

Making Electricity Capacity Markets Resilient to Extreme Weather Events

Marie Petitet,^a Burçin Ünel,^b and Frank A. Felder^c

As the 2021 events in Texas demonstrate, extreme weather events (EWEs) such as hurricanes and winter storms cause devastating power outages and blackouts, resulting in fatalities, human suffering and significant economic damage. Climate change may also increase the frequency, duration, and magnitude of EWEs, making it challenging to develop cost-effective policies to limit the effects of EWEs on power systems. Furthermore, EWEs create significant challenges for achieving reliable and resilient power systems. EWE is a common-cause failure that results in multiple equipment failures over short periods, thus quickly reducing the ability of the power system to function (i.e., reliability) and prolonging its recovery (i.e., resiliency) from large blackouts. EWEs also challenge power systems in the long term because system components must withstand increased EWEs (with low and uncertain probabilities) and changing electricity demand.

In liberalized power systems, extreme events such as the 2021 blackout in Texas have raised questions about whether electricity markets can ensure a sufficient level of reliability and resiliency, and if they can do so cost-effectively. Texas liberalized its electricity system in 2002, and since then, it has relied solely on energy (and reserve) markets, i.e., there is no market, to meet reliability and resiliency expectations. Texas is considered, or at least had been considered until its recent blackout, by many economists as a role model in market design. Although capacity markets have been introduced in many regions to ensure resource adequacy, the 2021 Texas blackout questions whether introducing a capacity market in Texas could have limited the 2021 event and what features capacity markets should have in the context of EWEs.

This article investigates what capacity market reforms could be undertaken to address EWEs and climate change better. It highlights that accounting for infrequent common-cause events such as EWEs is challenging but necessary to ensure future resource adequacy.

Based on our analysis of current practices in Europe and the U.S., we identify that regulators have acknowledged the importance of EWEs and climate change, but further improvements are necessary to consider them in reliability and resiliency analyses better. In Europe, resource adequacy considers climate change's impact on electricity demand and electricity generation, but EWEs are not explicitly assessed. In the U.S., policies addressing EWEs and climate impacts are being considered, but they do not specifically focus on capacity markets.

When capacity markets are implemented, we propose criteria for evaluating whether and how to use capacity requirements and associated markets to address severe weather conditions. These criteria intend to apply to any region and would require to be complemented by additional features tailored to the specificities of each region. First, capacity requirements must achieve policymakers' reliability and resiliency objectives by reducing the frequency, magnitude and duration of blackouts. Second, any capacity requirement should be cost-effective and integrated with other non-capacity requirements, such as transmission, distribution, fuel supply and other infrastructure systems. Considering the entire power supply chain and its interrelationships with other critical infrastructures is necessary to ensure resiliency. Third, a well-defined and measurable capacity product must be developed for a capacity market to produce the desired efficiency benefits. Sufficient credit and other policies are also necessary to ensure providers have sufficient incentive to perform when called.

a Corresponding author. King Abdullah Petroleum Studies and Research Center. Riyadh, Saudi Arabia. E-mail: marie.petitet@kapsarc.org.

b Institute for Policy Integrity at NYU School of Law.

c King Abdullah Petroleum Studies and Research Center.

In conclusion, reforming capacity markets to account for EWEs and other common-cause events is challenging. It requires updating resource adequacy modeling to incorporate common-cause capacity and demand dependencies and adjusting the definition of capacity. It also requires trading off between regulatory and market-based mechanisms to ensure capacity performs as desired and to have a cost recovery mechanism that effectively induces the desired resource adequacy investment cost.