



Memo

TO: MARKETS COMMITTEE OF THE BOARD OF DIRECTORS
FROM: DR. RENUKA CHATTERJEE
DATE: MAY 29, 2025
RE: CHILE AND IBERIAN PENINSULA BLACKOUTS

Overview

On February 25, 2025, Chile experienced a widespread blackout that affected 90% of the country and lasted several hours. The outage was triggered by the failure of a 500 kV transmission facility operated by the national utility. Similarly, on April 28, Spain and Portugal experienced widespread blackouts due to an unknown incident causing a disturbance on the system. MISO is reviewing these events to inform best practices and potential grid enhancements and will align these findings with MISO's Reliability Imperative to ensure reliability across our footprint.

Chile Blackout – February 25, 2025

Chile's unique geographical characteristics significantly impact its power grid. As a long and narrow country spanning over 2,500 miles from north to south but averaging only 110 miles in width, Chile has limited interconnections with neighboring countries. Chile's electricity network is further isolated by the Andes Mountains to the east and the Pacific Ocean to the west and south. While Chile's northern desert region has abundant solar resources, it has limited local demand. In contrast, Chile's central and southern regions have a more diversified generation mix, but they lack substantial excess capacity to stabilize the grid without consistent transmission support and imports from the north.

On February 25, 2025, at 3:16 p.m. CLT, Chile experienced a widespread power failure. The facility that triggered the incident was a critical component of Chile's energy infrastructure, responsible for transmitting power from the north to the more densely populated central region. Additionally, since Chile is in the Southern Hemisphere, the blackout occurred in late summer when relatively high temperatures influenced electricity demand.

Restoring power following the blackout was a complex undertaking. By 10:00 p.m. CLT, seven hours after the incident, between 25% and 50% of power had been restored. By the following morning, approximately 98% of electric service had been restored. Chile benefited from several

dispatchable hydroelectric facilities in the central region, where most of the population resides. The grid operator successfully leveraged these resources, alongside thermal generation units, to restore power after the event.

Iberian Peninsula Blackout – April 28, 2025

On April 28, 2025, at approximately 12:33 p.m. CEST, Spain experienced a rare, widespread blackout that affected 60% of Spain's national demand (roughly 15 GW) in a matter of five seconds. Spanish power grid operator Red Electrica and the Spanish government have indicated that "the outage was provoked by a strong oscillation in the European power system." This means the power system experienced a disturbance(s) that destabilized the grid, resulting in cascading outages. The Portugal power system was also impacted, losing 98% of its demand (7.8 GW). Both the Spanish and Portuguese governments have ruled out cyberattack.

At the time of the disturbance, the Portuguese power system was serving a total load of 7.9 GW. In Spain, the power system was serving a total load obligation of 26.7 GW. While this was not the peak hour for either power system, the total load being served by renewable resources at the time of the outage was 47% percent for Portugal and 69% for Spain.

Less than 24 hours following the disturbance in Portugal and Spain, the Portuguese government announced that power had been restored to all 6.4 million customers in Portugal, and Red Electrica stated that more than 99% of the country's demand was restored. Both Spain and Portugal used black start capable hydro generation. Wind and solar resources are not used for system restoration in Europe, so natural gas generation was used as restoration progressed. Additionally, Spain was able to import power from neighboring countries, France and Morocco, helping to restore the power system in a safe, quick and reliable manner.

MISO's Response to the Reliability Imperative

Both events serve as examples of the importance of the Reliability Imperative at MISO. Chile and the Iberian Peninsula both have isolated electric grids with limited transfer capabilities. These recent blackouts are a reminder of the critical importance of resilient, well-integrated transmission systems. While MISO is geographically distinct from Chile, Spain and Portugal, certain areas within our footprint do have challenging geography and transmission limitations.

The underlying lessons from this event are directly relevant to our ongoing work on stability attributes in grid reliability and system planning. The Iberian Peninsula blackout shows how increasing growth and reliance on inverter-based resources, like wind and solar, and the retirement of traditional, inertia-providing resources is diminishing the power system's ability to withstand disturbances. The blackouts in Chile and the Iberian Peninsula serve as critical case studies that reinforce and inform MISO's Reliability Imperative, especially as the grid transitions toward higher renewable penetration and greater complexity.