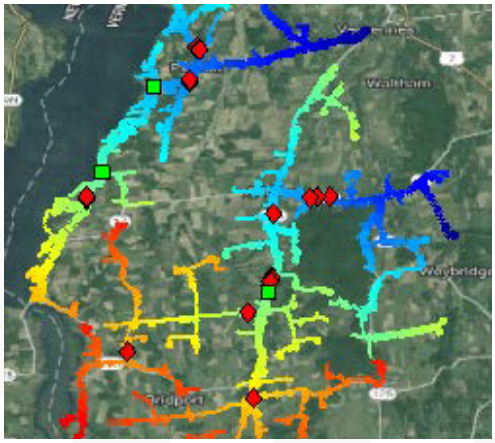
Vermont Regional Partnership Enabling the Use of DERs

CHALLENGE

In order for Vermont to meet its ambitious goal of 90% renewable energy penetration by 2050, an optimal and replicable approach to distributed energy resources (DERs) integration needs to be developed at the distribution level. Significant changes in the state's power distribution-system architecture and operations are needed to mitigate the impacts of high penetrations of variable DERs including solar, wind, and energy storage. Key insights from what we learn in Vermont can be applied to the rest of the nation.



Electrical feeders in Green Mountain Power territory with high DER penetration shown in red.

APPROACH

The objective of this project is to assist utilities in the state of Vermont in reducing impacts from high penetrations of DER by

- **modeling and optimizing DER integration to enable high penetration.** Develop methods and strategies to upgrade Vermont's distribution-system architecture and operations to minimize the negative impact of high penetration DERs on the grid. This project will include a pioneering analysis of the efficacy of both utility-owned and distributed storage as an enabler and driver of high-penetration renewable generation.
- **modeling and optimizing DER control to improve grid operations.** Develop control strategies to manage DERs to peak shave and limit demand resource rebound effects on distribution system performance. Control strategies will be optimized to allow the integration of high penetrations of variable and distributed resources without causing negative impacts on the distribution system.
- **assessing and improving wind, solar, and load forecasting to optimize renewable resources.** Identify opportunities for improving the solar and wind Vermont Weather Analytics Center forecasting of wind and solar outputs, and quantify forecast performance using operationally relevant metrics to improve utility DER command and control.

At-A-Glance

PROJECT LEADS

- **Robert Broderick**
  Sandia National Laboratories
  rbroder@sandia.gov
- **Mark Ruth**
  National Renewable Energy Laboratories
  mark.ruth@nrel.gov

PARTNERS

- Green Mountain Power
- Vermont Electric Cooperative
- Vermont Electric Company
- University of Vermont
- Georgia Institute of Technology

BUDGET

$1 million

DURATION

April 2016 – September 2017

TECHNICAL AREA

Systems Operations and Control

Lead: Jeff Dagle

Pacific Northwest National Laboratory

jeff.dagle@pnnl.gov

Rev. 2, June 2017

EXPECTED OUTCOMES

This project will overcome the grid modernization challenge of maintaining and enhancing grid performance and reliability, while integrating and controlling high DER penetrations on utility distribution systems. This project's key outcomes will be 1) to achieve resilient distribution feeders for high penetration of renewable energy generation, 2) to develop a replicable approach for leveraging utility-owned and distributed storage to address disruptive impacts and allow for high penetration of renewable energy generation, and 3) to develop innovative control strategies and forecasts that will reduce peak transmission demand costs while also mitigating solar-induced feeder voltage variability problems. Utilities will benefit from the new tools and processes developed; policy makers and regulators will benefit from the study results to inform policy and set goals; and, indirectly, the people of Vermont will benefit from a more reliable, sustainable, and cost-effective distribution system. Other states and utilities can benefit from the lessons learned through this project to enable further growth of renewables throughout the nation.

LAB TEAM

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Sandia National Laboratories

Launched in November 2014 under the U.S. Department of Energy's Grid Modernization Initiative, the GMLC is a strategic partnership between DOE Headquarters and the national laboratories, bringing together leading experts and resources to collaborate on national grid modernization goals. The GMLC's work is focused in **six technical areas** viewed as essential to modernization efforts:

Devices and Testing | Sensing and Measurements | Systems Operations and Control
Design and Planning | Security and Resilience | Institutional Support