GO solar CALIFORNIA

CSI RD&D PROGRAM

Distributed Energy Resources Integration

Grantee:
Electric Power Research Institute

Partners:
Meritage Homes, Southern California Edison, BIRAenergy, Proclus Engineering, Pathway Technologies

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$1,485,476

Match Funding:
$2,778,825

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2014-2016

RD&D Project Portal:
calsolarresearch.ca.gov/csi/109

Itron | CSI RD&D PROGRAM MANAGER

Demonstration of Locally Balanced Zero Net Energy Communities

OVERVIEW AND OBJECTIVES

California's *Long Term Energy Efficiency Strategic Plan,* released in 2008, establishes a policy that all new homes in the state be Zero Net Energy (ZNE) by 2020. As ZNE neighborhoods and communities become more prevalent, there is a need to better understand the impact that these homes, which include high-levels of energy efficiency and PV, will have on the utility grid.

To address this gap, the Electric Power Research Institute (EPRI) team evaluated the impacts of a Meritage ZNE neighborhood in Fontana on the local distribution system and to develop mitigation strategies using building energy management systems and energy storage. The team developed ZNE packages including photovoltaics (PV), home energy management systems (HEMS), storage, and demand response (DR) for inclusion in 20 ZNE homes across two transformers. Modeling approaches were used to predict the impacts on distribution systems and demonstrated how HEMS, DR, and storage can mitigate potential grid challenges at the transformer level. The primary goal of this project was to ensure that the widespread development of ZNE communities and the resulting grid integration is beneficial, rather than detrimental, to the operation of the electrical grid and the distribution systems.

The 20 ZNE homes on two separate transformers were equipped with monitoring and controls of solar and loads to measure grid impacts. To compare the impact of storage, (a) nine homes were also installed with energy storage systems while (b) eleven homes did not include energy storage.

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).

METHODOLOGY

The energy-modeling tool BEopt was used by the team to develop a package of energy efficiency features for inclusion in the Meritage home community in Fontana, CA. PV was included on all homes to help off set the energy towards ZNE. Energy storage requirements were evaluated with consideration for both thermal and electrical storage both at the individual home and transformer level. The research team developed approaches that employ energy storage, HEMS, and DR that ideally are beneficial to distribution-system efficiency and utility grid stability while maintaining operational flexibility.

Various storage options and technologie were evaluated to make determination for implementation. Due to various exteneous conditions the storage deployment at transformer level was not feasible. Therefore storage was deployed at the home level on all homes in one transformer and studied as a comparison to the other transformer with no storage. The distribution modeling used scenarios of Title 24 compliant homes and the upgraded ZNE homes to determine the impact on distribution feeders. The storage and PV load profiles along with net load profiles were analyzed both at individual home and distribution feeder level to determine impact of controls potential for the utility grid operation.

RESULTS AND OUTCOMES

The 20 ZNE homes were designed, constructed, and occupied within a year of the start of the research project. Based on modeling results, the added energy efficiency measures had a net cost of less than $1,000 and resulted in a reduction of 1.4 kW in the size of the 4 kW PV system (savings of about $5,000). The total incremental cost to achieve ZNE was approximately $17,000 per home. To alleviate distribution impact, these homes were set up with controllable loads and with behind-the-meter energy storage. Resource aggregation strategies were developed to connect measurements at the transformer with loads, storage and PV.

The results of the testing showed that energy storage when optimized for grid integration (charge in the morning, discharge in the evening) could reduce the peaks and valleys on the distribution network. The connected thermostat could absorb excess solar production through pre-cooling of homes, and a similar strategy is being implemented with water heating. Two important take-aways from the project were that the control strategy of energy storage could either strengthen or in some cases, accentuate distribution problems, and that modeling tools still have a way to go to address the prominent or “needle” peaks that will be more common in future buildings.

PUBLIC BENEFITS

Demonstrates technical and economic feasibility of ZNE (including PV) for California new homes.

Helps reduce system cost to ratepayers by offering multiple ways to mitigate grid impacts.

Informs utilities and developers about distribution system architecture, specifications, cost, and interconnection properties.

Fosters a better understanding of how ZNE communities impact the electrical grid and provides technological strategies to enhance grid benefits.