GO solar CALIFORNIA

CSI RD&D PROGRAM

Grid Integration

Grantee:
Southern California Edison

Partners:
Pacific Northwest National Laboratory, Qado Energy

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$853,556

Match Funding:
$1,644,346

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2014-2016

RD&D Project Portal:
calsolarresearch.ca.gov/csi/111

Itron | CSI RD&D PROGRAM MANAGER

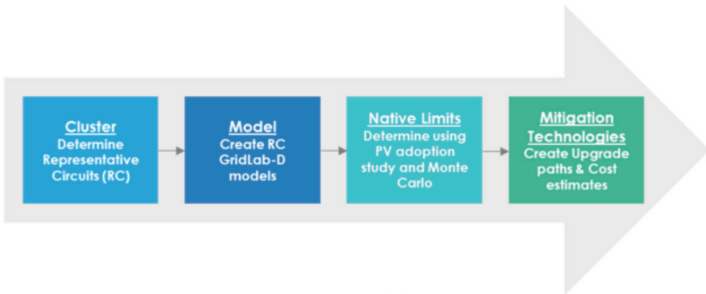
Advanced Distribution Analytic Services Enabling High Penetration Solar Photovoltaics

OVERVIEW AND OBJECTIVES

In order to meet California's aggressive renewable energy goals, a better understanding of current grid limits for solar penetration is needed as well as improvements for connecting photovoltaics (PV) to the utility grid. To address this barrier, the goal of the Southern California Edison (SCE) project was to conduct research to streamline the interconnection process allowing for higher penetration levels of distributed PV. To achieve this, the SCE team determined the native limits of distributed solar PV on the SCE system. Once native limits were determined, strategies were developed for upgrading the system to allow for higher penetrations of PV. Additionally, the project team developed an online tool that hosts models and provides a platform for model analysis. This platform is called GridUnity™ and has been developed by project partners, Qado Energy. Using the GridUnity™ tool, utilities can have control over how they configure, deliver, and manage sophisticated technology-driven customer programs and analytical services.

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).



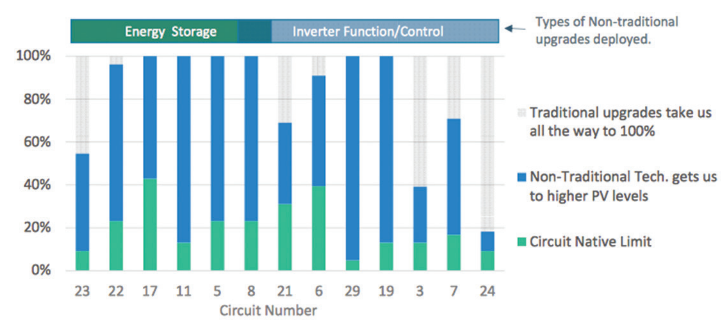
Research Project Steps

METHODOLOGY

It was not feasible to create circuit models for all of the 4,500 circuits in the SCE territory, so a set of representative circuits were chosen to represent all of the utility's circuits. This was done by first clustering all of SCE's circuits based on their characteristics and then determining the circuits that would serve as representative of the rest of SCE's territory. These circuits were clustered into 30 representative circuits and then modeled in GridLAB-D, with behind the meter residential and commercial loads. These models were then incorporated into a connectivity model that encompasses the entire representative feeders and validated with SCE customer usage data. PV was modelled as distributed systems based on customer PV adoption likelihood and Monte-Carlo simulations were then used to deploy adoption scenarios. The PV adoption models helped determine native limits based on 10 operational constraints. Traditional and non-traditional mitigation strategies were then developed for circuit upgrades to achieve 100% PV penetration.

RESULTS AND OUTCOMES

The research team found that 42-53% of SCE circuits are limited to approximately 50% PV penetration or less and at least 2 to 7% of the circuits have a native limit at or above 100% PV penetration. The most common violations experienced were power factor and voltage based. Determining how to achieve 100% penetration on legacy circuits was found to be challenging with possible mitigation measures leading to new violations. Controlling circuit voltage and circuit power factor simultaneously with capacitors was not found to be practical at high penetrations of PV. Energy storage is a technically viable solution for power factor, but may not be cost effective unless it is part of a larger multi-objective control strategy. Inverter-based Volt-VAR did not address low lagging power factor and high voltages at the same time, however Volt-VAR combined with other traditional upgrades can be highly effective. To develop complete upgrades for each circuit to reach 100% PV penetration was found to be problematic. It was observed to be relatively easy to clear violations on circuits with up to 70%-80% PV penetration, however clearing all violations in the last 20% became more difficult.



Traditional upgrades alone can reach 100% PV penetration. Emerging technologies can help surpass native limits, but may still require traditional upgrades.

PUBLIC BENEFITS

- Provide utilities insight into how to proactively develop cost effective mitigation strategies incorporating non-traditional technologies and better plan for the high PV penetration future
- Inform on-going grid modernization efforts and Distribution Resources Plan demonstrations which target increased penetration of distributed energy resources and understanding the value of these resources
- Increase understanding of the issues associated with high solar PV penetration and improve quality of interconnection applications