BACK POCKET INSIGHT

P178 RESOURCE PLANNING FOR ELECTRIC POWER SYSTEMS

Zero CO_2 Electric Sector Policy & System Reliability

by Naga Srujana Goteti, John Bistline, Nidhi Santen, and Steve Dahlke

KEY INSIGHTS

- Firm, dispatchable generation supports system reliability in a zero-carbon future with high variable renewables and energy storage.
- System reliability is sensitive to the assumptions made about renewable energy capacity contributions during the capacity expansion planning stage of resource planning.
- Increasing the reliability of zero-carbon portfolios may require strategies beyond common generation resource planning levers, including additional investments in transmission infrastructure and strategic resource placement during the planning stage.

Research Overview

New research explores the reliability impacts of transitioning to a zero-CO_2 electric sector by 2050, using EPRI's US-REGEN model to identify decarbonization technology pathways and a commercial resource planning tool to assess detailed planning, grid operations, and reliability impacts.

This research evaluates system reliability from the perspective of resource adequacy (assessing the system's ability to meet power and energy needs under operational uncertainties such as generator outages and variability in renewables and end-use loads). Detailed evaluations, including hourly probabilistic assessments and examining intra-regional transmission capabilities, are valuable for assessing system reliability. Technology portfolios are reoptimized using various decision levers when reliability criteria are not met.

Focusing on a service territory within the Western Electricity Coordinating Council (WECC) region, findings underscore the importance of a comprehensive approach to evaluating both generation and transmission needs at the planning stage for increasing the reliability of a decarbonized electric sector.

Summary of Findings

In a zero-CO_2 future, the Loss of Load Expectation (LOLE) and unserved energy may be higher when fossil fuel-based generation, including that with Carbon Capture and Storage (CCS), is restricted compared to a future without these limitations (Fig. 1, Table 1).

A set of transmission sensitivities conducted that showed substantial increase in unserved energy under specific assumptions also highlight the value of line upgrades and new transmission in mitigating potential energy supply shortages.

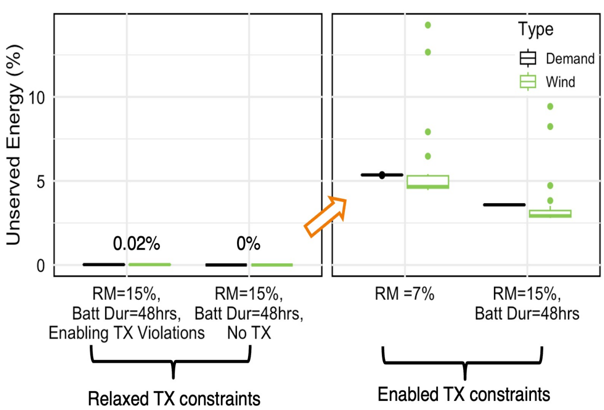

Figure 2: Boxplot of unserved energy (%) in an Absolute Zero-CO_2 2050. Comparing system reliability with increased reserve margin (RM) and battery duration through a probabilistic analysis of load and wind, across two transmission (TX) sensitivities

Table 1: Loss of Load Expectation (LOLE) (days/year), 2023-2050

Scenario	Base Case + Thermal Outages	Base Case + Thermal Outages + Storage Outages
Net-Zero 2050 (NZ50) Net-Zero economy by 2050	0.4	0.5
Absolute-Zero 2050 (AZ50) ▪ Net-Zero economy by 2050 ▪ Limits any fossil-fuel based generation by 2050	2	3.3

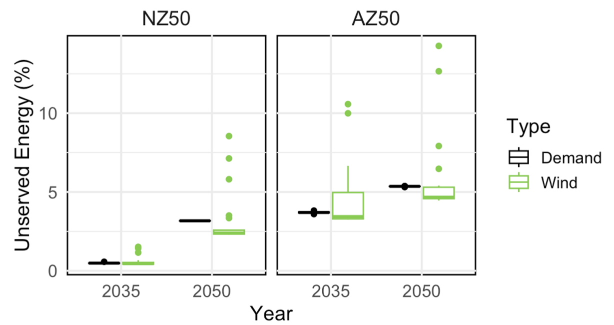

Figure 1: Boxplot of unserved energy (%) from a probabilistic analysis of load and wind (Monte Carlo analysis)

- High variability in unserved energy from wind uncertainty—due to significant wind-based generation in the resource portfolio, shows the system may be sensitive to capacity credit assumptions during the expansion planning stage (Fig. 1).
- Increasing the reserve margin and extending the duration of bulk energy storage resources reduce unserved energy (Fig. 2) with a 30% increase in total system cost.
- Modeling with realistic transmission constraints reveals higher levels of unserved energy (Fig. 2), suggesting a potential value in TX investments to increase reliability (upgrade potentials of up to 7x current capacities were observed under certain scenarios).

This research highlight is based on EPRI Report "Zero CO_2 Electric Sector Policy & System Reliability," Product ID 3002026594

RESEARCH CONTACT
Naga Srujana Goteti
ngoteti@epri.com

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