

HOW TO ENABLE FORECAST-DRIVEN OUTAGE PLANNING: A DATA-CENTRIC APPROACH FROM DOMINION ENERGY

How Dominion Energy leveraged Seeq’s advanced analytics solution to build a scalable forecasting framework, strengthen grid resilience, and future-proof outage planning amidst rapid load growth.

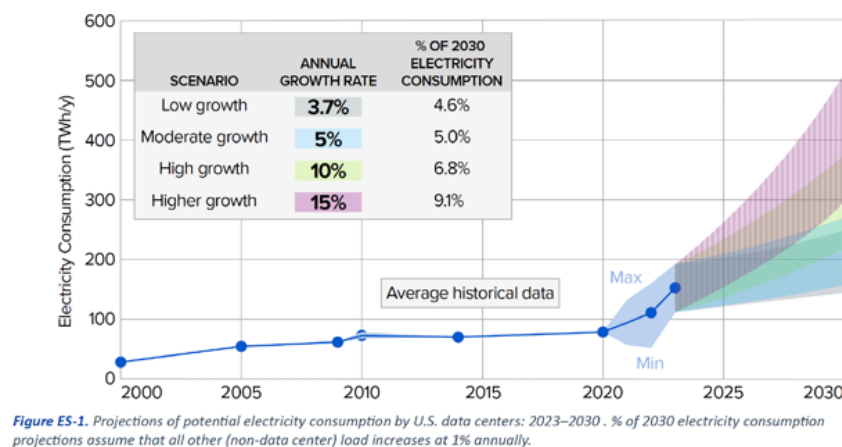
Dominion Energy, a leading energy provider serving over 3.5 million customers across Virginia and North Carolina, is undergoing a significant transformation in how it plans and manages outages on the power grid. Faced with unprecedented growth in non-conforming loads—driven by emerging technologies like data centers and electric vehicles—the company has adopted advanced forecasting techniques to enable proactive infrastructure planning and ensure grid reliability.

By integrating Seeq analytics with a comprehensive forecasting framework, Dominion Energy has not only enhanced its ability to predict demand but has also improved decision-making, reduced operational risks, and fostered enterprise-wide collaboration through transparent data visualization.

The Challenge

| Unprecedented Growth of Non-Conforming Load

Dominion Energy is experiencing rapid growth in non-conforming loads, such as data centers, which do not follow traditional daily or seasonal usage patterns. These loads create unpredictable spikes based on business-specific operations like artificial intelligence workloads, requiring more sophisticated analysis. In fact, the Electric Power Research Institute projects that by 2030, data centers alone could account for over 9% of all U.S. electricity consumption, underscoring the scale of this challenge.



| Disruption of Traditional Energy Planning

Residential energy use generally follows predictable patterns—peak demand in the mornings and evenings. In contrast, non-conforming loads are erratic and require real-time, granular monitoring. This complexity renders traditional planning practices obsolete and calls for agile and data-driven forecasting.

| Need for Accurate, Granular Predictive Models

As Dominion plans infrastructure upgrades and outage schedules, the margin for error in forecasting narrows. Inaccurate predictions can result in costly misallocations, unsafe operating conditions, or missed opportunities for timely infrastructure development.

Innovative Solution

| Deployment of the Seeq Analytics Platform

To address the data complexity, Dominion implemented Seeq—an advanced analytics toolset—integrated with PI System and predictive modeling capabilities. This enabled real-time visibility into grid conditions and historical trends.

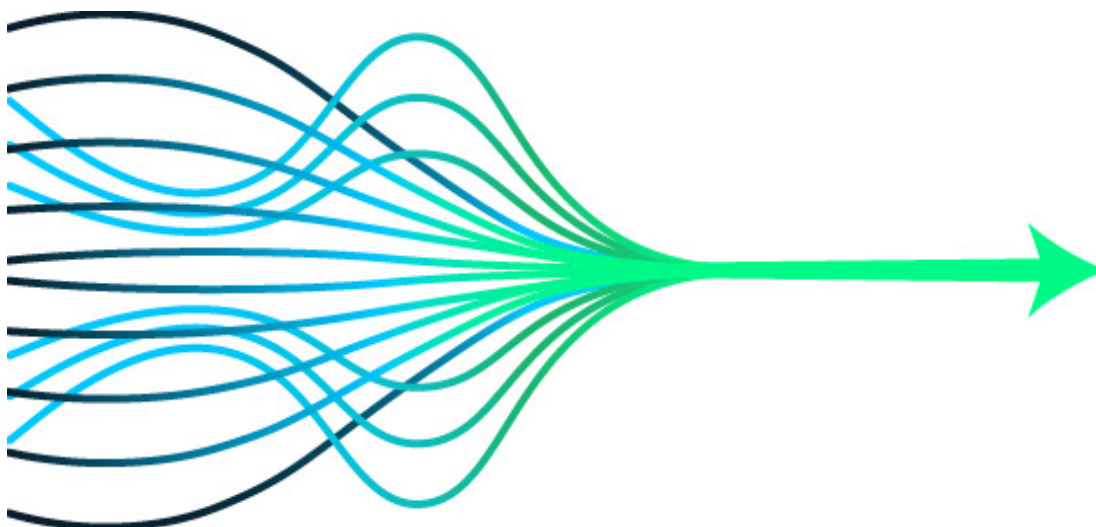
| Comprehensive Forecasting Framework

Dominion developed a robust, repeatable forecasting process that involves:

- Data collection and cleansing
- Pattern recognition and correlation analysis
- Model development and validation
- Stakeholder feedback loops for iterative improvements

| Integration of Multi-Source Data

Data from over a dozen systems—including PI tags, SCADA inputs, meter data, and customer ramp rates—was consolidated to create a unified, hierarchical structure across substations and transformers.



Key Achievements

1

Successful Infrastructure Upgrades

Dominion leveraged forecast insights to justify outage requests, enabling critical grid upgrades and expansions to support load growth without overburdening the network.

2

Reduced Contingency Risks

By using forecasted rather than nominal load data, the company mitigated the risk of contingency violations, such as transformer overloads or under-supported circuits.

3

Smarter Outage Management

Outages were reprioritized based on dynamic load forecasts rather than static timelines, ensuring upgrades occurred before load levels exceeded safety thresholds.

4

Enhanced Transparency and Stakeholder Trust

Power BI dashboards fed by Seeq and SQL databases presented clear visualizations of load forecasts, enabling system operators, planners, and PJM (Regional Transmission Organization) to make informed decisions.

Technical Approach

Multi-Step Forecasting Process

| Data Cleaning & Hierarchy Mapping

Using Seeq Workbench and Data Lab, engineers established transformer and substation hierarchies.

| Data Cleaning & Imputation

Techniques like low-pass filtering and moving averages addressed missing or noisy data, enhancing data quality.

| Pattern Recognition

Distinctions between conforming and non-conforming loads were clearly visualized, revealing diurnal and weekly trends.

| Statistical Modeling

Forecasts were constructed with both aggressive and conservative scenarios, including solar impact modeling and confidence intervals.

| Data Visualization Pipeline

- Local DuckDB databases and SQL integration supported historical storage and computation
- Forecast outputs were visualized using interactive Power BI dashboards, broadly available to foster collaboration.

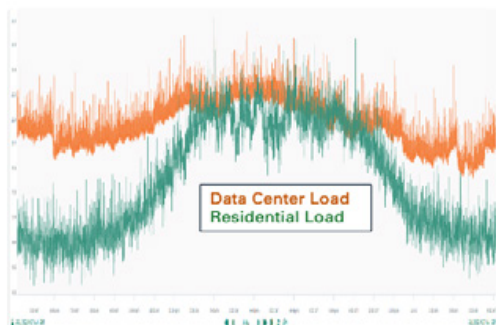
FRAMEWORK

Pattern Recognition to Build Load Profiles

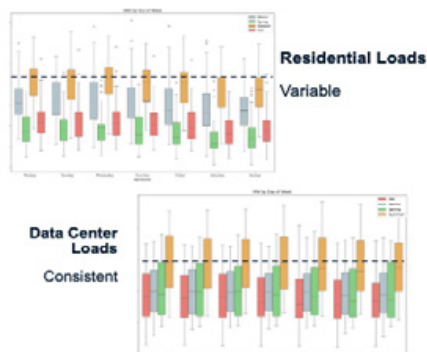
Conforming vs Non-Conforming



Daily Seasonality



Weekly Seasonality



Source: Dominion Energy – Planning for a New Tomorrow – Forecast-Driven Outage Planning | Conneqt 2025 Presentation

Outcomes



Improved Forecast Accuracy

By combining historical load data with future load commitments and new bulk load predictions, Dominion built robust forecasts with low Mean Absolute Percentage Error (MAPE) margins.



Enhanced Grid Reliability

More precise forecasts reduced the likelihood of operational disruptions, allowing the team to maintain N and N-1 contingency standards.



Proactive Infrastructure Planning

Outage plans shifted dynamically in response to forecasted load curves, often accelerating upgrades to avoid overload conditions within short timeframes.



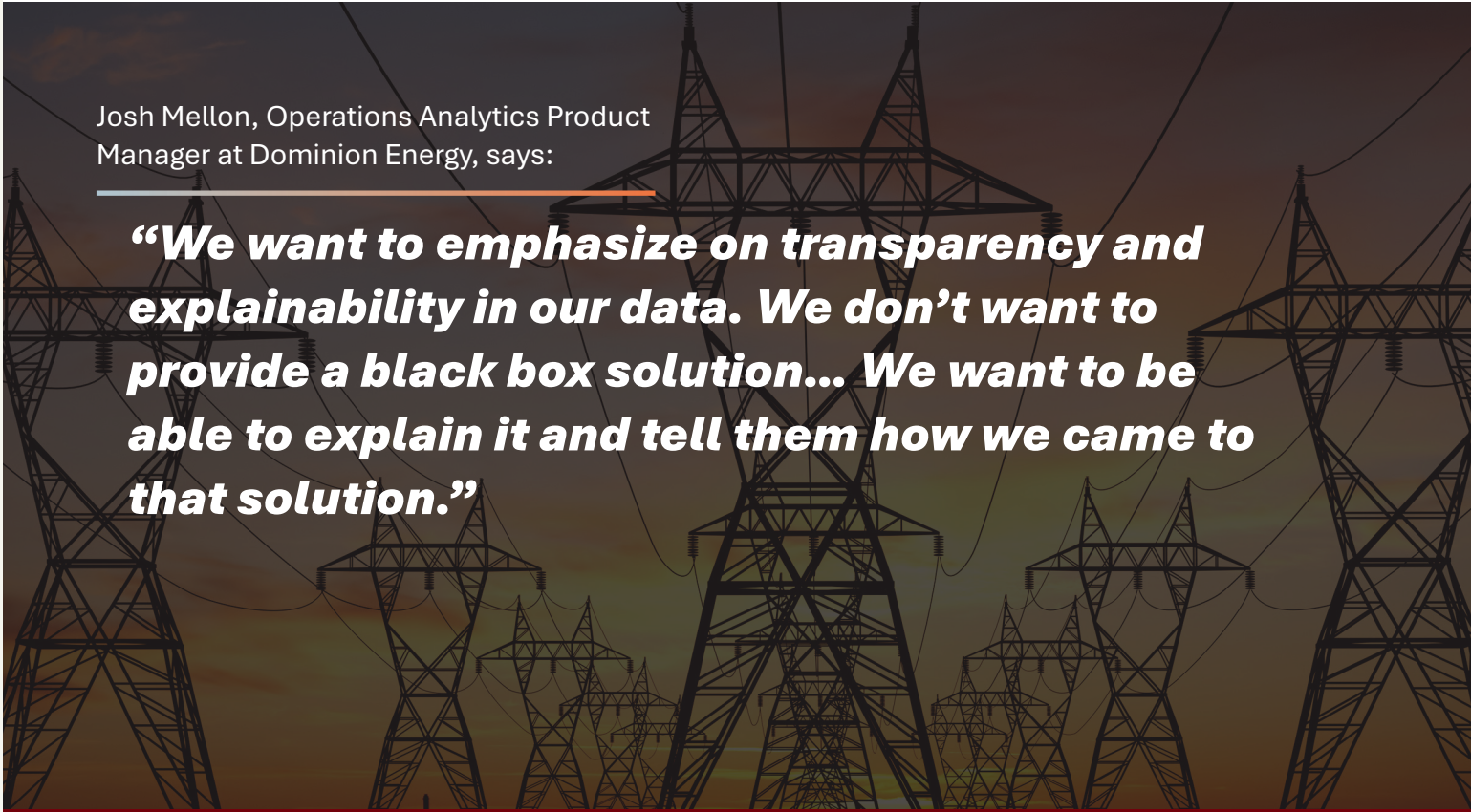
Significant Operational and Cost Efficiencies

Avoiding over- or under-estimation of load growth prevented unnecessary mobilization or cancellation of crews and construction, saving time and money.

Conclusion

Dominion Energy has demonstrated how a data-centric, forecast-driven approach can modernize outage planning and grid reliability in the face of rapid, unpredictable load growth. By integrating advanced analytics, real-time visualization, and collaborative feedback loops, the organization has transformed traditional utility operations into a more adaptive and resilient system.

Their experience highlights a scalable path forward for utilities seeking to stay ahead of evolving energy demands—balancing innovation with reliability, and turning complexity into clarity through intelligent forecasting and proactive infrastructure planning.

A background image showing a series of high-voltage power line towers stretching across a landscape under a hazy sky. The towers are silhouetted against a lighter background, creating a sense of depth and scale.

Josh Mellon, Operations Analytics Product Manager at Dominion Energy, says:

“We want to emphasize on transparency and explainability in our data. We don’t want to provide a black box solution... We want to be able to explain it and tell them how we came to that solution.”

Your Future With Seeq

Wherever you have data, Seeq can help you collect, visualize, and act on it. [Book a live demo](#) to see Seeq’s solutions at work.