Integration of DER Adoption Forecasting into Distribution Planning

Cooperative Research and Development Final Report

CRADA Number: CRD-11-00430 (Project H)

NREL Technical Contact: Garvin Heath

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
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Technical Report
NREL/TP-6A20-87446
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Cooperative Research and Development Final Report

Report Date: September 6, 2023

In accordance with requirements set forth in the terms of the CRADA agreement, this document is the final CRADA report, including a list of subject inventions, to be forwarded to the DOE Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Electric Power Research Institute (EPRI)

CRADA Number: CRD-11-00430 (Project H)

CRADA Title: Integration of DER Adoption Forecasting into Distribution Planning

Responsible Technical Contact at Alliance/National Renewable Energy Laboratory (NREL):

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Sponsoring DOE Program Office(s):

Office of Energy Efficiency and Renewable Energy (EERE), Solar Energy Technologies Office (SETO)

Joint Work Statement Funding Table showing DOE commitment:

No NREL Shared Resources

Estimated Costs	NREL Shared Resources a/k/a Government In-Kind
Year 1	$0.00
TOTALS	$0.00

Executive Summary of CRADA Work:

The objective of this project is to improve distributed energy resources (DER) technology, time, and locational impact analysis by incorporating customer adoption intentions and preferences into distribution planning and operations. The National Renewable Energy Laboratory (NREL) shall collaborate with EPRI staff to contribute to the development of methodology, literature review, analysis, and write-up for two sections of a report "*Identification and Overview of Methods for Mapping DER Adoption Forecasts*" and "*Comparative Analysis of Methods for Mapping DER Adoption Forecasts*."

CRADA benefit to DOE, Participant, and US Taxpayer: Uses the laboratory's core competencies

Summary of Research Results:

Task Descriptions:

NREL shall collaborate with EPRI staff to contribute to the development of methodology, literature review, analysis, and write-up for two sections of a report "*Identification and Overview of Methods for Mapping DER Adoption Forecasts" and "Comparative Analysis of Methods for Mapping DER Adoption Forecasts*".

In "*Identification and Overview of Methods for Mapping DER Adoption Forecasts*" NREL staff shall collaboratively work with EPRI staff to identify candidate methods for mapping customer adoption forecasts, associated with census blocks, into distribution system maps. This canvassing will include an accounting of the requisite data sources (and data availability) associated with each method, as well as their comparative strengths and drawbacks.

In "*Comparative Analysis of Methods for Mapping DER Adoption Forecasts*" NREL staff shall collaboratively work with EPRI staff to characterize how identified alternative methods could be used to map adoption forecasts to U.S. Census regions and other geopolitical areas into distribution systems and score each on how well it fulfills the requirements.

Note that neither of the above sections includes an *application* of said methods to a specific or generic distribution system, or an evaluation of how well the methods perform in an applied setting. Additional tasks to perform said application may be added at a later date based on mutual agreement between EPRI and NREL, including a funding and scope modification.

The project will culminate in a published report identifying and comparing methods for mapping DER adoption forecasts into distribution system maps. The report shall be co-authored by relevant EPRI and NREL staff, with EPRI as the primary author. The report shall be published in a publicly accessible format.

Task Results:

This research resulted in a white paper "Guidance on Solar PV Adoption Forecast Methods for Distribution Planning" jointly published by NREL and EPRI. The white paper is available at: https://www.epri.com/#/pages/product/000000003002014724/. The research was also presented at an EPRI Power and Delivery Unity Advisory meeting on September 17, 2018.

Electric utilities are modifying their planning and operational practices to integrate rising grid penetrations of DER, such as solar PV, while maintaining reliable and affordable electric service to their customers. If planned judiciously, these resources can be integrated into distribution at minimal cost, and even aid in deferring or avoiding future infrastructural upgrades. To do so, however, requires that planners have confidence in the DER adoption projections included in their load forecasts. This research provides guidance to distribution planners, load forecasters, and researchers on approaches for integrating PV adoption forecasting into distribution planning by exploring three core areas:

1. **Distribution Planning Applications and Considerations for PV Adoption Forecasts** –Example applications and criteria that utility distribution planners can consider when gauging the relevance of different adoption forecasting methods.
2. **Solar PV Adoption Forecasting Methods** – Adoption forecasting methods being applied in industry and academic circles, as well as each method's usefulness given respective key assumptions and data needs.
3. **Key Data Considerations for Solar PV Adoption Forecasting** – Data types for forecasting PV adoption and their suitability for identified PV adoption forecasting methods.

High-level findings include:

- Spatial resolution, planning period accuracy, data availability, and the desire/need for probabilistic forecasting assessments largely determine the suitability of a PV adoption forecasting method for distribution planning.
- The true value of increased adoption forecasting accuracy is tied to the expected improvement to planning decisions, not simply to reduced forecasting error.
- Individual-level data that may improve small area forecast accuracy include rooftop assessments, load profiles, household demographics, and point locations of the existing base of solar installations.
- Data-driven adoption forecasting methods are only as good as the data they observe, while theory-driven methods are dependent on the validity of specified relationships which govern adoption.
- Three major gaps exist in PV adoption forecasting modeling capabilities:
    - An accounting for local integration costs associated with PV penetrations beyond the grid's hosting capacity;
    - An understanding of the predictive accuracy of various adoption forecast techniques;
    - An evaluation of both the benefits of a) producing small-area adoption forecasts, and b) including the cyclical impact that distributed PV growth has on electricity rates.

Subject Inventions Listing: None.

ROI #: None.