EXECUTIVE BRIEF

Enhancing Grid Visibility and Reliability in Vermont's Electric Grid

Vermont, like many states, is experiencing a rapid transformation of its energy landscape. The rise of distributed energy resources (DERs), electric vehicles (EVs), virtual power plants (VPPs), and other grid-edge technologies is creating exciting opportunities, but also presents new challenges. One key area Vermont Electric Power Company (VELCO) and Vermont Electric Cooperative (VEC) are focusing on is improving visibility into the interactions between transmission and distribution systems. While this has been a challenge due to historically fragmented data, we are actively exploring innovative solutions to gain a more holistic view. This enhanced visibility is crucial for ensuring the continued reliability and high quality of transmission service as we integrate these new technologies and build a more resilient and sustainable energy future for Vermont.

This brief is a summary of key findings and recommendations from the evaluation of the GridVisibility Platform (GVP) supplied by GridVisibility, inc. The full GVP Evaluation Report was documented and delivered in November 2024. The report describes in greater detail an assessment of GVP, how it has been used so far, and how VELCO, can best deploy the technology to support their strategic goals and needs.

Assessment of GVP Technology

GVP is a high-resolution, time-synchronized data platform that uses broadband-connected sensors to track the availability and stability of the power grid. The technology presents a viable solution to improving situational awareness, transmission planning, and operational decision-making. To achieve these benefits, VELCO and its partners can focus efforts on applying GVP for specific value-add use cases, collaborate openly, and increase the scale and functionality of the technology over time.

STRENGTHS

- **Built for Big Data:** Use of the broadband infrastructure enables GVP to handle massive amounts of data, which is a bottleneck to classical monitoring solutions.
- **Rapid Deployment and Scalability:** GVP is designed to deploy and scale quickly with no necessary utility outages. The device placement centers around broadband network infrastructure which matches population densities closely.
- **Cross-Domain Visibility:** Combined with other existing monitoring systems, GVP can provide VELCO with synchronized, high-fidelity data. This will improve grid performance monitoring, enhance transmission planning and operations decision-making.

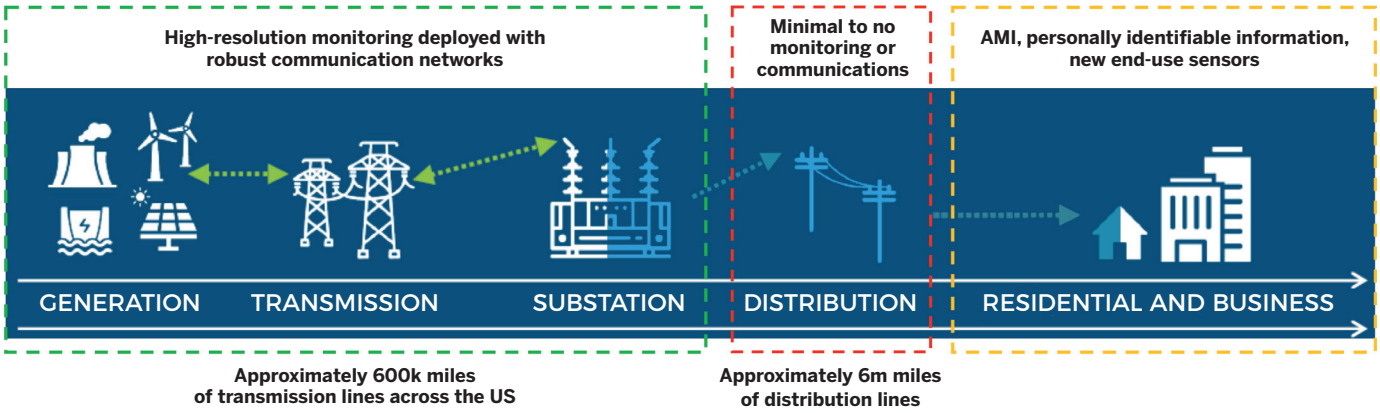
OPPORTUNITIES TO OPTIMIZE

- **Technology Limitations:** The GVP sensors are limited in two main ways: (1) the sensors have voltage only and lack real-time current measurements, and (2) installations are limited to broadband infrastructure locations. There are other noncritical yet important limitations to consider. VELCO and the project team have provided valuable insights, perspectives, and recommendations to GVP to address these limitations in order to unlock increased value such as transmission planning model validation, system fault location, and other critical functions.

OTHER CONSIDERATIONS

- **Need for Collaboration:** GVP is a resource that requires ongoing collaboration among stakeholders including the GVP provider, broadband infrastructure owners and operators, distribution utilities, transmission utilities, and system operators.

FIGURE 1: **High-Resolution Data Gaps in the Power System**



Limited measurement data of the interactions between transmission and distribution systems across the US—due to the vast scale and cost of communications infrastructure—limits situational awareness in this space. GVP sensors leverage broadband communications and provide a cost-effective, high-resolution monitoring tool that unlock new opportunities for situational awareness. SOURCE: GRIDVISIBILITY, INC.

- **Security and Regulatory Considerations:** The co-management of GVP data across infrastructure owners, operators, and third-parties will require careful consideration of cybersecurity concerns and NERC Critical Infrastructure Protection (CIP) Standards.

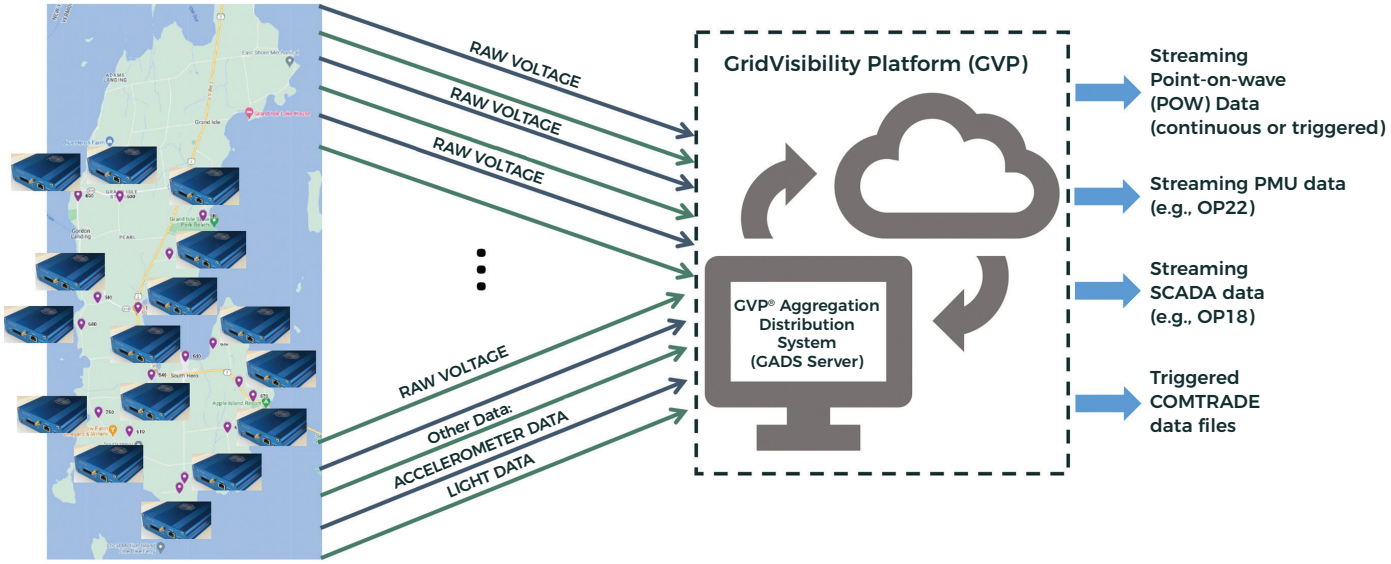
2024 Pilot Projects

In 2024, GridVisibility, inc. installed a total of 160 sensors, all without any utility outages from VELCO or VEC. Installations occurred in three sprints—March (17 sensors), November (43), and December (100)—and demonstrate the platform's ability to reach scale rapidly, efficiently, and without putting strain on the grid or utilities. Many of these pilots were deployed in Vermont as a critical proving ground. Work continues with project partners to further evaluate effective utilization and application of the technology for various purposes.

Recommendations for VELCO, VEC, and ISO-NE

The project team has devised a core set of recommendations moving forward:

FIGURE 2: **GVP Platform Configuration**



Configuration and data flow between GVP sensors and the GADS server for South Hero area pilot project.
SOURCE: ELEVATE ENERGY CONSULTING

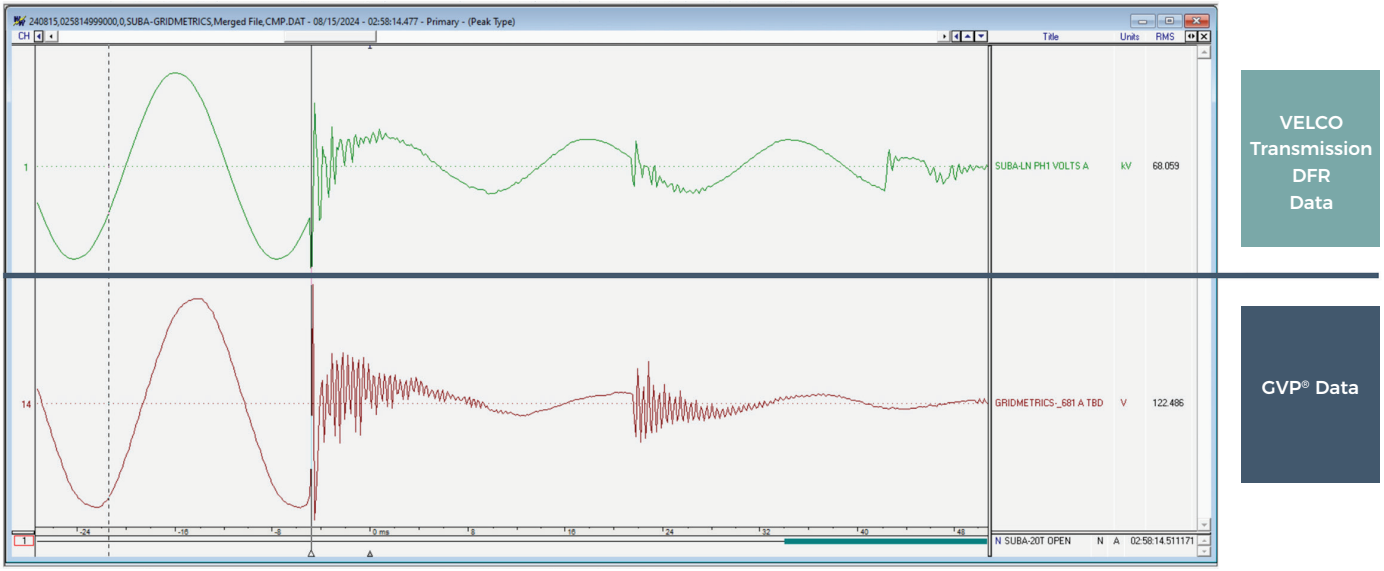
PRIORITY ACTIONS

- **Focus on High-Impact Use Cases:** VELCO should focus efforts toward applying GVP data to high-priority offline engineering applications such as forensic event analysis and dynamic model validation. These use cases may offer immediate, measurable benefits in understanding grid performance, supporting reliability, meeting regulatory obligations, and helping advance understanding of the aggregate impacts of DERs on the transmission system.
- **Make the Data Work:** Emphasize the delivery of high-quality, easily accessible data in formats that are compatible with VELCO's current tools and workflows, particularly for operational tools. During the evaluation, the GVP already had the capability to export data in CSV and COMTRADE formats. The project team expects the platform to develop additional data formats for continuous streaming data that enable integration and capability with other applications such as Wavewin and VEC's Camus software.
- **Foster Strong Collaboration:** Ensure continuous engagement with key stakeholders, including VELCO, VEC, ISO-NE, and other industry partners. Regular feedback loops will help refine use cases and ensure alignment with operational goals, facilitating the technology's integration into existing workflows.

ADDITIONAL ACTIONS

- **Pilot Deployments for Proof of Concept:** Undertake further proof-of-concept and pilot deployments of GVP in different areas of VELCO's service territory. These pilots will refine use cases, validate hardware performance, and provide real-world insights into the technology's effectiveness across varying operational contexts.
- **Apply to Non-CIP Environments:** Consider deploying GVP in non-CIP environments to avoid regulatory compliance complications that could dramatically slow down understanding and utilization of the technology. Examples could include using the technology for dashboards, visualizations, engineering alerts, etc. NERC is releasing a white paper describing a technology enablement concept called "RETINA" that could enable more effective testing of new technologies like GVP in the operational space moving forward.

FIGURE 3: **DFR and GVP Data Demonstrating Transmission and Distribution System Interactions**



Example of GVP data in Wavewin compared with VELCO COMTRADE data for a lightning strike and subsequent fault event. GVP data captures higher-quality data of dynamics between transmission and distribution systems than ever seen before.

SOURCE: ELEVATE ENERGY CONSULTING

Conclusion

Adding GVP technology to Vermont's monitoring systems can significantly enhance VELCO's visibility of the increasingly dynamic grid. Limited visibility of the distribution system beyond the substation, enormous costs to deploy distribution-level monitoring systems including phasor measurements units (PMUs), and the prevalence of DERs and grid-edge technologies in Vermont makes GVP a uniquely effective solution and important long-term partner. Over time, integration of GVP data into VELCO's transmission planning, design, and engineering processes can support long-term grid modeling, forecasting, infrastructure development, and regulatory compliance. This helps enhance VELCO's ability to anticipate and adapt to grid transformation during the energy transition.

Postscript

The initial engagement for this project was held with Gridmetrics. During the evaluation period, the team transitioned to a new company called GridVisibility, inc. This company acquired a license to Gridmetrics technology and secured all sensors and data that supported the VELCO pilot project and technology evaluation. Under the new company, the technology has been renamed as GridVisibility and is available within a product called the GridVisibility Platform. Though the names have changed, GridVisibility, inc. continues to enhance the Gridmetrics technology.