Multiple-Use Applications of Distributed Energy Resources to Meet Customer Needs and Provide Utility and Grid Services

Jonathan Hart, Pierre Bull, Kelsey Albers, and Sean Sevilla

The technical capabilities of behind-the-meter distributed energy resources (DERs) that generate, store, and manage power at customer sites are rapidly advancing, and their adoption is increasing. As technologies enter the marketplace, these resources are better able to meet consumer energy needs and provide valuable services to electricity grids, performing multiple services for customers, utilities, and grid operators. However, many jurisdictions lack the necessary trained workforce, physical infrastructure (advanced metering infrastructure), wholesale market access, and regulatory framework to allow DERs to provide multiple-use applications and value stacking that can better support grid and customer functions. Further, multiple-use applications are relatively new and only theoretically possible, with few demonstration projects completed that can inform the frameworks and policies needed for achieving greater DER revenue streams. This article will focus on demonstration projects led by the Center for Sustainable Energy (CSE) to assess multiple-use applications of DERs in meeting customer and utility needs.

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DERs IN DEMAND RESPONSE AND WHOLESALE MARKET PARTICIPATION

The CSE is seeking to overcome barriers of DER market adoption by identifying and addressing specific problems alongside testing and demonstrating potential solutions through two pilot projects designed to inform markets and policymakers. These demonstration projects seek to show how customer-sited or behind-the-meter DERs can operate and be paid for multiple-use applications by providing services to customers, the local utility, and the transmission grid operator, and to provide a comprehensive set of recommendations and

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lessons learned for further developing these markets for DERs.

To examine the role of DERs in demand response (DR), CSE is partnering with a diverse group of companies and organizations[1] on an automated demand response (AutoDR) workforce development project funded by the California Energy Commission Electric Program Investment Charge (EPIC). This effort targets understanding the nexus of workforce development, demand reduction, technical training, and stakeholder engagement required for wider application of DERs for AutoDR, with a focus on disadvantaged communities (DACs) as defined by California Senate Bill (SB) 535. Passed in 2012, SB 535 requires that the California Environmental Protection Agency identify DACs for investment opportunities and that the Department of Finance allocate 10 percent of available Greenhouse Gas Reduction Funds to projects located within DACs.[2] Throughout the first pilot, the project team will engage with small and medium-sized buildings (SMBs) in DACs to increase participation in integrated demand-side management (IDSM) programs and promote the adoption of AutoDR equipment.

CSE has partnered with Tesla, Conectric Networks, Olivine Inc., and DNV GL to demonstrate the ability of DERs to participate in the California wholesale market by providing energy and ancillary services.

In a second project, CSE has partnered with Tesla, Conectric Networks, Olivine Inc., and DNV GL to demonstrate the ability of DERs to participate in the California wholesale market by providing energy and ancillary services. The project resources consist of two portfolios of DERs: (1) solar photovoltaics (PV) paired with battery storage and (2) an array of building and equipment sensors with dynamic load controls. It is supported by a grant from the Energy Commission's EPIC.

The experiences and lessons learned during these projects will be broadly shared with industry, utility, and regulatory representatives at the projects' conclusion in early 2020. While these pilot projects focus on host sites in California, they are generally applicable nationally as utility customers increasingly look to DERs to reduce energy costs and electricity markets are faced with integrating more dynamic customer loads. Lessons learned through these pilots can help customers and grid operators integrate DERs for the benefit of customers and ratepayers.

BENEFITS OF DERS IN MULTIPLE-USE APPLICATIONS

The advent of cost-effective customer-sited generation, storage, and communication technologies is enabling customers to better control their energy usage by both reducing and shifting electrical load to reduce monthly bills. Many of these technologies are flexible in nature, can be controlled remotely, and can be aggregated into fleets of DERs located at remote sites. Additionally, many of these resources are not used every day or at all hours throughout the day, leaving time in which they could provide services for other entities. For example, an energy storage system located at a commercial facility may be discharged only a few times each month to reduce monthly demand charges. On days when there is no demand event, the system sits idle, ready to be dispatched when needed. In this case, the storage system could be used during the "off days" to provide other services.

Consequently, many DERs have available capacity and time they could be used to provide benefits for multiple entities and be compensated for such use. Examples of other value streams and multiple uses include DR

[1] Avery Energy Enterprises, Lawrence Berkeley National Laboratory, ICF International, California Labor Management Cooperation Committee, the California Labor Federation, ASWB Engineering, UC Davis California Lighting Technology Center, and Energy Solutions.

[2] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB535.

participation; distribution/transmission system upgrade deferral; resource adequacy/capacity; and providing energy, capacity, and ancillary services directly into wholesale markets. DERs providing multiple uses can even provide cost-effective alternatives to traditional resources that provide these services.[3]

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Recognizing these opportunities, the California Public Utilities Commission (CPUC) recently developed a loose framework of rules and best practices to allow energy storage systems to provide multiple-use applications and authorized the creation of a working group to further explore these principles.[4] The working group submitted its final report to the CPUC in August 2018 with recommendations on refining and implementing these rules.[5] In addition, organizations such as the Rocky Mountain Institute have developed rough frameworks of how energy storage systems could increase their value and provide multiple services.[6]

However, DER value stacking is still in the early stages of pilots and best practices, and many of the project developers who have experience in this area hesitate to share lessons learned to maintain an edge over their competitors. Consequently, the concept of DER multiple-use applications is not fully developed, and many technical, financial, and regulatory questions must be resolved before DERs will have access to numerous value streams. Many of the pilots and regulatory developments to date have focused on battery energy storage, and the rules, recommendations, and frameworks developed for batteries may not translate to other DERs or even other types of energy storage technologies. Therefore, a need remains for transparent lessons learned in this space and replicable strategies that regulators, project developers, and technology providers can implement to encourage multiple-use applications.

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Additionally, the existing workforce typically is not up-to-date on the latest technologies and capabilities regarding integrated demand-side management. This knowledge gap is due to a lack of understanding of IDSM programs and opportunities administered by investor-owned utilities (IOUs) and aggregators, as well as a lack of experience and familiarity with emerging IDSM-enabling control technologies, such as AutoDR communications equipment[7] and the OpenADR protocol. To further compound these issues, IOU programs have historically lacked comprehensive technical support services, resulting in a patchwork of industry knowledge among

[3] ConEdison. (2015, August 28). *Brooklyn Queens demand management program.* Project update presentation. Retrieved from https://www.coned.com/energyefficiency/pdf/BQDM-program-update-briefing-08-27-2015-final.pdf; Keener, P. (2014, April 1). *Distributed energy at the speed of ice.* Redding Electric Utility. Retrieved from https://www.tdworld.com/smart-energy-consumer/distributed-energy-speed-ice.

[4] Decision 18-01-003, *Decision on Multiple-Use Application Issues*, January 11, 2018.

[5] *Compliance Report of Southern California Edison Company (U 338-E), Pacific Gas and Electric Company (U 39 E) and San Diego Gas & Electric Company (U 902-E) on Behalf of the Multiple-Use Application Working Group*, August 9, 2018.

[6] Fitzgerald, G., Mandel, J., Morris, J., & Touati, H. (2015, October). *The economics of battery energy storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid.* Retrieved from https://rmi.org/insight/the-economics-of-battery-energy-storage-how-multi-use-customer-sited-batteries-deliver-the-most-services-and-value-to-customers-and-the-grid-executive-summary/.

[7] Goldman, C. A., Peters, J. S., Albers, N., Stuart, E., & Fuller, M. C. (2010, March). *Energy efficiency services sector: Workforce education and training needs.* Retrieved from https://emp.lbl.gov/publications/energy-efficiency-services-sector-0.

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specifiers, vendors, and installation technicians. Targeted training can help bridge this knowledge gap between the capability of technology enabling multiple-use applications and customer participation. This is especially important for stakeholders such as vendors and installers that have been identified as a key conduit of information to customers about IDSM programs and incentives.[8] The benefits of workforce development can also provide benefits through implementation of IDSM-enabling control technology and participation in IDSM programs, as a lack of skilled installers has also been identified by CSE's partners as a key factor in poor quality installations, creating a barrier to broader market adoption of new technologies.

AUTOMATED DEMAND-RESPONSE PROJECT DETAILS

One of the greatest barriers to enabling DERs to provide multiple-use applications is a lack of trained and knowledgeable workers who can provide these offerings to customers. To overcome this barrier, CSE and its partners are working to increase adoption of IDSM-enabling technologies by California SMBs to drive multiple uses and value streams for customers and grid operators, specifically in DR and AutoDR programs.

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Participation in IDSM programs can help facilitate reductions in energy consumption and more efficient energy usage, helping California move closer to state-mandated energy and greenhouse gas (GHG) emissions reductions goals as stipulated in Assembly Bill (AB) 758, requiring implementation of a comprehensive program to increase energy savings in existing residential and commercial buildings,[9] and AB 32, requiring California to reduce GHG emissions to 1990 levels by 2020.[10] The project team has partnered with seven Joint Apprenticeship Training Centers (JATCs) of the International Brotherhood of Electrical Workers (IBEW) to implement the training program. The training covers IDSM concepts, with a focus on load management and the application of AutoDR enabling controls.

AUTODR TECHNOLOGY AND OPPORTUNITIES

For AutoDR to be effective and dependable, the facility equipment must receive a signal directly from the utility or aggregator and execute a predetermined load shed strategy. To do this, a building requires hardware, typically called a Demand Response Automation Server (DRAS) client, that can receive a standards-based messaging protocol and translate messages to the building control system (such as Wi-Fi-enabled thermostats, direct load control switches, modified rooftop units, and network lighting controls). The load control (logic) device may also receive DR messages directly and translate them into the necessary load-shedding control sequences. The AutoDR workforce development project focuses on enabling AutoDR for lighting and HVAC, as these end uses were identified by project partners as having a high potential for adoption across small and medium-sized businesses and public facilities.[11]

The AutoDR project is using the OpenADR 2.0b communication protocol, which provides the enhanced functionality to enable resources to participate in shift, shed, and shimmy DR[12] and enable load controls

8 *California Statewide Automated Demand Response Program: Process Evaluation, Opinion Dynamics*, March 2014.

9 https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB535.

10 https://www.arb.ca.gov/cc/ab32/ab32.htm.

11 For this project, small and medium-sized businesses are defined as those with peak summer demands of 499 kW or less.

12 This demand response terminology was established in the *2025 California Demand Response Potential Study* (2017) by Lawrence Berkeley National Laboratory, where shift refers to DR that reshapes customer load profiles via price response or on behavioral campaigns, shed refers to loads that can be curtailed in an effort to provide peak capacity and support the system in an emergency or contingency event, and shimmy is the utilization of loads to dynamically adjust demand to relieve short-run ramps/disturbances from seconds to an hour.

to provide a variety of services including increased system reliability, decreased energy costs, and integration of renewable generation. With the OpenADR 2.0b protocol, enabled lighting systems can participate in DR events that provide shed and shimmy services while participating HVAC systems are more capable of providing shift and shed services. While retail DR programs currently available in the project territory only target load shed, the OpenADR 2.0b specification enables participation in future retail models of demand response. Prior to the demonstration, however, installation technicians have not had broad access to training programs that provide hands-on experience with controls that are OpenADR-certified.

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Workforce Development

To develop a skilled workforce that can install and configure load controls for multiple-use applications, CSE is addressing several market barriers identified by project partners. These include the lack of technical experience with AutoDR communications equipment among specifiers and installers, and a need for transparent and visible pathways for disadvantaged and underserved communities to enter the IBEW-National Electrical Contractors Association (NECA) inside wireman electrical apprenticeship program. While working to improve accessibility to these career paths, the project team also is identifying common barriers preventing apprenticeship enrollment of individuals from DACs. To take this a step further, the project team seeks to integrate lessons learned into apprentice recruitment efforts.

The project team designed a new California Advanced Lighting Controls Training Program (CALCTP) AutoDR course and online module that is now offered by partnering JATCs to existing fourth- or fifth-year apprentices. Following course completion, apprentices from DACs in IOU service territories are provided with on-the-job training. The hope is to expand career opportunities for installation technicians in building controls and increase the pool of electrical apprentices trained in AutoDR communications equipment installation. Apprentice recruitment outreach efforts and messaging can continue to be employed beyond the project timeline to continue driving apprentice recruitment, particularly in DACs.

Outreach and Recruitment

To promote economic opportunity in DACs through improving energy savings in existing buildings and provide on-the-job training opportunities for installers, this project is focused on promoting AutoDR incentive programs to SMBs in IOU service territories to encourage AutoDR communications equipment enablement and IDSM program enrollment. To market available programs, offerings, and technical support resources, the project team is collaborating with Pacific Gas and Electric (PG&E), Southern California Edison (SCE), Energy Solutions (ES), and the California Green Business Network (GBN) to promote PG&E's Fast-Track program and SCE's Express Program, as well as additional load management strategies that may be more realistic and attainable for SMBs, as they require a smaller up-front financial investment. The project team also will evaluate the feasibility of SMB participation in IDSM programs to understand SMB priorities and barriers.

To stimulate SMB enrollment in IDSM incentive programs, the project team is developing outreach partnerships, such as the GBN, to educate coordinators and business groups in DR/AutoDR and other load management strategies. Outreach stakeholders will be able to communicate program benefits and resources to green businesses and link them to technical support resources. Several load management strategies are included in the GBN's Tier 2 certification checklist, further incentivizing participation by businesses already engaged with the GBN. Project collateral

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will allow GBN coordinators to continue advocating for businesses to participate in load management programs well beyond the project term. Collateral created through these efforts will continue to support adoption of load management strategies and be shared through project collaborator networks.

A primary driver behind outreach and recruitment efforts is to create lasting tools for partners to continue recruiting apprentices and for these apprentices to successfully complete the CALCTP AutoDR course and identify continuing education opportunities in IDSM technologies. Title 24, part 6 of the California Code of Regulations (Title 24) 2019 updates are likely to prompt a suite of new DR/AutoDR installations. CALCTP AutoDR course completion gives contractors a competitive edge over others vying for the same opportunities and helps specifiers and contractors identify opportunities for multiple-use application enabling technologies. By identifying barriers to enrollment of SMBs in IDSM programs, programs can evolve to be more inclusive to customers and offer a variety of models for participation as current programs best serve larger buildings that are better positioned to assume project costs.

The project team hopes to address the potential of AutoDR and load management technologies to provide multiple-use applications by building a skilled workforce and increasing deployment of load management and AutoDR technologies and communications standards in DACs. Lessons learned will be shared to reveal barriers to SMB participation in IOU-administered DR/AutoDR programs, how existing technical assistance resources impact program participation, and how IDSM strategies should be considered as tools to achieve state-mandated energy and GHG emissions reductions goals stipulated by Assembly Bills 758 and 32.

WHOLESALE MARKET PARTICIPATION PROJECT DETAILS

The primary goal of this demonstration project is to develop operational strategies that allow behind-the-meter DERs to be bid directly into the California Independent System Operator (CAISO) day-ahead and real-time energy markets—primarily as proxy demand resources (PDRs)[13]—while still maintaining their intended value and service to customers.[14] In addition to CAISO's energy markets, the project's two portfolios will demonstrate new forms of market participation for DERs behind-the-meter by providing spinning reserves and simulating frequency regulation. In addition, the project will use direct metering for energy storage systems, which is a rarity among nongenerating resources in CAISO markets, to measure resource performance for market settlement purposes.

The project consists of two portfolios: Portfolio 1 is an aggregation of five public school facilities, each with behind-the-meter solar PV paired with battery energy storage, and Portfolio 2 includes two hotels outfitted with an array of wireless sensors and dynamic controls utilizing advanced energy management software.

Portfolio 1

The five public school facilities aggregated to form Portfolio 1 are located in Chino Hills, California. Each school has behind-the-meter solar PV and Tesla Powerpack battery energy storage systems with a combined capacity of 1.1 MW/2.09 MWh and submetering for performance evaluation. Portfolio 1 intends to participate in the market when the potential revenue gain from wholesale market participation via discharging or charging exceeds the potential cost savings from avoided retail utility costs

[13] PDR is a participation model that allows behind-the-meter resources to participate in the wholesale market as demand response. These resources are able to provide energy in both the day-ahead and real-time markets, as well as spinning and nonspinning reserves. In general, the PDR model is technology agnostic, and sites can use multiple resources to provide load reduction when participating in the market.

[14] The technologies used in each portfolio were installed with the primary purpose of reducing customer electric utility bills through demand and energy reductions. As a general rule, the technologies will not participate in the wholesale market at the risk of increasing customer bills unless wholesale market participation will more than compensate customers for increased utility bills.

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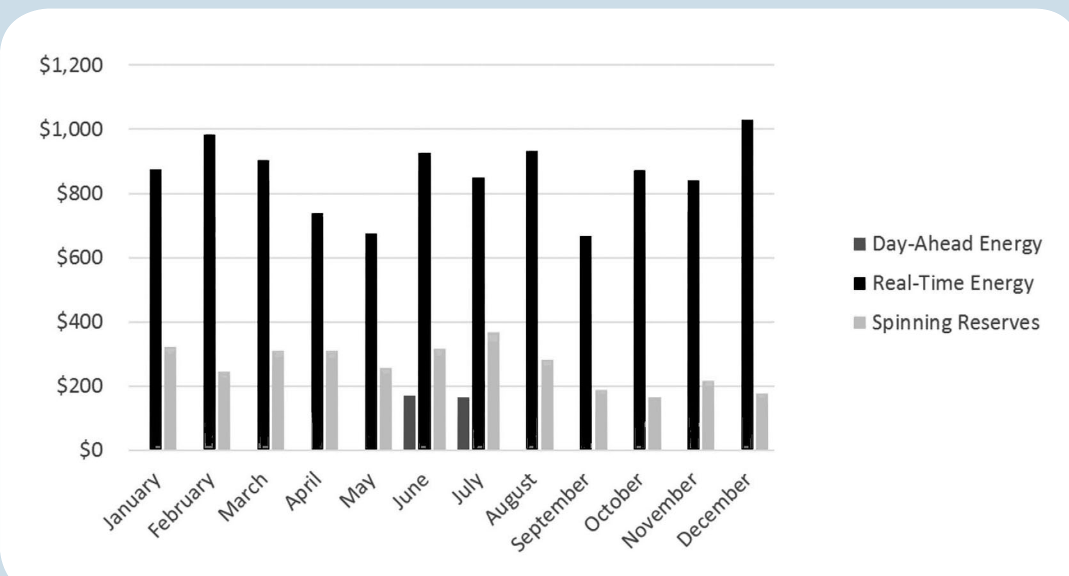
as dictated by the terms of the customer utility tariff.[15] In hours where the site has an opportunity to reduce load below its baseline, the battery operational strategy will evaluate when such participation exceeds the estimated marginal opportunity cost of such a dispatch. When it is economically attractive to participate, load reduction will be implemented through behind-the-meter dispatch of the battery. Once bids are submitted and market awards are received, Tesla can upload those economic price signals into the local optimization engine connected to the battery's controller. Under perfect 24-hour foresight when the day-ahead forecasted load and market price match up with actual conditions, the battery will dispatch at each scheduled hour in the day-ahead market and obtain a market award settlement in the exact amount as planned. However, as the day-ahead forecasts will inevitably be imperfect, the battery optimization will tailor the battery dispatch from its day-ahead program and use real-time (15-minute interval) market information to create an optimized real-time energy market bid.

In sum, the optimization solves for battery dispatch in the day-ahead and real-time wholesale energy market based on the retail tariff, forecasts of net load, potential market award, and imbalance charges (i.e., market penalty). **Figure 1** shows potential wholesale market revenues for this portfolio.

Tesla receives 15-minute metering and telemetry data from a variety of system assets, which include gross customer site load, PV generation, and battery state of charge, among other measurements. This data is then used to benchmark the performance of a given strategy or forecasting technique by comparing the 5- and 15-minute interval snapshots of each asset in the system with recent system and local net load conditions and wholesale market day-ahead prices. Tesla's continual learning process is designed to optimize system performance to maximize wholesale market participation revenue while also being attuned to any specific needs and expectations of the customer (i.e., the Chino Hills school host sites).

[15] The schools' retail utility tariff is based primarily on a noncoincident demand charge, grid electricity volume assessed on biseasonal, time-of-use block energy rates, and a suite of nonbypassable volumetric and fixed charges.

Figure 1. Portfolio 1 Potential Wholesale Market Participation Revenues



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In addition to providing energy into the day-ahead and real-time markets, Portfolio 1 also will provide ancillary services in the form of spinning reserves and frequency regulation simulation. While CAISO allows proxy demand resources to provide spinning reserves, it does not allow them to provide frequency regulation; therefore, the portfolio will bid spinning reserves into the market, and it will simulate frequency regulation by following actual regulation signals. These additional services will show how DERs can tap into multiple revenue streams in the wholesale market and the value they can provide. To date in California, few DERs have provided spinning reserves into the CAISO market, making this demonstration one of the first of its kind. Moreover, if the frequency regulation simulation is successful, this could be an opportunity to advocate for proxy demand resources to provide regulation in the market.

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This project is also using a newly developed metering methodology at CAISO, known as metered generator output (MGO), to directly meter the energy storage systems for performance and settlement purposes. MGO differs from traditional retail DR programs that utilize whole-premises metering (typically, the electric utility distribution company's revenue/billing meter) to baseline the performance of load curtailment during a given DR event. A counterfactual framework is established based upon the difference between a historical baseline value and the actual usage during the event period. This counterfactual approach is the default method for determining DR settlement for PDR resources participating in CAISO. Though baseline settlement methodologies can achieve a reasonably accurate pre- and post-event measurement for a variety of customer or facility types performing DR, baseline settlement inherently lacks precision and specific resource visibility.

Alternatively, the MGO method calculates DR performance by relying on a submeter that directly measures the contribution (energy delivered) by the registered generation device located behind the whole-premises revenue meter. Under this configuration, the Tesla Powerpack storage devices are submetered to determine performance during a DR event. A feature of this demonstration project will be to test the ability of MGO as a mechanism to ensure accurate compensation of behind-the-meter storage for its contributions to a DR event dispatch.

Portfolio 2

Portfolio 2 consists of two hotels located in San Diego and uses advanced energy management software developed by Conectric Networks to evaluate whole-premises metered performance. The two sites combined can reduce on-site load by up to 215 kW/1,300 kWh. Both hotel facilities are outfitted with thousands of lighting, thermal, and occupancy sensors throughout the common areas and guest rooms that are Wi-Fi-connected to Conectric's dedicated local area network gateway hubs, along with automated smart controls placed "over the top" on HVAC equipment (that had preexisting equipment management system controls of their own) and lighting switches (see **Figure 2**).

Portfolio 2 anticipates following a "price taker" strategy, meaning that the resource doesn't have a set price that wholesale markets must reach to submit a bid.[16] Rather, the portfolio plans to submit bids—effectively at zero dollars—during periods when the flexible capacity available is sufficiently large enough to make cost-effective bids. **Figure 3** provides an overview of potential monthly revenues from wholesale market participation.

16 "Price taker" has limited range for demand-response resources in the wholesale market due to FERC Order 745 Net Benefits Test (NBT), which establishes a bid price floor for demand-response resources. More information is available on the CAISO website at http://www.caiso.com/informed/Pages/StakeholderProcesses/CompletedClosedStakeholderInitiatives/DemandResponseNetBenefitsTest.aspx.

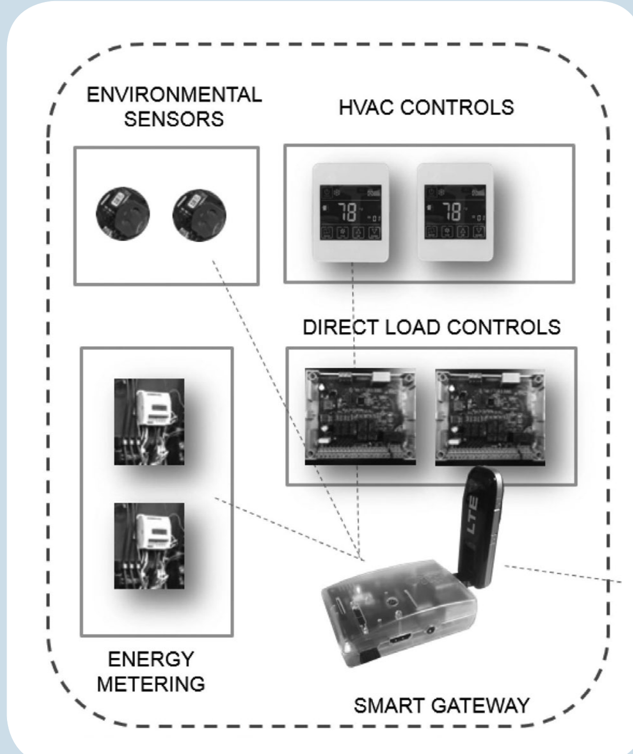
To provide both retail and wholesale services, Portfolio 2 includes load management strategies, a list of necessary data points to collect, a data collection and load control protocol, and protocols to perform automated load management responses to varying grid conditions. Portfolio 2 has two primary methods[17] to strategically manage site loads when participating in the wholesale market:

1. *Load shift* by primarily using the building's thermal mass as passive thermal energy storage.[18]
2. *Load shed* when peak-demand economic conditions merit additional reductions.

Specific load management strategies Conectric Networks plans to implement to deploy both load shift and load shed across both hotel facilities include the following:

- *Occupancy forecasting:* Using detailed analysis of historical occupancy patterns provided by the hotel, probabilities will be assigned to the occupancy of a specific use area. For example, only 1 percent of rooms are occupied between 3 and 4 p.m., increasing to 48 percent between 4 and 5 p.m., and 74 percent between 5 and 6 p.m. The amount and duration of cooling load shifting in guest rooms can be matched to the occupancy probability.
- *Precooling strategies*: The thermal characteristics of each zone and of each building as an aggregate compared to weather data and available heating and cooling capacity can determine the amount and duration of precooling required to deliver a certain reduction in cooling requirement at a later time. This fits with the demand shifting or thermal energy storage function.

Figure 2. General View of the Wi-Fi-Enabled Sensors and Controls (via Dedicated Smart Gateway Hubs) Outfitted in Portfolio 2 Hotel Facilities



- *Ventilation control:* Ventilation is often left uncontrolled or based on schedules not regularly updated. By adding occupancy information to ventilation control, it may be possible to manage ventilation to perform energy load shifting, shedding, or shimmy functions.
- *Pump control:* Hotel buildings have sizable water management systems designed to pump, distribute, heat, cool, and treat water. Some of the many water features include swimming pools, chillers for air conditioning, and boiler systems for hot water and heat—nearly all of which can be managed for energy load optimization. For example, it might be economically favorable to turn off water-pumping functions for a certain period to perform load shift or shed if the forecasted wholesale market price crosses a certain threshold. Or, if rooms are unoccupied for multiple

[17] This demand response terminology was established in the *2025 California Demand Response Potential Study* (2017) by Lawrence Berkeley National Laboratory and adopted into the record of the Demand Response Proceeding at the California Public Utilities Commission (Rulemaking 13-09-011), available online at http://www.cpuc.ca.gov/General.aspx?id=10622.

[18] The buildings' concrete walls and floors can hold and store heat, acting as passive thermal energy storage. No actual thermal storage device will be installed on the properties.

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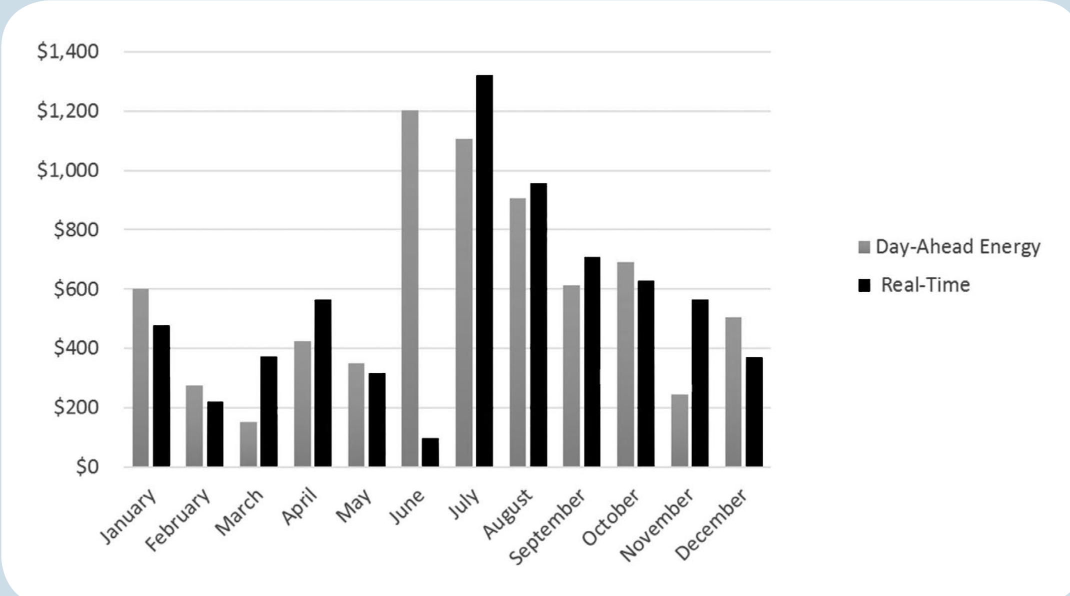
Figure 3. Portfolio 2 Potential Wholesale Market Participation Revenues



hours, it might be unnecessary to pump as much hot water through portions of the facility.

- *Lighting controls:* Customers typically find it difficult to control common area lighting because lighting systems in those areas tend to be connected to a single on/off switch. A user interface with an "over-the-top" network of subswitches or dimmers can be installed to make it easier to create individual lighting branch control.

PORTFOLIO TIMELINES

Portfolio 1 is currently in the process of registering its resources into the CAISO wholesale market. The project team anticipates it will be ready to begin market participation in summer 2019. Portfolio 2 is in the customer agreement phase, and the project team is hoping to begin market participation by late summer 2019. The project team will observe and analyze both portfolios' participation in the market into early 2020.

CONCLUSION

With declining costs and rapid technology advancements, DERs are increasingly adopted by customers to provide utility bill savings. Beyond customer bill savings, DERs can provide numerous benefits to utilities and grid operators. However, the DER multiple-use applications are a relatively new concept that have not been deployed on a large scale. Many technical, regulatory, and institutional questions must be addressed to develop viable frameworks, markets, and policies that allow for multiple-use applications. Additionally, the existing workforce is not adequately trained on these types of technologies and value streams.

Through these two pilots, the CSE hopes to inform the industry and stakeholders on the market integration steps and operational strategies of multiple-use application DER portfolios participating in utility programs and wholesale markets. Additionally, CSE hopes to refine training and educational materials that can train the existing and future workforce to become skilled with DER technologies and the practice of value stacking. With the lessons learned from these pilots, the project team plans to inform stakeholders on policies and practices that can allow DERs to provide greater benefits to customers and the overall energy grid.

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