

Energy Efficiency and Automated Demand Response Program Integration: Time for a Paradigm Shift

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ABSTRACT

The practice of Integrated Demand Side Management (IDSM), closely coordinating multiple demand side resources, can offer a more forward-thinking, smarter approach to building energy management, helping customers to maximize cost-effective savings and controls opportunities. While IDSM has been frequently discussed, many utilities are now pursuing innovative approaches to program design that allows for enhanced coordination among energy efficiency (EE) and Demand Response (DR) programs. This paper highlights opportunities, challenges, and lessons learned in implementing the IDSM aspect of the Pacific Gas and Electric (PG&E) Company's Automated Demand Response (ADR) Program that can be translated to future IDSM utility programs across the country.

As peak demand pricing structures become commonplace, customers stand to benefit significantly from increased controls in their facilities, allowing them to curb load when it's most expensive. Coupling a DR controls enhancement with an EE measure has the added benefits of (1) making otherwise costly controls, more cost-effective, (2) catering to capital budget time-horizons, and (3) potentially reducing administration complexities associated with separate projects. Unfortunately, barriers such as segregated incentive structures, and unaligned program goals for long term demand reductions versus demand flexibility, persist. The ADR program explored ways to improve program design and overcome these barriers including separate funding mechanisms for IDSM projects, streamlining measures, and facilitating trade ally, customer, and utility program coordination. This paper evaluates the efficacy of these methods and highlights the importance of integrating EE and DR into one incentive program instead of matching an EE program with a DR program.

Introduction

Integrated Demand Side Management (IDSM) refers to the concept of integrating demand side (DSM) resources such as energy efficiency (EE), energy conservation, demand response (DR), advanced metering, and distributed energy resources such as renewables, distributed generation (DG), and storage. IDSM utility programs promote at least two of these resources instead of traditional utility programs which focus on only one resource at a time, which results in many missed opportunities for greater energy management.

Examples of IDSM Programs

While most utilities across the country are beginning to learn about the benefits of IDSM projects, only a few have moved forward with deploying IDSM programs. There are at least two other utilities besides PG&E that have designed IDSM programs that can also help to guide the

design of future IDSM programs. The first is a pilot for the commercial sector by Southern California Edison and the second is a program targeting the residential sector developed by NV Energy.

Southern California Edison: Upstream HVAC and ADR Pilot

Southern California Edison (SCE) is conducting an upstream incentive pilot during 2013-2014 that integrates automated demand responsive controls with the sale of high efficiency heating, ventilation, and air conditioning equipment. In an upstream program, incentives are provided to equipment suppliers such as HVAC distributors rather than “downstream” end user customers. While upstream incentive programs are not new, the authors are not aware of previous applications to ADR. The pilot will operate as a part of SCE’s current upstream HVAC efficiency program for commercial end use customers. Thus, the pilot is also an IDSM program, since it simultaneously incents energy efficiency and ADR to promote market adoption of qualifying HVAC equipment with ADR controls equipment. Results are pending conclusion of the pilot at the end of 2014. Key activities of the pilot include:

- Working with existing upstream HVAC distributors and manufacturers to increase the technology availability of ADR-capable, high efficiency HVAC equipment: Qualifying HVAC equipment consists of unitary air conditioners, variable refrigerant flow (VRF) systems, and chiller systems.
- Providing selected HVAC distributors and contractors with an upfront incentive for installing ADR-enabled HVAC equipment with pre-programmed DR strategies and configured to receive DR event signals from SCE. This incentive is layered on top of the incentive participants receive from selling energy efficient HVAC equipment;
- Providing HVAC distributors and contractor participants with a bonus incentive payment for successfully enrolling the SCE customer in a qualifying DR program;
- Providing information, tools, and training on benefits of DR and ADR to upstream market actors;
- Testing multiple strategies for end user customer engagement and DR program enrollment by distributors and other market actors.

NV Energy: mPowered

Another example of other utilities pursuing an IDSM rebate program includes NV Energy’s deployment of an integrated energy management program that combines demand response and energy efficiency for southern Nevada residential customers. The program includes free installation of a no-cost intelligent thermostat and a free subscription to the EcoFactor energy optimization service. In addition to energy benefits, the customer benefits by having access to an online control panel to customize HVAC schedules, adjust temperature settings and view energy savings reports from any computer or smartphone (NV Energy).

Residential participants are required to have broadband internet and central air conditioning. The energy efficiency savings are generated from the energy optimization service that adapts the HVAC system based on specific characteristics of a customer’s home including outside weather conditions, current temperature comfort settings and thermal properties of the home. In exchange for the energy efficiency savings, participants are required to participate in DR events, though opt outs are allowed. After the completion of one full DR season in 2013, NV

Energy realized both EE and DR savings and based on consumer surveys found a high level of satisfaction among their customers. By targeting one specific measure, HVAC, in a targeted sector, residential, NV Energy found success in an IDSM program (NV Energy).

Background on IDSM Programs in California

In California three major factors are driving more IDSM programs for electric utilities. First, in 2003, California's principal energy agencies – the California Energy Commission, the California Public Utilities Commission, and the California Consumer Power and Conservation Financing Authority - adopted the loading order to guide energy decisions. The loading order ensures that that energy efficiency (EE), demand response (DR), renewable, and distributed generations (DG) are considered, in that order, before building new power plants (CEC 2005). According to the 2003 Energy Action Plan, the intent of the loading order was to develop and operate California's electricity system in the best, long-term interest of consumers, ratepayers, and taxpayers. From an environmental and economic stand point, it is much cleaner and cheaper to reduce energy consumption by using energy more efficiently and consciously than to build more power plants (State of CA 2003). For this reason, the investor-owned utilities which include PG&E were instructed to administer and implement the loading order.

The second major motivating factor for including an integrated EE and DR option in the PG&E ADR program is the many benefits to the customer. One benefit is that IDSM projects have been found to be able to produce multiple benefits to the customer from one project where it would normally take multiple projects to achieve. The customer is able to realize energy efficiency and demand reduction benefits at the same time to lower their monthly electricity bill. With IDSM projects the customer receives demand management and also control benefits. By completing both the EE and ADR project at the same time, the customer can experience reduced costs and administration complexities normally associated with separate projects. Another benefit is this approach caters to capital budget time-horizons such that customers can plan and budget for a large IDSM project in their capital budget instead of having to fit in multiple unplanned smaller project which are harder to fund. This specific type of IDSM project which integrates EE and ADR leverages the rebates available for energy efficiency upgrades in combination with incentives available for Auto-DR equipment to help make costly controls more cost-effective for customers. The customer can realize the benefits of the additional control during a DR event but also year round. These many benefits of IDSM projects positively impact the customer which is a large priority for PG&E.

The third and final factor behind promoting energy efficiency and automated demand response in one program is to support California's zero net energy goals. The California Energy Efficiency Strategic Plan states that, "50 percent of existing buildings will be retrofit to zero net energy buildings by 2030 through achievement of deep levels of energy efficiency and clean distributed generation" (ZNE Stakeholders 2011, 18). Instead of only realizing demand response resources from the PG&E ADR Program, by also including an IDSM focused portion, the ADR program will secure energy efficiency and demand response resources with the energy efficiency savings promoting California's zero net energy goal.

PG&E ADR Incentive Program

The California investor owned utility Pacific Gas & Electric Company (PG&E) deployed a 2012-2014 Automated demand response (ADR) Program that included a separate incentive

budget specifically for projects that integrated energy efficiency and automated demand response technologies. The IDSM portion of the PG&E ADR Program was created to support California's loading order for electricity resources and promote and demonstrate customer benefits of IDSM projects. In deploying this IDSM portion, the PG&E ADR Team encountered challenges and obstacles that can be leveraged by others developing an IDSM program.

The PG&E ADR Incentive Program provides incentives and technical assistance to commercial customers investing in energy management equipment and controls that enable automated demand response. The ADR Program is implemented by Energy Solutions and ASWB Engineering on PG&E's behalf. Customers who sign up to participate in an Auto-DR Program receive automated DR event signals from PG&E. These signals are sought out by a technical solution on site that is linking and initiating pre-programmed DR strategies at the customers building. The ADR Program offers an incentive of \$200/kW and two higher incentive tiers for advanced technology HVAC and lighting to cover the cost of equipment used to automate a buildings ability to respond in a DR event. The ADR Program utilizes a split incentive structure to further motivate customers to not only install but utilize the installed controls. The customer receives 60% of the approved incentive value once the equipment is installed, commissioned and verified. The remaining 40% payment is performance based and is paid after the completion of one full DR season and is pro-rated based on the customer's performance over the DR season as compared to their committed kW load shed value (ES 2013).

In addition to monetary incentives the ADR Program also provides technical assistance. The ADR Technical Team is available to complete onsite screening audits and vendor audit report reviews to determine a customer's kW load shed potential. This includes a technical review of a potential customer's current electricity usage and load curve as well as a calculation of the customer's most recent average summer season baseline. Following installation and commissioning of the Auto-DR equipment, the ADR Technical Team completes a test simulating a DR event to ensure that the building can automatically shed load as compared to the expectations set with the customer by their vendor. It was found to be helpful to the customer to have an outside party assist with verifying that the equipment is installed as expected and operational.

IDSM Policies

The PG&E ADR Program set aside about 26% of the total incentive budget for IDSM projects that integrate both EE and ADR. To support California's loading order for electric resources, IDSM projects are required to complete and have verified by the utility their energy efficiency measures before the ADR incentive is paid. Also, since PG&E EE rebate applications are able to cover up to 50% of the eligible EE project cost and ADR projects are able to cover 100% of eligible ADR project costs, the EE incentives are applied first and then ADR incentives are applied to preserve the loading order. This ability to layer incentives allows for more cost-effective integrated projects.

To be eligible for the IDSM funding, the EE measure selected by the applicant had to meet the eligibility requirement for a PG&E EE rebate. This allowed the ADR program to leverage the existing structure in place for EE verification instead of creating a new and separate verification process (ES 2013).

To further leverage the existing EE incentive and rebate process at PG&E, the ADR Program allowed an IDSM application to apply for a deemed rebate, customized retrofit

incentive or third party incentive. A deemed EE rebate is a standardized rebate that applies to a specific piece of equipment with a set rebate amount. A customized retrofit EE incentive is targeted towards unique projects that usually combine multiple EE measures. These projects complete a customized EE calculation based on the specific characteristics of the building and proposed EE measures. The final type of eligible EE incentive is the PG&E Third Party Programs that are managed by an implementation specialist and generally target a specific hard to reach sector. These programs also complete customized EE calculations as the projects are complex and can involve multiple measures. Although all three pathways are eligible as a part of an IDSM project for ADR incentives, the deemed rebate has the shortest processing time as compared to the customized and third party incentive programs.

IDSM projects follow an adjusted ADR application process to streamline and reduce processing time of these inherently more complex projects. The first step where an IDSM project is unique is that a description of the EE project must be included in the ADR audit report. This is to ensure that the EE measure is taken into account when calculating the kW baseline for the ADR measure. In some projects the EE measure is for a separate building system than the ADR measure which does not result in noticeable interactive effects in the baseline calculation. But if for example, the EE and the ADR measure are both targeting the HVAC building energy system, the kW load reduction from EE must be taken into consideration before calculating the potential ADR kW load shed.

Finally, to support program coordination, the ADR Technical Team is available to verify the installation of the EE and ADR measures when going on site to complete the load shed verification test. This was dependent on the two measures being completed on a similar timeline and assisted with speeding up the payment of both incentives in situations where the PG&E EE team was backlogged. By leveraging the ADR Technical Team some customers only had to work with one verification visit instead of having a technical staff visit from both the EE and ADR program.

PG&E ADR IDSM Program Challenges

Implementing the IDSM portion of PG&E's ADR Program encountered multiple challenges because at the core it was still focusing on coordinating between two essentially independent PG&E EE and DR incentive programs.

First, the ADR program rules and policies were developed independently from the existing EE programs. The design of the IDSM portion, furthermore, was limited to fit within the current ADR and EE program structures instead of having the flexibility to better integrate the EE and ADR in a single program process. The ADR program was rolled out separately from existing EE programs, so that attempts to better integrate the EE effort could not stray very far from the already existing program policies.

Another challenge encountered was that permanently reducing consumption through EE also reduces the available load for demand response. This increases the importance of coordinating facility audits between ADR and existing EE programs. Challenges included difficulty in accessing the necessary EE audit information so that adjustments can be made for DR load shed calculations. Additionally, attempts to integrate DR-specific audit elements required training of EE-audit engineers that was not pursued.

The tension caused by reduced DR potential resulting from efficiency projects causes many DR vendors to discourage aggressive implementation of energy efficiency measures at customer facilities in order to maximize ADR incentives they apply for. Alternatively, DR

vendors simply ignore or omit the permanent load reduction impacts from efficiency when estimating DR potential. While the PG&E ADR program fully supports the California loading order of implementing EE before DR, it does highlight the difficulties when DSM programs have different goals. The next challenge was therefore balancing the goals of the many different stakeholders: Customer, EE Program, EE Vendor, ADR Program, ADR Vendor, Utility and Utility Account Manager. While each stakeholder has multiple goals, including ensuring customer satisfaction, in general the largest motivating goal that was found per stakeholder is listed in Table 1 below and the outcome displays that few of the goals are aligned.

Table 1. Goals of IDSM project stakeholders

Stakeholder	Goal
Customer	Reduce electricity bill
EE Program	Claim largest possible energy (kWh) savings
EE Vendor	Install as many EE measures as possible to increase project installation revenue
ADR Program	Claim largest possible demand (kW) savings and facilitate IDSM projects
ADR Vendor	Install as many ADR measures as possible to increase project installation revenue
Utility	Support the customer to install EE and ADR
Utility Account Manager	Claim kWh towards personal EE goals

Due to this misalignment of stakeholder goals it was possible for one stakeholder to push their goals to the forefront depending on the situation and potentially lose sight of the larger goal that implementing an IDSM project would support all stakeholder goals. The misalignment of goals also highlighted that extra effort is needed to complete an IDSM project and was a reminder of the additional complexities of IDSM projects.

Finally, aligning the timing of EE and DR program application processes and conducting site verification following project installation presented a larger challenge than anticipated for the IDSM projects in the PG&E ADR Program. The energy efficiency projects could participate in one of three energy efficiency rebate programs outlined in the IDSM Policies section above: Deemed, Customized, or Third Party Programs. Each of these EE program application types took a varying amount of time from beginning to end. The deemed rebate application process took the shortest amount of time because the energy savings calculations had already been completed on a per unit basis so the customer only needed to provide documentation supporting the purchase of the unit and the rebate could move forward. In these situations the EE and ADR applications rarely held up the other. For a customized and third party incentive each project had to have an energy efficiency calculation completed that was specific to that location and project parameters. The customized calculations took multiple weeks to complete the review and approval process. Also, since the EE programs were not operated by the same staff as the ADR Program the timing of the audit reviews and verification visits varied greatly depending on the current pipeline of the EE program. Since the customer could not be paid their ADR incentive until the EE project was verified, there were customers that had to wait weeks and sometimes months before receiving their ADR incentive as they were waiting for the EE project to be reviewed and verified.

Lessons Learned

Due to the challenges encountered the PG&E ADR Program is still completing outreach for potential IDSM projects and has not yet reserved all available IDSM incentive dollars. While the IDSM portion of the program was not a complete success the program team has realized three main lessons learned that can be applied to other utility programs across the country and to other IDSM programs that integrate not just EE and ADR but even EE, ADR and DG or even renewables.

The biggest lesson that was found in many different aspects of implementing the IDSM portion of the ADR Program was that the current IDSM paradigm of taking an EE program and added it to an ADR Program needs to change because at the base was still two separate programs. The customer still needed to complete two separate applications, to learn and follow two different program processes, to communicate with many different stakeholders to complete the project and to receive two separate incentive checks. Having two different program implementers for the EE and the ADR can create conflict of goals and limit the ability to collaborate towards a common end goal. This additional complexity on top of the technical design of an IDSM project limited some projects from moving forward.

The second lesson learned is that in the current paradigm of adding two or more energy management programs together to create an IDSM program, the customer needs an unbiased champion. A major challenge found in the PG&E ADR Program was that with the many different stakeholders and stakeholder goals it became increasingly difficult for the customer to navigate the entire process on his or her own. The ADR Program was able to play this role of customer champion in many situations because of the program goal of implementing not just ADR but also IDSM projects. The customer champion had a general technical understanding of EE and ADR and could provide technical support to the customer regarding how the two types of measures could create synergies. The customer champion was able to facilitate communication between all the stakeholders when issues arose. During these negotiations, it was useful to have someone that fully understood the goals of each stakeholder to help work with each one to align the various goals. Ideally in the new paradigm where IDSM is a fully integrated type of program the customer champion would be the IDSM program implementer.

Finally, the last lesson learned is that the energy industry would benefit from more firms and utilities with experience in implementing IDSM projects. Many companies have focused on one specialty of the energy sector, EE, DR, renewables, but rarely are companies strong technically in multiple resources. Integrated audits have been one way to promote IDSM but in reviewing such audits as a part of this IDSM effort it was apparent the specialty of the company as the other aspects of the audit report was weaker. The ADR Team was able to play the role of customer champion because the team had experience with not only the technical and process side of the ADR Program but also had past experiences with the technical and process side of the many EE Programs. The regulatory entities in California have made it clear that the future of energy management will not be siloed in the EE, DR, DG, etc worlds but will instead be an integrated effort of all energy resources. The energy industry now needs to mobilize to be able to design IDSM programs and support these more complex IDSM projects that will likely become the standard.

Conclusion

IDSMS are proving to be a key factor in reducing energy consumption and helping to keep the environment clean for future generations in California and other states across the country. Utility energy management programs that combine multiple demand side resources create greater program efficiencies and provide more comprehensive energy management solutions to the customer. The benefits and concept of IDSMS are proving to be easier to understand than the successful implementation of an IDSMS project. PG&E included an IDSMS portion in the 2012-2014 ADR Program to begin to better understand potential barriers to a program that motivates not only ADR but also EE. One main lesson learned is that an IDSMS program should not only match a separate EE program with an ADR program but instead derive from a specific IDSMS program design from the beginning. This is the next step in the evolution of IDSMS programs, to create a program that incorporates multiple energy resources and measures so a customer can meet all of his or her energy management needs in one program. This is the paradigm shift that energy industry needs to complete to truly unlock the potential of IDSMS programs.

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