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King Abdullah Petroleum Studies and Research Center

Policy Responses to the Reliability Crisis in the Power Grid

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About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and appliaed research.

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From China, Europe, Central Asia, India and to the United States, there is a reliability crisis in electric power grids. Why are power grids so brittle and what should policymakers do?

In September 2021 across eastern China, power cuts and blackouts slowed the country's economy and further disrupted global supply chains. Europe faced real fears of power outages during the winter of 2021-2022, with energy supplies from Russia being threatened. If unusually cold weather or additional electricity supply problems had occurred, the results would have been catastrophic.

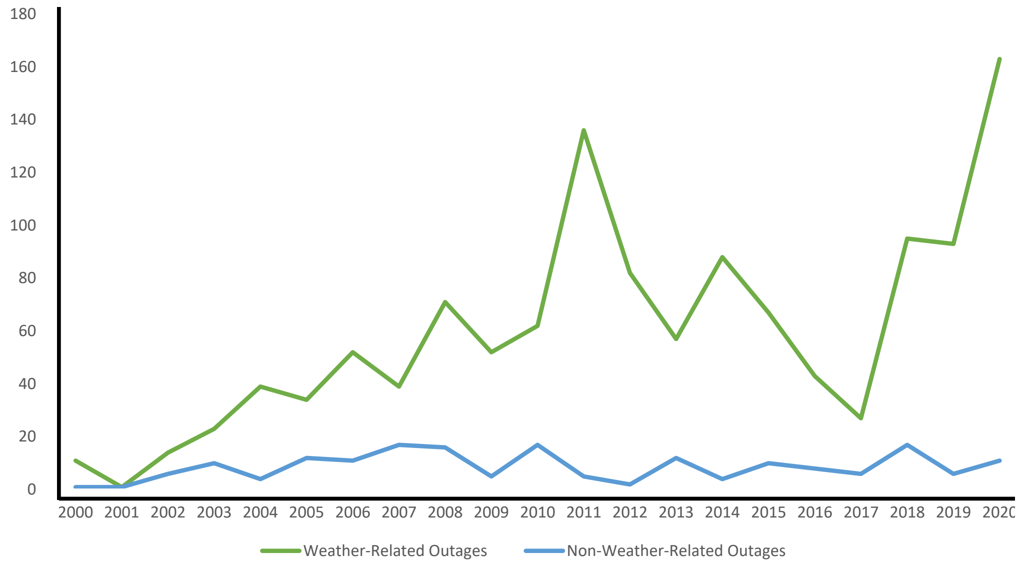
In January 2022, blackouts swept across central Asia affecting millions of people in Kyrgyzstan, Uzbekistan and Kazakhstan. India continues to experience power outages in 2022 as it did in 2021. Extreme heat, coal shortages, and a growing economy have caused the worst outages in India in over half a decade.

The United States is recovering from outages, including the massive winter storm in 2021 that devastated the Texan and the surrounding region's power grids and August 2021 blackouts in the Midwest due to heavy rains and high winds causing 850,000 customers to lose power. In November 2021, over 63,000 homes and business lost power in and around Los Angeles.

This situation is not expected to improve. For example, the North American Electric Reliability Corporation (NERC) released its May 18, 2022, forward-looking reliability assessment that warns of increasing risks to the grid. Droughts, heat waves, outages of major transmission lines, generation reserve shortages, supply chain issues, cybersecurity threats, tripping of solar generation, and wildfires are all identified as potential major threats to reliability.

Any meaningful effort to transition the energy sector to a low-carbon future relies upon the expansion of electricity into transportation, heat-intensive industries, and hard-to-abate sectors such as maritime and aviation, using large amounts of renewable energy. Solar and wind power are intermittent and, as their role in the grid expands, integrating their variable production into the grid is an additional reliability challenge.

Figure 1. Number of U.S. Weather Related Power Outages are Increasing Relative to Non-weather Related Ones (2000-2020)



Given the geographic scope of the reliability crisis and the long list of threats it poses, how should policymakers think about this problem for their region or country? The types of questions they are asking include whether the threats are unique to a particular location or context, how should they be prioritized, and should each threat be addressed individually or are there broader policy responses?

These reliability hazards are so damaging because they incapacitate multiple parts of the grid simultaneously and, in some cases, when demand for electricity is the highest. Severe weather can shut down generation plants of all types, damage transmission lines and substations, and disable distribution lines, poles and transformers. Cybersecurity risks, supply chain problems, and fuel shortages can do the same.

Grid reliability analyses, metrics, and policies have historically centered around analyzing independent failures of generation, transmission and distribution components. In the past, the types of major common causes or dependent failures were not systematically identified, tracked, analyzed, and addressed. Somewhat recently, the term 'resiliency' has entered the power sector's lexicon to both label these common-cause threats and to emphasize the importance of not just preventing power outages but also recovering from them quickly.

So how should policymakers respond coherently and systematically to these challenges? First, power grid reliability and resiliency policies should be centered around common-cause failures, those low or lower probability events that have high impacts. These possible accident sequences need to be identified, based both upon actual events and creative brainstorming, and dissected. Systems need to be developed that evaluate relevant historical data, such as severe weather events over recorded time, and record failure modes, pathways, frequencies, and impacts.

Second, reliability data, analyses, and studies should be shared. Given that many regions and countries are electrically interconnected with alternating current across governmental boundaries, a power system failure in one region can bring down power systems in others. Connected regions should consider forming interregional reliability organizations, if they have not already done so, starting with studies and potentially expanding to include joint planning and operational coordination.

Third, resiliency planning is necessary to mitigate the impact of common-cause failures. Policies to prevent blackouts should be integrated with those that reduce their duration and mitigate their social and economic impact. For instance, severe cold conditions require policies to weatherize the entire supply chain from generation to distribution. They also require investments in warming centers in case power outages occur. Furthermore, the ability to rotate power outages across all customers is critical to ensure periodic, if interrupted, access to electricity during emergencies, particularly during severe cold or hot weather.

Of course, policymakers should not lose sight of other reliability-related challenges their grids may face, such as inadequate levels of investment, regulatory and market shortcomings, and legal and jurisdictional constraints.

The power grid is fundamental to society. Our safety, health and economy depend on a reliable and resilient grid. To achieve grid reliability requires putting common-cause failures at the center of reliability and resiliency analyses and policies.

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