EPRI ARTIFICIAL • INTELLIGENCE

Using Smart Meter Data for Distribution Network Visualization and Management

Future Grid

Startup
Future Grid
Melbourne, Australia

Hosts
FortisBC
VEC

FORTIS BC™

VERMONT ELECTRIC CO-OP INC

Technology Solution

The roles of distribution system operators (DSO) will continue to transform due to increasing customer adoption of distributed energy resources (DER), as well as electrification of transport, heating, and other end-use sectors. DER deployment and electrification can create challenges for DSOs by introducing variable renewable generation and by changing energy flows and load profiles, especially on secondary networks where visibility typically is limited. New grid management tools are needed to help DSOs take advantage of DERs and other sources of demand-side flexibility as solutions for improving reliability.

Using smart meter data to gain visibility into low-voltage network assets opens up new possibilities for highly granular distribution system planning and operations.

This pilot project was launched to adapt and test Future Grid's software, which is widely used by utilities in Australia, for providing DSOs in North America with low-voltage network visibility for grid and customer assets. Future Grid's solution leverages advanced metering infrastructure (AMI) for distribution system management by applying smart meter energy consumption, voltage, and power quality data to model secondary networks and support DER detection, grid diagnostics, phase balancing, predictive analytics, grid planning, and other uses.

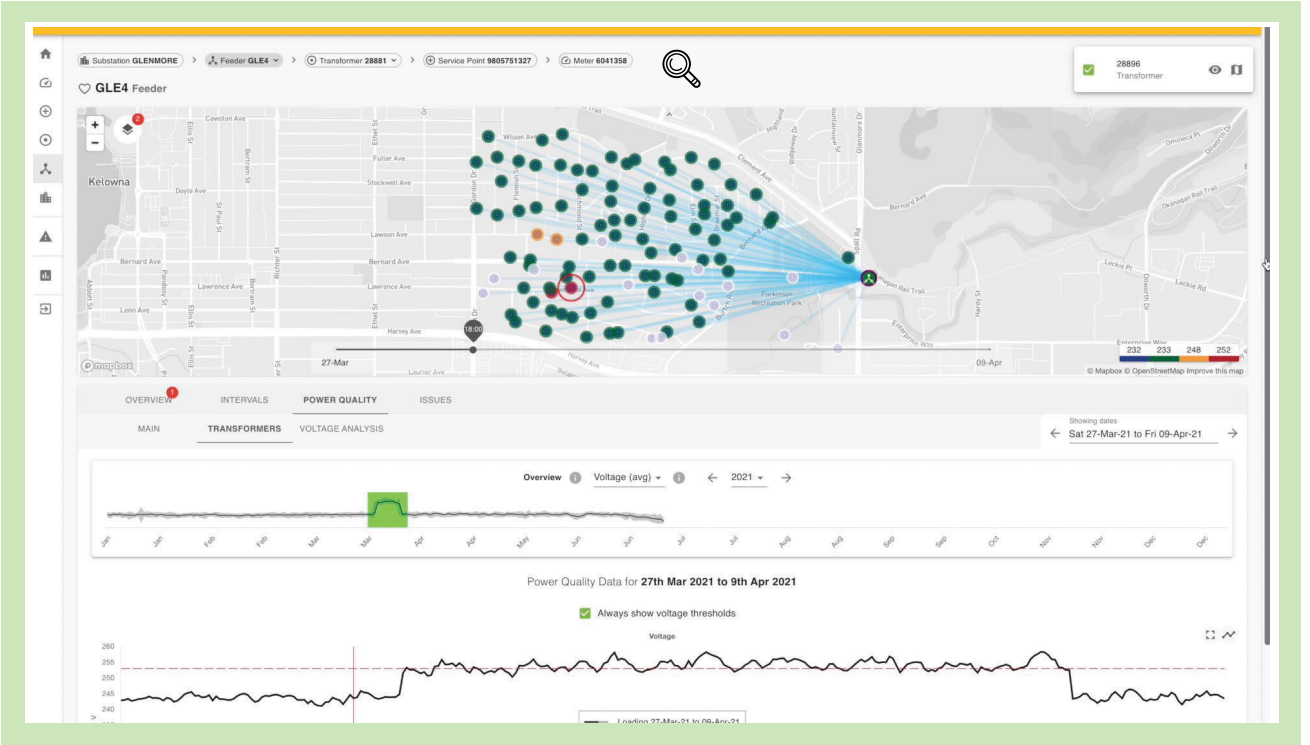
Project Overview

This project engaged Future Grid, EPRI, and host utilities Vermont Electric Cooperative (VEC) and FortisBC, a Fortis company, in pilot software deployments focused on demonstrating the leveraging of both smart meter and GIS topology data for building digital twins of secondary networks supported by analytics that can be utilized to inform operational and planning decisions.

Primary use cases explored for Future Grid software included providing visibility for secondary network assets (tranformers, fuses), detecting DERs and electric vehicles (EV), ensuring voltage compliance, and monitoring and managing transformer/transformer bank utilization. In addition to ingesting data transferred from FortisBC and VEC sites, the pilot project scope involved use of Future Grid's cloud-based software for the following tasks:

- Detection and mapping of power quality anomalies, DER installations, EV locations, etc.;
- Mapping of overall solar PV and EV counts by feeder;
- Visualization of consumption data per site and per meter, transformer, feeder, and substation;
- Visualization of voltage, constraints, and exceptions; and
- Visualization of transformer demand, constraints, and exceptions, including aggregation of exceptions per feeder.

Metrics of success included demonstrating how existing smart meter and GIS data can be used (1) to accurately represent and characterize secondary networks to support operational and planning workflows; and (2) to provide insights for identifying problems, anticipating upgrades or service requirements prior to outages, accommodating the growth in EV and distributed generation and storage, and improving the safety and reliability of the distribution grid.



Future Grid demonstrated the ability to detect utility and customer assets, visualize power quality and other characteristics, and provide insights on the operations of secondary distribution networks.

Results & Learnings

Originally developed for the Australian grid, Future Grid's solution was quickly adapted for use by host utilities in the United States and Canada.

Apart from typical data ingestion difficulties, such as GIS anomalies and obvious data errors, the pilot project went smoothly. Using the software to identify actionable anomalies on secondary networks—such as overloaded transformers, outages, and under- and over-voltage events—proved to be effective and useful.

The project demonstrated the importance of thoughtful design in turning large volumes of data into actionable intelligence. Users found it relatively easy to navigate from a high-level "issues" report in order to check on a particular transformer and its associated meters, and then to actually view the transformer in question via a tie-in to Google Street View. The ability to sort transformers by capacity factor was useful in identifying those with little available capacity, suggesting areas within the network where the utility might be able to take preventive action in order to prevent outages and improve customer service.

The software's intuitive web-based interface also was able to assist FortisBC in identifying and visualizing customer power quality issues. Valuable insights were gained even though the pilot used only data from a single substation, and the data were relatively sparse (60-minute voltage and energy data). Using finer-grained data—for example, at 15-minute intervals or less—is expected to allow Future Grid's software to deliver even more value across a range of use cases.

Implications & Next Steps

Based on the success of this pilot project, FortisBC is working on transferring all of its AMI meter and GIS data—approximately 850 GiB—into the Future Grid platform to see how the tools work with larger data sets. In addition, FortisBC is planning on reprogramming its smart meters for 5-minute intervals and deter

mining how best to live-stream the data for software ingestion.

Many of the insights gained by Future Grid about differences between the Australian and North American grids have already been incorporated into the software, such as per-phase analysis and visualization for multiphase meters. The company is continuing to enhance its EV charger detection capabilities and plans to collaborate with FortisBC to pilot this feature.

Resources

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TESTIMONIAL: Future Grid

This demonstration project tested our solution in a new operating environment, generating learnings both for Future Grid and our utility partners. For example, upon discovering that meters in North America can report multiple voltages because of phase-to-phase arrangements, we modified and augmented our software to enable multiphase visualization.

TESTIMONIAL: FortisBC

Within a few weeks of ingesting an extract of our hourly meter data and GIS distribution network topology data, Future Grid started to deliver results. This has helped us identify minimum and maximum voltage excursions and instances of transformer overloading, and it has provided a more granular view of distributed generation and potential feeder-level impacts.

TESTIMONIAL: EPRI

This Future Grid demonstration showed the value that can be gained by intelligently processing the large volumes of AMI data many utilities already have. Coupling that data with a smart and responsive user interface means that utilities can spend less time learning and more time applying the tool to maintain and improve the grid.

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