to extreme weather events is not an option – it is a must. While stakeholders are driven by diverse motives, everyone has a role to play, and there are some common obstacles to be overcome together to ensure that energy supply is secure and reliable, now and in the future. The energy system will only be able to play its crucial role as the backbone of the global economy if all stakeholders work together.

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