

DR17.03 Demonstration of Affordable, Comfortable, and Grid-Integrated ZNE Communities

Overview

The research goal of this project is to demonstrate the design and installation of advanced DER measures for all-electric Zero Net Energy (ZNE) homes within the multi-family housing sector. A secondary objective is to study how ZNE homes in this segment perform with solar and thermal storage. The mission will be to develop the strategies for effective integration with the electric grid. This project will include load management and load modifying end-use operation, along with energy efficient technologies such as smart air-conditioning controls and other end-use measures. Both demand response “shift” and flexibility capabilities are being assessed.



Architectural Rendering of ZNE MF housing

Project outcomes aim to offer:

- Guidance for the development of the next iteration of buildings that will meet the planned 2020 and beyond requirements of the Title 24 California Energy Code for OpenADR communications and flexible appliances
- Neighborhood planning tools and assistance to developers and builders engaged in constructing all-electric master communities interested in ZNE construction. These buildings will ultimately feature built-in demand response capabilities and support utility distribution system planning through updates of the T&D planning models for sizing transformers and circuits.

The developer of this project (Meritage) will be installing an integrated all-electric measure package consisting of numerous energy technologies for customer interest and to enhance desirability and comfort, as follows:

- Induction cooktops
- Open ADR-connected Application Program Interface (API)-controllable heat pump water heaters
- Heat pump clothes dryers
- Electric barbeque grills
- High-performance windows
- Variable refrigerant-flow heat pumps
- Network-connected smart thermostats with DR capabilities
- Ducts located in conditioned attic spaces
- Voice assistant-driven smart home energy management systems
- Smart intermittent ventilation systems
- Integrated smart electric load panels, with built-in circuit energy monitoring
- Integrated grid distribution planning for ZNE
- Integrated DR controls to improve electric load shaping

This project will additionally provide feedback on the implementation of voice-activated smart-speaker demand response control of the in-home technologies and grid-interactive heat pump water heaters.

The project was funded under the EM&T Market Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

This project is a collaboration between SCE, EPRI, and Meritage Homes, which is a builder and seller of multi-family housing. SCE is providing technical assistance with design, construction management, and demand response innovation review.

The project is being co-funded by the SCE Emerging Market & Technologies program and is supplementary to work funded by the CEC Electric Program Investment Charge.

Results/Status

This community of 44 multifamily homes distributed over eight buildings is fully occupied except for a couple of model homes. These homes are monitored with circuit level monitoring in 28 out of the 44 homes. Sixteen of the 28 homeowners have signed data agreements that allows for continuous data collection from these homes.

The data from these homes are analyzed to understand the DR potential in the community in terms of kW of load that is attributable to HVAC and water heating which are the major controllable end-uses. The community has 66 kW potential for DR in Summer and 29 kW for DR in Winter per DR event assuming full community participation.

Significant challenges exist in automating the implementation of DR as the HVAC and heat pump water heaters use proprietary Application Programming Interfaces (API) that do not allow for easy integration with 3rd party DR management systems. The inability to integrate proprietary APIs led to the investigation of behavioral DR. Persistent challenges in the form of limited community interest in participating in DR events through 3rd party DR Auction Market (DRAM) Aggregators calls for approaches to improve customer engagement in this community for the DR potential to be realized.

Next Steps

Comprehensive analysis of data from this community is currently underway including insights on challenges and opportunities for programmatic DR implementation in all-electric ZNE communities. A final report including this analysis and insights is expected by Q4 2022.