

Sharm El-Sheikh Adaptation Agenda

TECHNICAL REPORT

2030 Adaptation Outcomes for Resilient Energy Systems

This publication draws on analysis from the UN Climate Change High-Level Champions and McKinsey Sustainability



Marrakech
Partnership



INVESTING IN RESILIENT ENERGY SYSTEMS

Universal access to resilient energy systems is key for sustainable and inclusive economic growth

A resilient energy system is capable of absorbing climate shocks and ensuring provision of power during and after climate-driven hazards. If resilience is not built into energy systems, energy provision is put at risk from climate hazards, and substantial economic and societal impact could ensue. For the purpose of this analysis, energy systems refer to generation, distribution, transmission and consumption of electrical power.

Macro-trends are increasing the importance of building resilience into energy systems

Climate hazards are increasing in prevalence and intensity, increasing the number of exposed people and the energy systems that serve them. By 2030, Race to Resilience analysis estimates that over 50% of the world's population could be exposed to climate hazards. This analysis suggests that 1b-1.5b people may have more than 25 percent of their working hours exposed to 34C wet-bulb temperatures, with significant disruption to their livelihoods.

Energy systems are expanding to meet growing demand, in order to serve a growing global population with increasing energy consumption and meet the demand for electricity as the global economy decarbonises. In many cases, energy infrastructure is expanding in regions with high levels of existing hazard exposure, such as Africa and South Asia. Estimates vary, and depend on broader assumptions, but suggest 40-50 percent growth in installed generation capacity between 2020 and 2030¹.

The nature of energy system vulnerability is shifting as a result of the energy transition. Generation technologies such as solar, hydropower and nuclear energy have different vulnerability profiles and resilience-building requirements. For example, hydropower can be vulnerable to heat stress and drought as evaporation reduces reservoirs required to generate power². IEA predicts renewable generation capacity could increase by 60 percent from 2020 to 2026³.

Building resilience into expanding and transitioning energy systems is critical to safeguard the positive impacts of increased access and clean energy, whilst ensuring wider community and societal resilience.

Increasing climate hazards risk damaging and disrupting energy systems

Climate hazards can impact energy systems in two primary ways. **1) Hazards such as flooding, storms and wildfires can damage infrastructure**, resulting in disruptions to electricity provision until repairs are made or energy is redeployed from functioning parts of the grid. It is estimated that 30-40 percent of power lines and generation capacity could be exposed and vulnerable to riverine flooding, coastal flooding and/or wildfires in a 2°C world⁴.

¹ IEA World energy outlook 2020 report, Enerdata analysis

² C2ES (2022) Drought and climate change

³ IEA Renewable 2021 report

⁴ McKinsey & Company analysis, with calculations based on the RCP 8.5 and a multi model ensemble

2) Extreme heat can reduce the effectiveness of power generation and transmission, whilst also increasing demand through increased use of powered cooling. Examples of reduced effectiveness include increased losses during transmission⁵ and reduced output efficiency of solar panels⁶. The impact is an energy deficit that could cause black-outs or brown-outs in periods of extreme heat. It is estimated that in a 2°C world, 10-20 percent of power generation and 50-60 percent of power lines could be at risk of reduced efficiency due to temperatures exceeding 40C for more than 7 days per year⁷.

There are 7 key investment areas that support universal access to resilient energy systems

These investments can provide access to improve the resilience of disconnected communities, develop flexible and responsive systems that can withstand climate variability and protect at-risk infrastructure from acute climate hazards.

	Investment areas	Focus
Provide access to disconnected communities	1 Off grid / back-up solutions	Developing independent networks to improve the rate and quality of electricity access
	2 Diversified renewable power	Developing a diverse set of distributed renewable generation assets to avoid concentration in exposed areas and produce flexible capacity
Develop a flexible and responsive system with sufficient redundancy	3 T&D build-out	Building out T&D network to enable the integration of distributed renewables
	4 Storage solutions	Developing electricity storage solutions to enable the integration of diversified, variable renewables
	5 Smart grid technology	Building new or retrofitting existing grids with smart technology to enable flexible management of supply and demand and improve ability to maintain provision
Protect at risk system infrastructure	6 Asset hardening	Upgrading infrastructure and components to maintain generation, transmission and distribution during and after hazard events
	7 Planning tools and data	Developing hazard and exposure data and analytics capabilities to inform the location and design of new build assets and retrofits

Whilst capital is flowing into these areas, there is a need to increase investment, especially in LDCs

There is already significant investment flowing into both energy access and the development of flexible and responsive systems. Whilst both are experiencing a well-coordinated push for increased investment, more capital is required to reach the Breakthrough 2030 goal of universal access to diverse, distributed and reliable energy.

In asset hardening, the challenge is even greater. Developed country utility companies are raising and deploying capital for hardening, and governments are providing technical and funding support such as the United States Department of Energy \$20B 'Building a Better Grid Initiative'. However, developing country utilities and governments struggle to fund hardening, and have growing volumes of infrastructure at risk of climate hazards. Investment gap analysis shows the potential investment shortfall in LDCs would be as much as four times the needed capital to harden exposed assets⁸.

⁵ Kosec et al. (2017) Dynamic thermal rating of power lines
⁶ World Economic Forum (2022) Why don't solar panels work as well in heatwaves?
⁷ McKinsey & Company analysis
⁸ McKinsey & Company analysis

There are a number of opportunities for investors to fund resilience building activity

Opportunities to unlock investment in the identified areas include:

- Multilateral Development Bank (MDB) supported blended finance products that can catalyze private financing for utilities, government and public-private partnerships projects to support asset hardening, smart grid installation and T&D build-out in countries with high climate hazard exposure
- Debt and equity to scale Original Equipment Manufacturers (OEMs) developing and manufacturing hardened equipment and smart grid technologies and retailing to emerging markets with high climate hazard exposure
- Early-stage investment in affordable smart grid technologies and digital planning solutions

ACKNOWLEDGEMENTS

About UN Climate Change High Level Champions

The UN Climate Change High Level Champions engage non-State actors to support governments in delivering the goals of the Paris Agreement. Working with the Marrakech Partnership - a global alliance of more than 320 major initiatives and coalitions - the Champions enhance the ambition of cities, regions, businesses and investors and other non-State actors, to collectively race towards a fair, resilient and zero carbon world.

Author Acknowledgements

The UN Climate Change High-Level Champions would like to thank McKinsey Sustainability for providing analysis to this report, alongside special thanks to Flavia Howard, Kelly Carlin, Albena Ivanova, Peter Hall, Hamid Samandari, Amr Seleem, Aaron Bielenberger, Suzanne Angliviell, Oliver Walker, Chania Frost and Peter Douglas