ESIG ENERGY SYSTEMS INTEGRATION GROUP

ESIG REPORT

Long-Term Load and DER Forecasting: Use Cases, Barriers, and Recommendations for Scalable Deployment

EXECUTIVE SUMMARY

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Long-term load and distributed energy resource (DER) forecasting is critical for achieving clean energy and decarbonization goals, ensuring a reliable, resilient, and affordable energy system. Traditionally, these forecasts, conducted annually by entities like utilities, states, and ISOs, focused on total annual energy and peak demand. This approach was adequate for a grid dominated by centralized generation and a predictable demand pattern in which the past was representative of the future. However, the evolving energy landscape—marked by variable renewable generation, unprecedented load growth from electrification (buildings, transportation, data centers, manufacturing), and rising customer-sited DERs (solar, battery storage, electric vehicles)—necessitates a paradigm shift. Traditional forecasting practices are no longer sufficient for this complex, dynamic grid.

Addressing the Primary Forecasting Issues in a Transforming Grid

This report represents the culmination of the work of the Energy Systems Integration Group's Long-Term Load and DER Forecasting Task Force and addresses key forecasting issues in this transforming grid. It outlines the need for high-resolution, time-based forecasts (8,760 hourly profiles) to capture the correlated impacts of weather on demand, generation, and the nuances of DER behavior. Accurately predicting future energy demand requires explicit modeling of various demand-

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side modifiers—including energy efficiency, solar, battery storage, economic growth, new customer business loads, electric vehicle charging, and building electrification—to arrive at a net load forecast.

Policy-driven technology adoption introduces uncertainty, demanding careful modeling to avoid double-counting impacts, as well as the need to study multiple future scenarios. Improved time-series characterization and enhanced geographic granularity are vital for accurately forecasting future net load and localized demand variations, or load pockets. In addition, system operators, utilities, and other planning entities are realizing the need to reconcile their load projections to ensure consistency across diverse planning processes and use cases.

Key Takeaways

A Shift Toward 8,760 Time-Series Forecasting Can Significantly Improve Temporal Forecasting Accuracy

Moving toward 8,760 hourly time-series forecasting can significantly enhance temporal accuracy, providing a more precise assessment of how DERs, electrification, and climate trends influence load patterns.

Greater Geographic Granularity Can Address Several Forecasting Challenges

DER adoption is not uniform and can trigger significant local distribution system upgrades. Granular geospatial forecasting helps planners anticipate and manage these challenges.

Emerging Adoption and Behavior Trends Require New Forecasting Approaches

New industries and accelerating adoption of customer technologies are rendering forecasting based on historical trends less reliable. More granular, end use–focused methodologies that also model the drivers and patterns of technology adoption are becoming increasingly required.

Scenario Planning Is Essential for Capturing Uncertainty

Given the rapid changes in energy demand, technology, and policy, scenario-based forecasting is crucial for assessing a range of possible futures and improving system-wide preparedness.

Coordination Across Forecasting Entities Is Increasingly Critical Through Integrated Planning Approaches

Multiple entities often produce forecasts for overlapping regions, leading to inefficiencies and potential errors. Integrated planning approaches necessitate greater coordination and data-sharing among grid planning entities.

Incorporating Climate Change Models into Forecasting Remains Complex

Most current load-to-weather models rely on historical data, which may not fully capture climate change impacts. It is necessary to enhance methodologies to consider extreme weather and updated climate models.

Reconciliation Between Top-Down and Bottom-Up Forecasts Is Complex

System-level (top-down) and aggregated local (bottom-up) forecasts covering the same area often conflict. To improve forecast alignment, planners must manage differences in forecast components, reconcile how local and system peaks relate, and properly allocate system-level data to local grid areas.

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Known New Customer Loads Must Be Carefully Integrated into Forecasts

Reconciling base load growth derived from economic indicators with known new customer load growth data (e.g., data centers, large manufacturing) is a key challenge to avoid double-counting.

Transportation Electrification Presents Similar Reconciliation Challenges

Like known new customer loads, transportation electrification forecasts need proper integration to avoid overestimation by overlapping with baseline or other load growth projections.

Future Price Signals May Influence Load Forecasting

Future price signals from dynamic rates, demand response, and local flexibility markets can significantly influence load patterns and should be incorporated into scenario analyses where relevant.

The challenges facing long-term load and DER forecasting present opportunities for innovation. Advanced, granular forecasting methods, coupled with scenario-based approaches and robust stakeholder coordination and data sharing, are vital for ensuring grid reliability and effective planning in the face of tomorrow's energy landscape.

Long-Term Load and DER Forecasting, by the Energy Systems Integration Group's Long-Term Load and DER Forecasting Task Force, is available at https://www.esig.energy/long-term-load-and-der-forecasting/.

To learn more about the topics discussed here, please send an email to info@esig.energy.

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