# Demand Response in New Construction: Could this be the Beginning of a Beautiful Relationship?

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**ABSTRACT**

Southern California Edison (SCE) has embarked on a pilot program to integrate automated demand response into the California statewide non-residential new construction energy-efficiency program, *Savings By Design*. The Integrated Demand Side Management Commercial New Construction Pilot (Pilot) is one of the tactical outcomes of the California Long-Term Energy Efficiency Strategic Plan policy, which requires California utilities to bundle energy efficiency, demand response, and distributed generation strategies to provide a comprehensive and integrated energy management plan for customers. The purpose of the Pilot is to provide technical support and incentives that encourage *Savings By Design* participants to include Auto DR technologies during building design as well as to develop and implement targeted DR curtailment strategies.

An assessment was conducted in 2013 to sharpen the Pilot's focus and refine the implementation strategy for 2014. This paper will describe the Pilot's initial strategies for integrating Automated DR as an "add-on" to the SBD program. We also review customer and program execution challenges. We examine how four recent events—the adoption of a LEED DR credit, California's Title 24 requirements that lighting and HVAC equipment have Auto DR "capability," the inclusion of standardized communication protocols, such as OpenADR, in Title 24 and the movement to Time of Use and Critical Peak Pricing—will impact integration of AutoDR into building construction. We also present a case study of DR integration with a LEED-rated luxury hotel. Finally, we summarize the recommended modifications to the 2014 Pilot design to help SCE achieve its strategic objectives.

## Introduction and Background

The design and delivery of demand response and energy-efficiency programs have traditionally been conducted independently, due to reasons such as varying value propositions, program channels as well as regulatory process and constraints. The 2008 California Public Utility Commission California Long Term Energy Efficiency Strategic Plan (CLEESP), updated in 2011, set a goal for all new construction: zero-net energy (ZNE) by 2030 for commercial projects and 2020 for residential projects. The Strategic Plan recognized the need for integration between energy efficiency and demand response to meet this goal, and defined initial guidance on areas for coordination for the California IOUs.

In 2010, SCE was the first utility to officially pilot the integration of demand response in commercial new construction as part of its IDSM portfolio. Supporting the infrastructure required for demand response at the point of new construction alleviates costs typically incurred in retrofits and reduces DR program costs. New building owners are also able to immediately enjoy the benefits of DR as soon as the building is occupied.

The goals of the DR IDSM Non-Residential New Construction Pilot are to:

- Facilitate IDSM new construction projects with enhanced building design and operating practices,
- Develop estimation tools for assessing savings from the incorporation of DR technologies or strategies, and
- Develop integrated best practices that can be applied to commercial new construction projects.

Achieving the Pilot's primary objective of integrating automated demand response-enabling technology into the existing SCE new construction incentive program meant combining two separate program delivery channels at SCE: Automated Demand Response (Auto-DR) and *Savings By Design*. Each of these efforts is briefly described below.

**Automated Demand Response**

Automated DR technology enables a customer's facility to execute a pre-programmed set of actions to reduce electric load after receiving a communication signal from the utility. SCE offers a financial technology incentive (TI) for existing buildings to offset the cost of technology and equipment needed to enable Automated DR. Incentives are also available to help offset the cost of developing a load shed strategy. As a condition of payment, a building owner then needs to enroll in one of several demand response program offerings. Verification of load shed is conducted during a two-hour test event. Incentives, based on the results from the test event, are paid at $300/kW of load shed, up to 100 percent of the project cost.

Customers who participated in the retrofit program prior to January 2013 were paid the full incentive at the time of the verification and test event. This strategy was modified in 2013 to a 60/40 split; the first payment (60 percent) was to be paid following the test event. The second payment (40 percent) would be paid one year after the test and is pro-rated, based on DR program participation over a 12-month period. The purpose of this change was to ensure that technology incentives actually resulted in DR program participation and demand reduction.

Many of the market channel partners for the TI program are Automated DR vendors. They help promote the program to customers, install the technology, and often develop the load shed strategy to meet the customer's needs.

**Savings By Design (SBD)**

*Savings By Design* is the California statewide new construction energy-efficiency program that has two tracks for participation, Whole Building Approach and Systems Approach. The ***Whole Building Approach*** (WBA) is geared toward more complex buildings that are early in the design phase, where energy modeling is used to optimize the interactive effects of various building systems. Incentives are determined by using a sliding scale that calculates the percentage of kWh savings when compared to Title 24 requirements, up to a cap of $150,000. For the WBA, design team incentives are offered in addition to bonus incentives for end-use monitoring and enhanced commissioning.

The ***Systems Approach*** (SA) is for less complex projects (or projects later in the design phase) and helps designers to optimize the energy efficiency of systems within a building. A flat incentive rate is provided for therms, kW and kWh savings.

Both approaches derive customer incentives based on *calculated* savings and are paid post-construction, following on-site verification of design changes or efficiency measure installations.

Market channel partners are architect and engineering firms. They help promote the program at the critical design stage and often conduct the energy-efficiency simulations, using an approved list of tools to estimate energy reduction.

SCE engaged Rouleau Consulting Group to conduct an interim assessment of the 2010 DR IDSM Non-Residential New Construction Pilot. The purpose of this assessment was to conduct a functional process evaluation of the lessons learned from the limited operations of this Pilot through August of 2013. The review documented the Pilot process, gauged progress to date, identified challenges to achieving the integration, and provided recommendations for further Pilot refinement. The assessment included interviews with utility staff, market stakeholders and other relevant entities as well as market research from secondary data sources (e.g., relevant reports, industry best practices, and existing program plans).

This paper will share some of the key findings from the Pilot assessment. Information will be presented in the following sections:

- Pilot Summary
- Strategic Approach
- Customer and Program Execution Challenges
- How Recent Events Impact the Integration Effort
- Case Study
- Program Improvements

## Pilot Summary

The core features of the Pilot Program included a building owner incentive of $300 per kW of verified load reduction, technical assistance to help develop a load shed plan, and an education and training course for the staff and market allies (including A&E firms and building contractors). Additional efforts taken by SCE to build a strong foundation for overall program integration included the cross-training of a key energy-efficiency employee (across SBD and DR) and working collaboratively within the company to market the program through SBD and key account representatives. SCE was also a flagship sponsor for the US Green Building Council's LEED Demand Response Partnership Program (DRPP), an effort to promote the adoption of the LEED DR Pilot credit by utility customers as well as conduct research and develop best practices in this area.

## Strategic Approach

The initial Pilot integration approach involved taking the incentive process from the retrofit Auto DR program and incorporating it into the existing *Savings By Design* model. The SBD and key account staff helped market the Auto DR feature to qualified SBD candidates. Interested customers would work with SCE to estimate the building's load shed potential

strategy early in the building design phase. SCE would help sponsor the load shed plan, either through funding a customer-elected engineering firm, providing an internal SBD engineering resource, or providing a third-party engineering firm that has a contractual relationship with SCE. Once the building was constructed, the equipment would be verified and a two-hour test event would be conducted to confirm the customer's estimated load reduction. A $300/kW incentive would be paid according to the retrofit program guidelines, either 100 percent upon verification or, beginning in 2013, 60 percent upon verification with the remaining 40 percent prorated after a year of DR participation.

The Pilot was primarily marketed by SBD reps as a special opportunity for SCE customers. Leads were also generated by key account reps and A&E firms. Figure 1 illustrates the building types noted as "leads" in the tracking database. From the inception of the Pilot to the time of the interim assessment, a total of 45 projects were identified as potential candidates. Of that number, 12 projects that were initially considered participants did not proceed, eight progressed towards a Pilot project, two cancelled and two projects made commitments to proceed. The remaining projects were still in the sales and project development cycle.

The three most common types of buildings tracked as opportunities are community colleges, offices and refrigerated warehouses/process facilities.

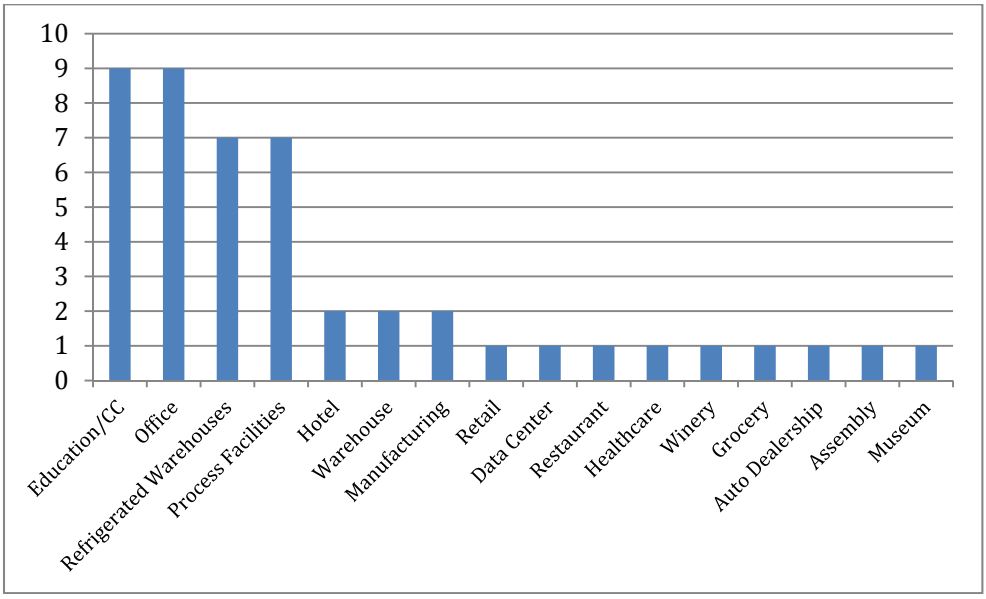


Figure 1. Pipeline of pilot opportunities by building type.

## Customer and Program Execution Challenges

Integrating an automated demand response component into a statewide energy-efficiency new construction program is challenging for various reasons. First, the two programs are separate in both theory and practice; they are two "silos" of operational procedures and financial regulatory accounting. There is also a steep learning curve by all parties to make the DR "sale" because DR is a complex business proposition. It is even more challenging to make the sale at the point of new construction, which in itself is complex, time-sensitive and has a long lead time.

Based on the activities conducted in the Pilot assessment, four key internal programming challenges were noted.

1. **Current program payout method does not fit well with new construction.** DR incentive programs are not designed to accommodate long periods between program enrollment and customers receiving their incentives, as most customers require repayment of their investment within a year. This may not work well in commercial new construction since the payout point is 2-4 years or longer. The 60/40 split would add another year on top of the construction time, which further reduces the impact of the incentive. In addition, basing the incentive payment on test verification (at the time of completion) can be unreliable and not representative of the estimated load potential based on an actual load profile, since the building may not be fully occupied.
2. **A need for reliable DR load shed estimation tools.** Most DR load shed assessment tools are designed for use when there is a historical load profile. This is obviously not available when the building does not exist. Reliable assessment tools are needed to help provide the building owners with an estimate of the load shed potential and to assess the investment and potential payout.
3. **Inconsistency in funding sources and requirements.** Funding for energy-efficiency programs and DR programs often comes from separate sources. Restrictions in California prohibit energy-efficiency dollars from being used to support DR, and co-mingling of funds may keep incentives separated. In addition, a process similar to the one used by SBD would need to be put in place to commit funds for future payouts.
4. **Competition with the retrofit program.** Feedback from potential Pilot candidates indicated that they were willing to wait until after the construction is completed to participate in the program. They would still be able to receive $300 per kW to retrofit the energy management system through the retrofit Auto-DR efforts, thus working with actual load profile data as opposed to load shed assumptions. This would also eliminate having to address DR during the high-pressure time of construction.

Other common concerns that were raised by the Pilot and SBD staff include:

- **Minimal load shed potential.** A perception exists that there is minimal load shed potential in SBD buildings that are, by definition, already more efficient then code and that addressing Auto DR at the time of new construction might not be appropriate or cost-effective.
- **Need for early involvement.** Part of the success of SBD is that it relies heavily on the A&E channel partners to engage building owners ion EE opportunities at that critical juncture, early in the design phase. To do the same for Auto DR, the Pilot will have to engage the A&E firms in the topic of DR which they may not be familiar with, offer training and possibly provide design team incentives, encouraging them to discuss the opportunity with their clients and offer the service of calculating the load shed plan.
- **Estimating energy use for unoccupied tenant space is difficult.** The owner may be building a shell for a tenant build-out later, making demand reduction estimates more difficult without advance knowledge of the building type and calling into question how DR will be addressed with tenants.

- **A need to understand the customer process.** One size of Auto DR does not fit all, making it difficult to sell DR at the time of building design. Ideally, the SBD representative should be well informed about the customer's energy use and how dropping load might impact what is important to the customer. This tends to be a high-touch sale, requiring skill and understanding of the customer's needs and concerns.

Aside from these internal challenges, understanding the customer's concerns and motivations can help determine the Pilot's strategic direction. Through in-person discussions with SCE staff and field delivery personnel, conversations with the Pilot management team and stakeholders, and a review of literature that includes LBNL's January 2010 report (Goldman 2010), key barriers and benefits have been identified and presented below in Table 1. Understanding these motivations and reservations can help customize the Pilot to promote the benefits and overcome the reservations.

Table 1. Summary of customer-perceived benefits and challenges/barriers

| Benefits | Challenges/Barriers |
|---|---|
| ✓ Minimal incremental cost for the inclusion of Auto-DR equipment at new construction<br>✓ Financial incentives and technical assistance<br>✓ LEED DR credit of 2 points (if applicable)<br>✓ A more advanced EMS for increased building functional optimization<br>✓ Immediate participation in utility DR programs<br>✓ Added conservation strategy<br>✓ Leveraging of utility assistance for 2013 code Auto DR equipment compliance | ✓ Perceived loss of building control; DR events will disrupt building operations<br>✓ Customer benefits not understood<br>✓ Perception that the utility benefits from DR more than the customer<br>✓ Perception that DR is not worth the hassle<br>✓ Lack of faith in the future of DR programs since utility programs change or are discontinued<br>✓ DR programs are too complicated to understand<br>✓ Participation can wait until after the building is constructed |

## How Recent Events Impact the Integration Effort

Four noteworthy events will help gain additional customer interest and help boost uptake in Pilot participation.

1. The official adoption in July 2013 of the USGBC's Demand Response LEED credit.
2. Title 24 changes (effective July 1, 2014) requiring automated DR for lighting controls and recommending a similar approach for HVAC.
3. The inclusion of standardized communication protocols, such as OpenADR, in Title 24 for automated DR functionality and movement of the industry in that direction.

4. The eventual deployment of dynamic pricing tariffs such as Time of Use (TOU) and Critical Peak Pricing (CPP) for all non-residential customers

First, the official adoption of a ***LEED Demand Response Credit*** that took place in July 2013 (LEED v4) will most likely increase interest by customers who are seeking LEED certification, which is the case for many SBD projects. Where there is a demand response program available, the building owner can obtain 2 points by participating in an existing program and completing the following activities:

- Design a system with the capability for real-time, fully-automated DR based on external initiation by a DR Program Provider. Semi-automated DR may be utilized in practice.
- Enroll in a minimum one-year DR participation contractual commitment with a qualified DR program provider, with the intention of multiyear renewal, for at least 10 percent of the estimated peak electricity demand.
- Develop a comprehensive plan for meeting the contractual commitment during a Demand Response event.
- Include the DR processes in the scope of work for the commissioning authority, including participation in at least one full test of the DR plan.[1]

The LEED DR credit has meaningful synergies with the SCE IDSM Pilot program since the candidates must engage in the same activities that are important to the Pilot and provide supporting documentation. These requirements provide a solid tie-in to the Pilot effort and could be reflected in the Pilot's own set of program requirements, in part or in whole, to provide consistency and send a strong signal to the market. This also presents further opportunity for co-marketing and collaboration with USGBC as the Pilot moves forward.

The second event involves the 2014 changes in California's Title 24, requiring lighting and HVAC equipment to be Auto-DR capable (but not requiring connection). This is a significant leveraging point as now the two largest new construction measures will have some form of Auto DR capabilities. Educating customers about the new requirements and technology options would serve as a good foundation for discussing SCE's DR offerings. Testing whether incentives are still needed, assisting building owners in developing a DR strategy, and connectivity will be the logical next steps for the Pilot.

In addition, the requirements for standardization in communication protocols for automated demand response through protocols, such as OpenADR, will facilitate the incorporation of demand response-ready equipment in facilities. Standardized communication protocols facilitate and simplify the communication aspects that are critical for automated demand response functionality and success. This capability may be an important aspect to emphasize in a set of criteria for the Pilot effort. SCE's Auto-DR retrofit program currently requires OpenADR compliance.

Finally, as part of a statewide initiative designed to improve grid reliability, many business customers have been transitioned to Time of Use (TOU) rates during 2014. These rates provide a fixed schedule of energy prices during on-peak and off-peak periods for summer and

[1] US Green Building Council, LEED (Leadership in Energy and Environmental Design) Building Design and Construction: New Construction v4, Demand Response, 2014.

winter seasons, providing a price signal for customers to manage their energy costs by shifting their energy usage. This, in turn, reduces grid congestion during peak periods and reduces the strain on the grid during the peak summer season, In addition, Critical Peak Pricing (CPP) rates are an optional dynamic pricing alternative that provides a slight discount on energy prices in exchange for a voluntary reduction in peak energy usage that is requested on an as-needed basis. During the CPP event, energy prices are raised to a higher level, and customers who can reduce load during these specially dispatched events (up to 12 times a year) can reduce their costs overall. The implementation of Auto-DR technology in the building can greatly assist customers in responding to these events and help reduce their overall costs.

## Case Study

In 2012, this "two-program" approach was applied to a new construction project that was screened through the *Savings by Design* program and determined to be a good candidate for the Pilot. The owner of the Shore Hotel, a 164-room luxury hotel certified as LEED Gold, was highly motivated to incorporate "green" design into the facility. When the benefits of automated demand response were discussed as part of the Pilot, the owner was further interested in the concept of paying less money for more benefits. The major benefits included reduced fuel costs during non-peak versus peak time, and the increased functionality of the energy management system.

Due to the delay in rolling out the Pilot, conversations with the owner about Auto DR took place during the construction phase rather then the earlier design phase. Incorporating Auto DR at this later stage required additional wiring for DR systems that could have been avoided if it had been designed into the building plans. The engineering analysis estimated a reserved load reduction of 57 kW. Table 2 lists the demand response measures that were defined for the facility. This estimate was based on a combination of spreadsheet calculations and EnergyPro modeling.

Table 1. Demand response measures implemented in case study

| Measure | Estimated Load Shed |
|---|---|
| Reset chilled water supply temperatures to 54°F from 44°F | 25 kW |
| Increase the CO setting of the parking fans | 15 kW |
| Turn off parking non-emergency lighting | 9 kW |
| Close chilled water valves to public corridors to ventilate only as oppose to cool and ventilate | 1 kW |
| Controlled lighting to be dimmed by 60% | 7 kW |
| **TOTAL** | **57 kW** |

A two-hour test event, in accordance with the Auto DR incentives program procedures, was conducted to verify the estimated load reduction. The results showed a total load reduction of 27.3 kW, a 52 percent decrease compared to the original estimate. Based on a review of the original engineering analysis and the construction timelines for this project, Rouleau Consulting Group concluded that the discrepancy between the engineering estimate and the test can be attributed to two factors: overestimation of the load shed opportunity across all measures

(resetting the chilled water supply temperature and increasing the CO setting of the parking fans were the largest load shed estimates) and uncertainty regarding the performance of the DR measures during the post-installation test. The latter point about actual performance of the DR measures during the test event could be attributed to uncertainty about whether retail and food service facilities in the hotel were operational at the time of the test event.

This case study illustrates the importance of incorporating DR early in the design phase and the need for accurate and transparent load shed estimation tools in new construction. With the lack of historical building performance data it is important to gauge how accurate load shed estimates can be made on a measure-by-measure basis. This case study also called into question whether the retrofit approach for paying incentives (on a test event) would work in the new construction environment, where the building may experience delays in full occupancy for many months.

## Program Improvements

In 2014, some of the critical Pilot execution issues center around bolstering the Pilot infrastructure, working more collaboratively across divisions with market partners, and adjusting the Pilot design and incentive structure to be more in line with the unique aspects of a new construction project. Some of these are detailed below:

### Program Incentive

The current DR measure incentive structure, based on a retrofit model of existing buildings, does not work well for a new construction scenario. The incentive amount, testing and payout strategy are based on assumptions that the building is in full use and that estimates are based on known load. One possible method to rectify this situation is to simplify and adjust the current building owner's incentive amount and structure, aligning this with the logistics and timing of the SBD Program. This could be done by paying the incentive on the *estimated* kW load shed reduction and paying the full incentive amount (versus the 60/40 split) upon building completion and verification, similar to the SBD approach. The SBD energy-efficiency incentives process commits incentive dollars in one year (when the customer signs on to the program) for payment in some future year (when the construction is complete and verified). To align with this procedure, the Auto DR incentive structure will also have to account for similar long-term commitments.

Furthermore**,** once there is a better understanding of how the 2014 Title 24 changes will impact the standard installation of Auto DR technology into new buildings, the need for owner incentives should be revisited. And, finally, offering design team incentives that would help engage market allies and create a reimbursement mechanism for load shed calculation services should be considered as discussed further below.

### Technical Assistance

Continuing to provide technical assistance for the development of the load shed strategy plan is critical to integration. This would offset the customer's having to incur the cost of the load shed strategy, which can be an expensive endeavor. This assistance may be needed initially, when design teams begin their involvement. In this instance, the goal would be to enhance the

capability of the A&E firm to conduct the DR load shed analysis on behalf of its clients. This is similar to the evolution of energy-efficiency modeling services now offered by the A&E firms; initially, very few firms offered this service and now the vast majority of them have staff members who can provide this service for the client.

### Program Tools

In order to base the incentive on a load shed estimate, and have confidence when talking with building owners about potential DR opportunities, there is a need for consistent and transparent tools. While there are a number of modeling tools and calculators for energy-efficiency measures, there is a lack of similar tools for demand response. Lawrence Berkeley National Laboratory (LBNL) has developed the Demand Response Quick Assessment Tool (DRQAT), which has been created from the EnergyPlus platform and has the potential to help derive load estimates consistently across projects. At this time, the DRQAT is still being tested and is only available for a few market sectors (office and retail buildings), so there is a need for the development and testing of other tools as well.

### Engaging Market Channels

Introducing DR early in the design phase of the project is critical to influencing the building design and equipment selection. Toward this end, SCE could test a design team incentive for projects that fall under the SBD Whole Building Approach in return for bringing building owners on board and calculating estimated load shed. This is similar to how A&E firms are currently compensated for their involvement in SBD. To create this type of incentive, training and education efforts would be required. Sustainability consultants may also be valuable in influencing building owners; partnering opportunities with this group should be explored further.

## Conclusions

The Pilot effort by SCE demonstrated that leadership at the tactical level is necessary to implement policy change. It has also explored the dynamic nature of this effort in the "real world" and the need to make adjustments along the way as lessons are learned. Additionally, SCE is committed to meeting the state goal of Zero Net Energy (ZNE) by 2030 for all commercial new construction. Integrating demand response into new construction is a natural progression in that direction.

In January of 2014, SCE transferred program management of the Pilot to a new organization designed to develop new programs, and launch them into the traditional portfolios for energy efficiency and demand response. The Pilot is being redesigned with the input and lessons learned from the mid-term assessment, and will be considered for future program designs in the next round of energy-efficiency and demand response program applications. For 2014, SCE will limit the Pilot to a smaller number of participants to be chosen from a strategically targeted set of market sectors. This will help manage the budget, and customer expectations as well, maximizing the learning process across a number of market sectors and building types. From this group, case studies will be developed to emphasize success stories and test the appropriate tools to help facilitate the accurate identification of DR opportunities.

This year will be an important time to continue the testing of IDSM marketing and engagement strategies for new construction, as well as taking advantage of LEED and Title 24 changes related to automated demand response. The future for integration looks very promising for the building industry as a result of this Pilot, and the leadership of others committed to this vision. It appears that demand response and energy efficiency could be committed to each other for the long term.

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