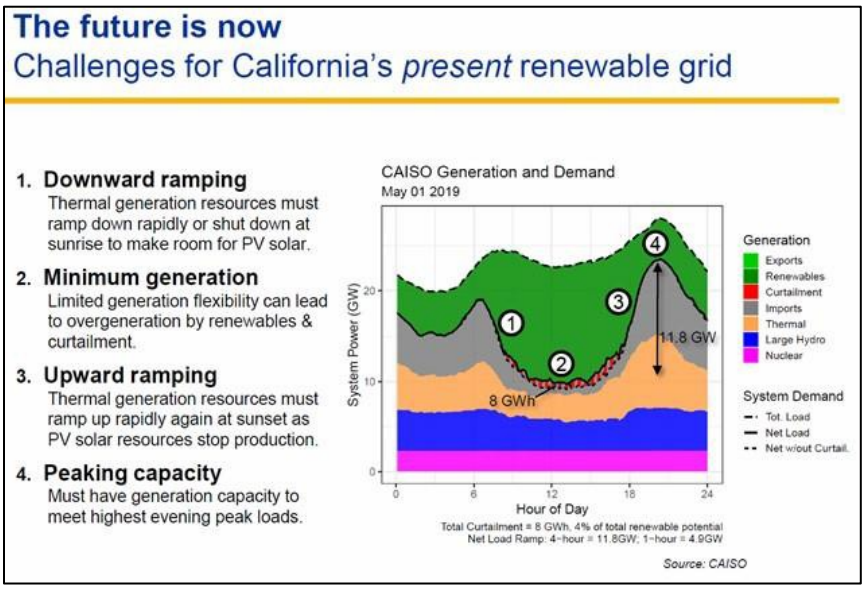
SCE EM&T PROJECT: DR20.02 WEDGEWOOD DEMAND FLEX TESTING

Status: In progress

Overview

The ability to shift loads without significantly impacting tenant comfort is key to California's ability to address California grid challenges. The grid obstacles include power intermittency, demand peaks, and localized capacity resulting, in part, from rapid growth and scaling of customer self-generation, behind-the-meter storage, and intermittent loads such as new electrification loads and EV chargers. Smart buildings are needed to compensate for differences between forecasts and actual loads. Recent work by LBNL in its DR Potential Study confirms that the load-resource balance is already increasingly difficult to maintain on sunny spring days.

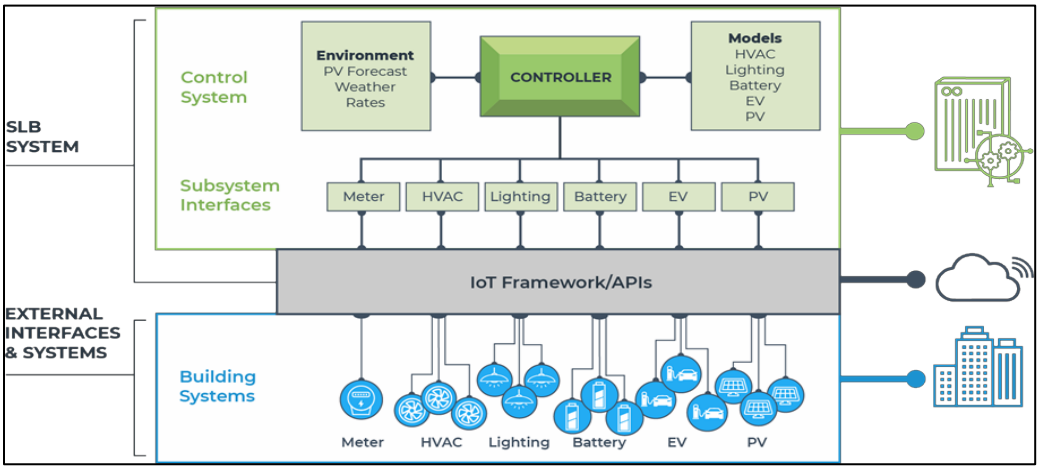


California's Future Renewable Grid Challenges

While the issues of ramping, "duck curve," and curtailment of renewables have been discussed for years by planners and operators throughout California, progress has been slow in developing technologies and programs that directly address these issues. In the meantime, solar deployments have continued at a rapid pace. More and more customers are adding both solar and storage "behind-the-meter", in efforts to manage their energy costs and ensure reliability in an uncertain energy future.

At the same time, the combination of behind-the-meter distributed energy resources (DER) and advanced system controls have been shown to be intelligently controlled to better manage customer loads in order to participate in traditional load shed programs, or to conform to emerging time-of-use rates and other emerging energy pricing signals. For example, there are current software systems

designed to use predictive algorithms that optimize loads based on predicted and actual weather and solar generation. These systems are thus able to manage customer loads in concert with the needs of both the grid and the customer's operations.



Intelligent Load Balancing Software Illustration

The Wedgewood Demand Flex Testing Project will evaluate the energy and non-energy impacts and benefits of using an innovative load management software platform. This software will optimize the commercial building's HVAC operations in coordination with the building's onsite generation system of solar power. The study will be conducted at an 83,000-square feet commercial office building located in Redondo Beach, California. The facility has two floors with over 500 employees working across nine different businesses. The site has a 625-kW solar PV system installed on its rooftop and on top of carport canopies in the parking lot. Major end-use energy consumers at the facility are heating ventilation and air conditioning (HVAC) equipment, electric vehicle (EV) charging stations, lighting systems, and other miscellaneous loads.

The Wedgewood campus has a combination of factors that are favorable for electric load optimization techniques and Demand Response capability, as follows:

- Solar PV production accounts for a sizeable portion of the facilities' total energy usage due to the size of the system.
    - The facility is on TOU rate structure TOU-GS-3 Option E (previously TOU-GS-3 Option R) allowing for shift opportunities.
    - Fixed operating schedules provide an opportunity for time-based optimization, reducing variability in the machine learning algorithm.
    - System Demand Response capability is fast and flexible and can increase or decrease power many times each day relatively quickly.

Wedgewood Building Demonstration Site

In a phased approach, the Wedgewood Demand Flex study has developed a set of research hypotheses which will evaluate the ability of the software to modify the Wedgewood HVAC operations in two ways, shown below, to support current and future California and SCE DR programs and load management initiatives:

1. Load Shift Hypothesis: First, can the software effectively reduce the customer's HVAC-related demand charges by between 10% and 25%, without negatively impacting building tenant comfort, by shifting operations and increasing loads during SCE's non-peak TOU periods, and reducing loads during peak periods?

2. Load Shed Hypothesis: Second, by driving a deeper level of HVAC setback than under normal operating conditions, can the software enable two to four hours of load shift of at least 20% of whole-building load in response to simulated day-ahead, hour-ahead, and 15 minutes-ahead load curtailment signals from SCE?

The intelligent software system was designed to reduce a customer's peak demand by shifting energy use from more costly demand periods to periods when the

building's solar PV panels are generating power, using its algorithm based on forecasted and actual weather conditions. Under this scenario, and the customer's current rate schedule (TOU-GS-3-E), the software is expected to reduce customer demand costs between 10% to 25%, while minimally impacting tenant comfort. The team will examine the M&V (Measurement and Verification) results of the reduced customer demand and costs by shifting energy use from more costly demand periods to periods where the building's solar is predicted to be generating power, based on predicted and actual weather conditions. Full data analysis of the load and the efficacy of the load management system will be examined and reported.

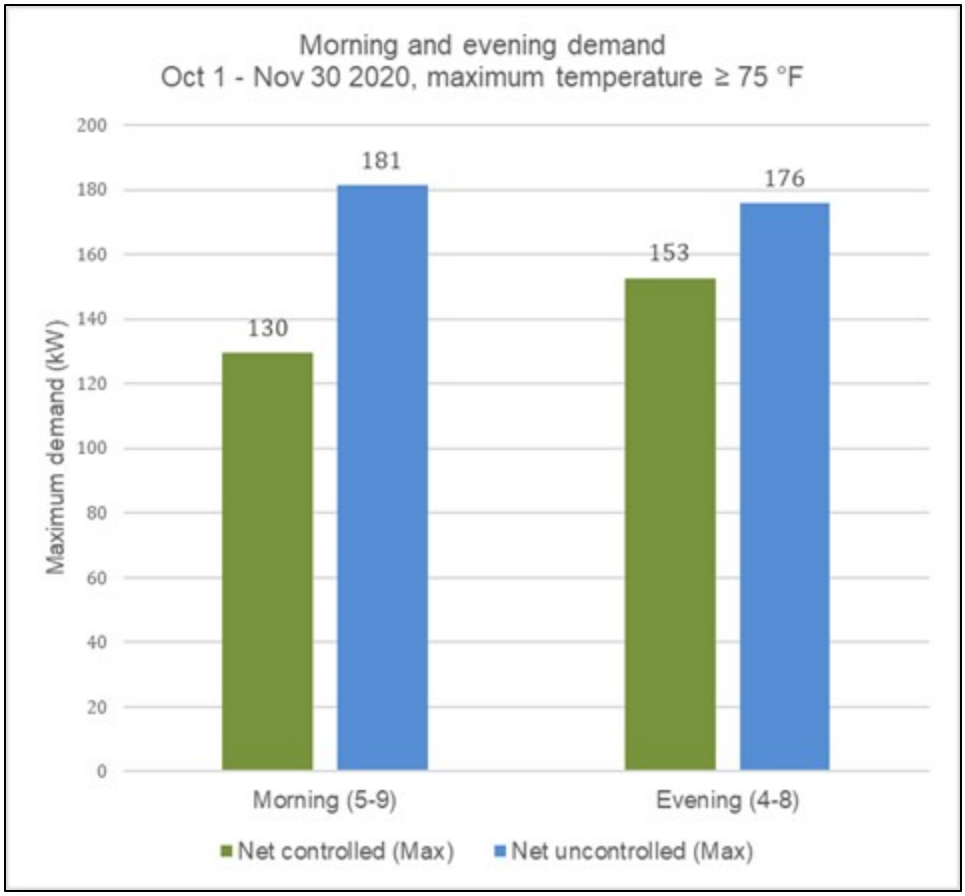
The project was funded under the EM&T Technology Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities. The Technology Transfer category advances DR-enabling technologies to the next step in the adoption process by raising awareness, developing capabilities, and informing stakeholders during the early stages of emerging technology development for potential DR program and product offerings.

Collaboration

The EM&T program team has engaged Alternative Energy Systems Consulting (AESC), Incorporated as the lead contractor, and Extensible Energy is providing the DR management software platform by working with the Wedgewood facility team for system integration. SCE is also sharing the scope of this work with its partners within the ETCC and other research organizations to provide advisory services and technical review. While the building owner at Wedgewood is conducting an equipment upgrade at this facility and leveraging energy efficiency funding, no DR co-funding or cost-sharing with other utilities, private industry, or other third-party groups for this project was requested or received.

Results/Status

The project to date has demonstrated that significant demand reductions at the demonstration site can be achieved during peak demand times through load shifting. Demand was reduced 15.5% on warmer days when cooling was needed, with reductions of 28% in the morning and 13% in the evening (see the figure below). In addition, the control software was able to reduce energy consumption in the evening hours by 19%, while compensating with increased energy consumption in the afternoon when there is substantial renewable solar generation. Additionally, the system was able to shed load of approximately 14% compared to the maximum observed peak demand for the one-hour DR test.



Morning and Evening Demand Reduction due to Control on Warmer Days (Maximum Temperature > 75 F)

If deployed at multiple sites and at scale, this demonstrated load-flexibility could provide a significant demand shifting benefit for utilities, integrate renewable resources into the California grid, and potentially add significant direct utility cost savings to the site customers. In addition, the ability to shift demand from periods with less solar generation into periods with more solar generation would support the state's policies for reducing emissions from fossil-fueled generation.

Next Steps

All field project activities have been completed and remaining data analytics and findings are being incorporated into the development of the final draft report. The SCE project staff will initiate review of the final draft report submission and project closeout presentations. The final report is planned to be submitted for review in early Q2 of 2021.