GO solar CALIFORNIA

CSI RD&D PROGRAM

Grid Integration

Grantee:
DNV GL

Partners:
Sacramento Municipal Utility District, Hawaii Electric Companies (HECO, MECO, HELCO), Pacific Gas & Electric, and City of Roseville

CSI RD&D Funding:
$943,555

Match Funding:
$901,345

Project Timeframe:
2012-2015

RD&D Project Portal:
calsolarresearch.ca.gov/csi/85

Tools Development for Grid Integration of High Photovoltaic Penetration

OVERVIEW AND OBJECTIVES

This project addresses the lack of high quality, high resolution, field-measured photovoltaic (PV) data to inform adequate modeling of high-penetration PV on the utility system. This research targets the development of methodologies and software for evaluating high-penetration PV on the distribution grid and builds on work conducted under the prior CSI RD&D Solicitation #1 project with the Sacramento Municipal Utility District (SMUD) and their partners.

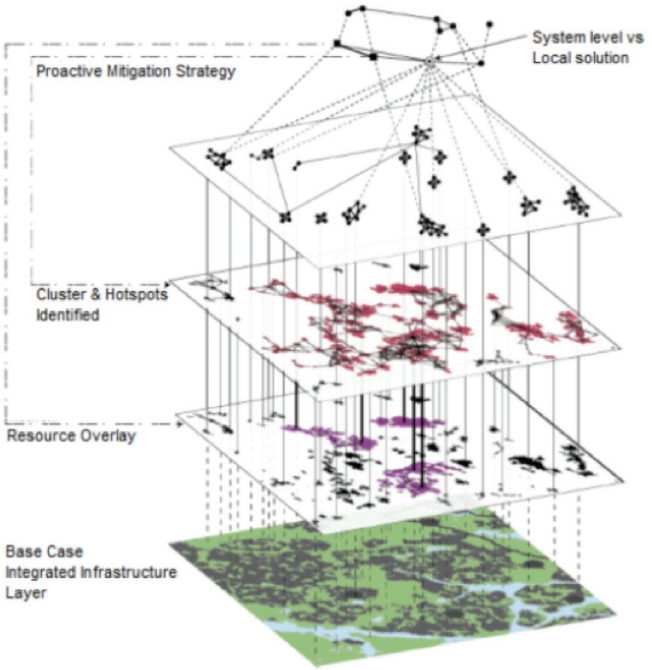
Transmission simulation tools define both congestion zones and optimal locations for new generation through map overlays of renewable resource potentials across the transmission grid. The objective of this DNV GL research was to integrate the distribution grid with a visual mapping tool (i.e. GIS-compatible platform specified by the utility) into an expanded locational value methodology. The approach assessed impacts across the system from a strategic development and grid enhancement perspective. California Rule 21 and Hawaii Rule 14H sets guidelines for analyzing PV installations. The methodology and process was used by utilities to facilitate distributed renewable resource expansion without negatively impacting system performance.

The second objective of this research was to develop a validation approach for evaluation of PV integration. Studies were carried out on potential impacts to individual feeders, substations, utility regions, and utility grids from high penetrations of PV. The participating utilities select different feeder configurations to demonstrate, evaluate, and validate high PV penetrations under steady-state, contingency, and dynamic scenarios. This objective was to document the ability of the software tools to study PV integration.

This document provides a brief project description. For more detail on the project and the California Solar Initiative's (CSI) Research Development, Demonstration & Deployment (RD&D) Program, please visit calsolarresearch.ca.gov

The CSI RD&D Program is managed by Itron on behalf of the California Public Utilities Commission (CPUC).

Itron CSI RD&D PROGRAM MANAGER



Graphical representation of the proactive modeling approach

METHODOLOGY

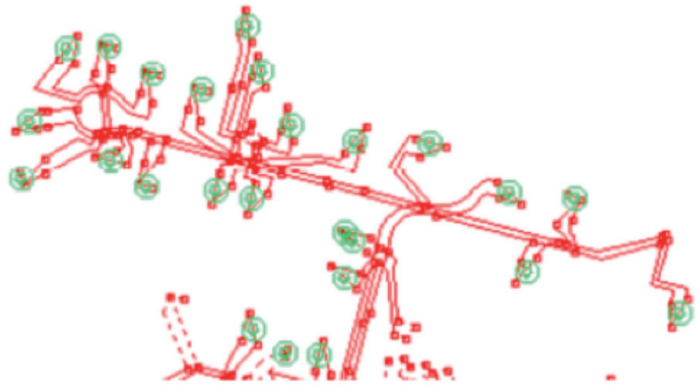
The DNV GL team explored a nodal approach for locating PV strategically, by integrating the distribution grid and a global visual mapping tool into an expanded locational value analysis. The visual map located potential PV development sites such as roof space and vacant lots. The nodal approach aggregated and assessed impacts across the system from a strategic development and grid enhancement perspective. The methodology and process were used by the participating utilities to facilitate expansion of PV into the grid without negatively impacting system performance. The four utility partners (Pacific Gas and Electric, Hawaiian Electric Company, SMUD, and Roseville Electric) selected different feeder configurations to demonstrate, evaluate, and validate high PV penetrations under steady-state, contingency, and dynamic scenarios. The project also conducted case studies for evaluating PV penetrations on the distribution grid.

RESULTS AND OUTCOMES

The final project report includes the results from the studies conducted by each of the four electric utilities with selected feeders of different line lengths, line characteristics, customer, mix and customer load/PV locations that potentially limited the amount of solar that could be installed on the feeders. Each utility had specific study objectives, informed by its territory's geography, customer demographics, and historic PV penetration. These objectives included the determination of individual solar limits per feeder, solar limits on a large substation, mitigation measures, voltage impacts under solar shut down and start up, and impact on line regulators and capacitor banks on long distribution feeders.

Before undertaking this study, it was believed that feeders could be grouped into similar profiles to reduce the need to conduct studies on every distribution feeder. However, it was found that every feeder had unique line characteristics and load distributions that make it difficult to classify feeders.

For each utility, the final report includes one or two examples of the feeder analyses undertaken. The full utility reports can be found through the CPUC CSI RD&D project portal listed on the previous page.



Detailed feeder model representation of a single distribution circuit and associated distributed roof-top PV systems (shown in green).

PUBLIC BENEFITS

- A proven methodology acceptable to both the utility and the regulatory agencies that shows positive and negative impacts to high penetrations of renewables in a particular service area or to a region.
- The methodology is available to any size utility with their specific load forecasts, system peak demands, service areas, lengths of distribution lines, customer mixes, and distribution line conductor sizes.
- The methodology enables the utility planner to study one individual feeder, a group or regional group of feeders, an entire distribution system, and secondary service drops to customer's meters.
- This research report provides a list of necessary data requirements and time increments of data to complete detailed distribution steady state, dynamic, and transient studies.