Integrated Demand Side Management Case Study Report

Final Report

Prepared for the California Public Utilities Commission

Submitted by Evergreen Economics

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1 Executive Summary

An examination of existing buildings for which owners have chosen to engage in energy efficiency, demand response, and distributed generation provides a fresh and useful perspective on California's goals to move toward greater integration of demand side management. Ultimately, how well customer-sited resources are integrated depends on what resources are presented to the customers, how well they understand them, how well they serve the customers' facility needs, and the overall financial incentives.

Initially, California Public Utilities Commission (CPUC) staff and Evergreen Economics provided detailed descriptions of what would constitute the kind of project that could serve as a nonresidential integrated demand side management (IDSM) retrofit case study. A memo outlining these characteristics was submitted to the California Investor-Owned Utilities (IOUs) in the form of a data request, which can be found in Appendix A of this report. In response to this data request, the IOUs nominated 24 customer locations and provided data describing the facility, the customer, the projects, and the programs that contributed financial incentives and/or other support to the customer relevant to the project. Evergreen Economics staff reviewed the details of each project and provided a summary memorandum to the IDSM Project Coordination Group (PCG). Following this memorandum, Evergreen submitted a data collection and analysis plan that stipulated the facilities selected for case study, the planned analyses, and the requisite types of data sought for each. This case study data collection and analysis plan, as well as utility and customer interview guides, can be found in Appendix B of this report.

1.1 Case Study Findings

We conducted three case studies and discovered the following common project themes:

1. All three organizations had an interest or public mandate to minimize operating expenses.
    a. Both Clovis Unified School District (CUSD) and Irvine Unified School District (IUSD) were under budget pressure in 2008/2009 and needed to reduce operating costs.
    b. The recession of 2008 as well as a general mandate by the constituents of the City of Hawthorne created pressure to maintain efficient building operations with minimized costs.
2. Although the IDSM projects considered for each case study were implemented post-2010, all three organizations had already taken their first energy conservation measures in 2008.

    a. The 2008 actions were taken in response to a combination of AB 32 legislation,[1] internal budget pressures, and a variety of support services and programs to promote energy conservation, as well as economic recovery stimulation efforts such as the American Reinvestment and Recovery Act (ARRA).
3. All three organizations had made a formal commitment to energy conservation and sustainability during the 2008/2009 period, as evidenced by:
    a. A formalized energy policy, or in the case of the City of Hawthorne, a Climate Action Plan.
    b. A permanent assigned energy manager that took direct responsibility for utility costs, energy conservation efforts, and energy-related investments.
    c. Energy audits completed by all three organizations for all of their facilities in anticipation of future opportunities to make energy improvements.
4. Each organization also had regular interactions with non-profits, utilities, and government programs that supported and encouraged energy conservation in a variety of ways.
    a. The City of Hawthorne joined The South Bay Council of Governments and received support from the International Council for Local Environmental Initiatives (ICLEI) to develop its Climate Action Plan. The City also worked closely with Southern California Edison (SCE) to participate in its Energy Leader Partnership program.
    b. CUSD worked with the Federal Energy Education program and Pacific Gas and Electric Company (PG&E) in 2008/2009. Through these organizations, the District received support for developing its initial energy policies and monitoring plans, and for making operational and equipment changes through the Retrocommissioning program in 2008. Eventually, they also received support from PG&E through the Continuous Energy Improvement program, which assisted in developing long term energy improvement plans.
    c. IUSD worked with The Energy Coalition and SCE to learn about energy conservation and to develop its initial formal energy conservation plans in 2008/2009.
5. All three organizations had an active relationship with their utility, either through an account manager or an energy-related program, or both.

[1] Assembly Bill 32 (AB 32) is the California Global Warming Solutions Act of 2006. It requires by law a substantial reduction of greenhouse gas (GHG) emissions, such that the state achieves 1990 levels of GHG by 2020. AB 32 was the first program in the country to take a comprehensive, long-term approach to addressing climate change, and its design reflects the state's desire to improve the environment while maintaining a robust economy.

6. Both school districts—IUSD and CUSD—viewed energy conservation as an asset to their educational curricula, and used their energy conservation strategies and renewable energy installations as platforms and opportunities for expanding this area of their educational curricula.
7. Funding opportunities were presented to all three organizations that provided significant cost savings for energy improvements, such as ARRA, Proposition 39 funds, the California Solar Initiative (CSI) and a host of utility programs, including local government partnerships. In addition, Clovis County passed a bond measure—bond Measure A—in 2012 that provided funding for the District's facilities. The bond measure built on previously completed audits, and stipulated the selection of efficient energy-using equipment where these were an option. The bond measure included $25 million specifically for the installation of distributed generation. In the case of IUSD, it received capital assistance for its solar installation via a third party vendor, SunEdison. SunEdison is a solar installation company that was able to offer IUSD a power purchase agreement, by which the District would not have to pay any upfront cost, but could simply lock in a lower long-term electricity rate for power generated by the photovoltaic systems.

We believe that none of these factors were independent of the others, but that each facilitating component was in fact enabled by the others; together, they supported comprehensive energy retrofits. Moreover, the initial actions that were taken in 2008/2009 laid important groundwork from which the retrofits implemented post-2010 could take place. In particular, the funds offered by ARRA and Proposition 39 required the submission of detailed planning documents. Projects that were "shovel-ready" were more likely to be selected for funding. Thus, the previous planning and analysis work done as part of developing energy policies, the Climate Action Plan, and preparing material in support of bond Measure A, all lent themselves well to successful project funding applications.

It is less clear to us why the case study sites nominated by the utilities featured primarily publicly owned facilities. It may be worth considering this dynamic further to understand whether those happen to be the customer types utilities know the best (and thus are the ones they think of) or whether it had more to do with public entities having a greater direct responsibility to implement policies of AB 32, or perhaps whether public entities were responding to greater amounts of financial and program support from federal and state agencies, versus their private sector counterparts.

1.1.1 Key Facilitating Factors

For all three case studies, the implementing organizations had executed critical groundwork that positioned them well to leverage resources and opportunities that led to the IDSM projects. Three key elements of this groundwork are:

- Having an assigned permanent energy manager, responsible for planning and implementing energy conservation strategies and projects;
- A formal Energy Policy that stipulates specific strategies and goals, and builds in accountability and monitoring of progress toward those goals; and
- Completing Integrated Energy Audits (that include analysis of distributed generation opportunities).

These three key elements provided a strong organizational core from which support from various programs and funding opportunities could be leveraged. Each organization received assistance from utilities and non-profits to complete—or put into place—each of these core elements.

1.1.2 Implications for Achieving Integrated Demand Side Management

Utilities administer a variety of energy efficiency programs—some cross-cutting and some for specific customer sectors—as well as demand response and distributed generation programs. Internal integration appears to come in the form of communication within the utilities and presentation of the utility's services by the customer's account manager who serves as a one-stop shop. As such, customers with a dedicated account manager who take the initiative to present utility offerings in an integrated fashion probably receive a more holistic overview across the various energy resources versus unmanaged customers who face a wide array of program offerings across efficiency, demand response, and distributed generation. Nevertheless, programs are still internally distinct and operate in parallel rather than as integrated programs.

Furthermore, a full integration of demand side management activities would need to encompass coordination or alignment of incentives and resources provided to customers within and external to the utility-customer relationships. While that might be difficult with federal initiatives, such as ARRA, state-level policies and programs could be coordinated more closely.

In addition to multiple funding sources, opportunities for a fuller integration of demand side management opportunities are affected by a regulatory framework that operates with separate funding streams, different operational guidelines, and the utilities' limited flexibility to fund distributed generation programs. In contrast to energy efficiency and demand response, distributed generation does not fall primarily within the utility paradigm. External funding sources, such as federal and state grants, and a seemingly growing industry of solar developers, compete for the customer's attention on issues related to customer-sited power generation. As noted in our case studies, these external forces were influential in spurring large solar generation installations at the case study sites, while the efficiency and demand response activities were comparatively small.

Efforts to promote IDSM need to account for external forces such as third-party grants and market actors encouraging organizations to sponsor installation of distributed generation (mostly photovoltaic arrays). Private vendors are continuing to promote a variety of solar offerings—both customer owned and third party owned—and even venturing into energy storage. These factors complicate the integration of distributed generation with energy efficiency and demand response. Indeed, coordination across regulated and unregulated industries as a matter of policy may be difficult. An alternate approach to promoting integration is to ensure that rate-based incentives provide the proper signals to customers and third party market actors. Indeed, the seemingly disproportionate ratio of investment dollars allocated to solar generation over investments in efficiency or load-shifting at our case study sites was marked and warrants more investigation. It is important to note that there is real progress being made in the realm of rate-based incentives. In particular, in 2015 PG&E began offering its "Solar Choice Program", which offers customers the option of purchasing solar power without owning a photovoltaic system or housing one behind the meter. Solar Choice is early in its development, but its structure has the potential to support a great deal more variety and flexibility for customers to select across different bundles of demand side management options.

Utilities were much more likely to nominate publicly owned and oriented buildings than privately held ones. Due to limitations of the sample and study approach,[2] it remains unclear whether opportunities are simply greater at public facilities than at private ones, or if there are other forces at work. The issue warrants further attention, in particular to discern the characteristics that distinguish public and private sector managed buildings and affect patterns and pathways that lead to IDSM retrofits, and related resource needs.

Customers took actions to retrofit their buildings as a way to address their facilities' needs. Although the integration of demand side management may be a priority of California policymakers, facility managers think primarily in terms of building functions, costs, and project opportunities. In this context, projects happen if they make sense, either because they serve a building need, demonstrably reduce operating costs, or the associated program incentive is highly attractive on its own.

The demand side management programs utilized in retrofit projects highlighted in this report underscore the typical delivery mechanisms for integrated offerings. Typically, IDSM offerings are not delivered via programs that combine resources, but by human resources that support the intelligent combining of programs. IOU representatives present their offerings in a comprehensive, integrated fashion to communicate options and built-in incentives to the customers. For the PG&E-based case study, the utility customer relationship manager serves as a single point of contact to assist program participation across all demand side management options. For the SCE-based case study, the Energy

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[2] See Section 3.1 for related discussion of Study Limitations.

Leader Partnership and the South Bay Council of Governments coordinated service to offer a strategic approach to the customer that spanned demand side management resources.

Nevertheless, there are strong program drivers leading customers to take action outside the paradigm of the utility-customer relationship. External incentives to install distributed generation seem possibly misaligned with an IDSM policy. Further consideration is needed on how external non-utility market actors and funding sources drive customer behavior and what incentives utility rates for net metering provide to encourage IDSM in line with the California loading order.

2 Introduction and Background

This report highlights three case studies Evergreen Economics conducted to help inform a collective understanding of how demand side management (DSM) activities are currently integrated through actual building retrofits by utility customers, our thinking about how DSM efforts may benefit from further integration, and how that might realistically be implemented. The case studies are part of the 2013-2014 EM&V Research planned under the Integrated Demand Side Management (IDSM) Research Roadmap.

For this exploration, we looked at the process by which energy efficiency, demand response, and distributed generation measures are coordinated and integrated in a real-world setting. We focused on understanding the implications of integration for the customer and utility program decision-makers, and strived to develop these case studies to provide insight on these issues and highlight gaps and unresolved questions.

The case studies were chosen from a set of buildings nominated by Southern California Edison (SCE), Pacific Gas and Electric Company (PG&E), and San Diego Gas & Electric (SDG&E). To be considered, the utility's recommended customer needed to have conducted a retrofit at a single building within a two-year timespan after January of 2010 that included the following elements:

- Energy efficiency improvements;
- Grid-connected, behind-the-meter, renewable distributed generation; and
- Enrollment in a demand response program or active management of peak demand using monitoring and control equipment, permanent load shifting, or energy storage.[3]

Furthermore, we required that the sites have less than 200 kilowatts of annual peak demand—limiting case study sites to small and medium-sized facilities—and we requested that the customer be willing to 1) participate in the case study process, 2) share costs, expected benefits, realized benefits, and usage information, and 3) discuss the decision-making process and outcomes.

The utilities nominated 24 buildings at nine facilities (one utility nominated 16 different buildings owned by the same customer). Although we selected only three buildings for case studies, the nature of the nominated buildings is instructive in its own right. A few of the commonalities among the nominated facilities include:

[3] However, we ultimately selected one case study site that did not participate in demand response activities. As noted in this report, that customer's utility limits the demand response offerings available to customers with net metering. We chose this site for a case study, in part because of the utility-imposed limitations on demand response program eligibility and the reduced financial incentives for participation in demand response.

- All but one of the nominated buildings were publicly owned. Eighteen were school district buildings, four were managed by municipal government or similar public entities, and one was a community college. Only one nominated building was privately owned.
- Most of the buildings participated in the air conditioner cycling program as their engagement with demand response.
- For all of the nominated buildings, the solar installations were substantially larger in scale than energy efficiency retrofits, from an investment and generation perspective. The solar installations have median system capacities in the 200 to 300 kW range (producing in the range of about 290,000 kWh to 435,000 kWh), while the median estimated annual energy savings for energy efficiency retrofits were in the 30,000 to 50,000 kWh range. At these values, the annual electricity generation is about ten times the energy savings achieved through efficiency.

3 Case Studies

We studied three facilities that had recently implemented retrofit projects and that fit our case study criteria. We explored two of these projects in detail and examined the third project with a broader view.[4] In this section, we describe all three of these projects and include details about the energy-related upgrades, installations, and demand response activities at each of the buildings. For the two more detailed case studies, we also present background on the facilities, describe why the decisions were made to retrofit the facilities, discuss the influence of utility and non-utility factors, and share observations about the degree to which the projects were integrated. Finally, we discuss the implications of the case studies on efforts to promote an integrated approach to adoption of demand side management measures.

3.1 Methodology and Limitations

The case studies are based on a review of relevant utility data and interviews with people directly involved in each of the projects. The data we reviewed include utility program records of facility energy consumption and billing history, program applications and tracking data, and other project documentation. Interviews were conducted with the utility account representative involved with each project, the key decision-maker(s) in the project sponsors' organizations, and third parties that support the implementation of retrofits and incentive programs. As applicable, we also interviewed the utilities' evaluation staff and program staff.

The descriptions of the projects provide the basic context from which we delve deeper into the various dynamics at play when buildings undergo changes that affect their energy efficiency, peak load, and generating capacity—in other words, renovations that look like integrated demand side management (IDSM). Understanding how these projects came to be—including the initial needs addressed by the project, the information sources used, and drivers behind the choices made—provides insight into the degree to which IDSM does, does not, and could manifest itself in building retrofits.

Readers should note that the case studies are qualitative in nature. The descriptions and discussion below are intended to bring to light opportunities and challenges encountered by customers and program staff in the application of IDSM concepts to non-residential building improvements. We explore project drivers, funding sources, program participation, and the roles of utility representatives and third parties, as they relate to project composition and timing. Ultimately, however, the case studies are based on just a small number of examples among a very diverse population of buildings and decision-makers. While illustrative and informative, the insights from these case studies cannot be extrapolated in a direct way to other populations of non-residential buildings. Instead,

[4] Analysis was limited by access to data and information.

they offer a useful first step on a longer learning path to a firm understanding of non-residential IDSM adoption behaviors.

3.2 Project Details

Our retrofit project case studies are comprised of three sites:

- Mountain View Elementary School, a public elementary school in the Central Valley that is served by Pacific Gas and Electric Company (PG&E);
- A municipality-owned community-assembly building in Los Angeles County that is served by Southern California Edison (SCE); and
- A building owned and used by the Maintenance & Operations Department of a school district in Orange County that is also served by SCE.

These three buildings were renovated between 2010 and 2014; the projects encompassed energy efficiency improvements, participation in demand response rates, and the installation of photovoltaic generation.

3.2.1 Case Study 1: Mountain View Elementary[5]

The first case study site is located in California's Central Valley, in PG&E's service territory. The retrofit project was implemented at Mountain View Elementary, the main buildings of which were first constructed in 1990. The school is in the Clovis Unified School District.

About Clovis Unified School District

Clovis Unified School District (CUSD) is a large and diverse suburban school district serving the Central Valley communities of Fresno and Clovis.[6] The District's schools serve a student population of more than 40,500 students who come from a geographic area covering approximately 198 square miles (510 km^2). CUSD has 32 elementary schools, five intermediate schools, five high schools, four alternative schools, one adult school, one online school, the Center for Advanced Research and Technology (CART), and one outdoor and environmental education school. CUSD manages over 4.5 million square feet of conditioned space, operates 11 swimming pools, and maintains numerous stadiums, sports fields, and play areas on its 1,220 acres.

Clovis Unified School District Energy Policy

CUSD is very dedicated to its energy management and facilities management activities. The District goals direct each facility to be a valuable resource both for the students and

[5] http://cusd.wpengine.com/wp-content/uploads/2015/06/Mountain-View-Elementary-School.pdf
[6] https://lucidconnects.com/company/press-center/students-in-two-california-school-districts-reduce-electricity-consumption-by-18-percent-and-save-over-16000-dollars-during-three-week-competitions

for the community at large. CUSD posts information about its approach to energy management on its website,[7] stating that it "…takes a pro-active approach to managing energy use …in order to be a good steward of both its financial resources and the world's environment." In an effort to achieve this goal, CUSD launched an energy conservation program in 2008 and was successful in decreasing energy consumption for the District by 19 percent, allowing it to expand facilities by 1,000,000 square feet while keeping total energy bills flat. The buildings in the District get used for a variety of community purposes beyond education, such as for meeting space for local groups and for sporting events such as USA Swimming's regional championships.

The 2008/2009 retrofits were implemented with support from the National Energy Education programs, a program offering support and incentives for schools to improve the efficiency of their facilities and provide examples and education for the community.

According to CUSD's website, the 19 percent reduction in energy consumption equals 1,336,803 kWh of electricity, 42,866 therms of natural gas, and 8,008 gallons of water, which translates to a reduction of greenhouse gases equal to 139 fewer automobiles on the highway annually, or 19,851 tree seedlings planted and grown for 10 years.[8]

The District's energy management staff has stated three primary goals: to maintain comfort and safety in occupied facilities, eliminate energy waste, and save dollars. During the period of June 2008 to August 2009, the District's energy education efforts were responsible for cost avoidance of more than $2.4 million (the cost of approximately 25 teaching positions).

Efforts that CUSD highlights to support these goals include:

Manage Comfort & Safety in Occupied Areas

- Coordinate facility use with operation of lighting and HVAC equipment
- Monitor operational efficiency of equipment

Eliminate Energy Waste

- Audit every building at least once per week
- Track and analyze consumption for building efficiency
- Maintain the guidelines described in CUSD Governing Board Policy 5201 – Energy and Water Conservation Program

[7] http://www.cusd.com/facilities-homepage/energy-mgmt/
[8] http://www.cusd.com/facilities-homepage/energy-mgmt/

- Pursue third party accreditation of energy conservation through the Environmental Protection Agency's Energy Star Building Label for CUSD facilities

Save Dollars

- Minimize consumption and demand charges throughout the District's facilities
- Evaluate usage trends for abnormalities and pursue resolution of overcharges
- Maximize the District's use of rebate and grant programs to reduce utility expenses

Costs for the District's energy management program and staff are paid with money saved through energy reductions.

Policy Guidelines: CUSD revised its policies[9] to support a District-wide energy and water conservation program at the start of the 2007/2008 academic year. The CUSD Governing Board instituted the energy and water conservation program, reflecting its commitment to both conserve natural resources and to save money to support other District needs. The program stipulates the following:

- The Board shall establish goals to help reduce the District's consumption of energy and water;
- Programs will be instituted to increase awareness among employees and students of the need to conserve energy and water;
- There will be regular monitoring of energy and water consumption, including maintaining accurate records of energy consumption and costs;
- Information related to the goals and progress of the energy conservation program must be made available to the local media; and
- Specific strategies will be implemented, and procedures designed, to conserve energy and water.

Assignment of Energy Program Responsibilities: The CUSD Governing Board holds the District's principals accountable for energy management at his or her campus or department; the principals must ensure energy audits are conducted and conservation program outlines are updated. Furthermore, energy management at each campus will be a part of the annual evaluation of the principal.

The policies also assign responsibility to the District Superintendent, who must ensure that personnel complete regular inspections of District facilities and operations in order to

[9] http://boardpolicies.cusd.com/CUSDDocViewer/

make recommendations for maintenance and capital expenditures that will ensure the District meets its energy and water conservation goals.

In addition to stipulating responsibility and accountability to the District's principals and Superintendent, the policies also establish a full time position within the District for a dedicated facilities Energy Management Systems (EMS) Coordinator. The EMS Coordinator reports to the Assistant Superintendent of Facilities Services and is responsible for the following:[10]

- The Energy Management System Manager performs routine audits of all facilities and communicates the audit results to the appropriate personnel.
- The Energy Management System Manager is responsible for either directly or indirectly making adjustments to the District’s energy management system (EMS), including temperature settings and run times for heating, ventilation and air conditioning (HVAC), and other controlled equipment.
- The Energy Management System Manager provides regular reports to the school principals and departments indicating performance with regards to energy savings.

New Construction and Modernization: The District policy with respect to designing new facilities and renovating existing ones is to minimize the demand for electricity and water in order to help conserve natural resources and to save money to support competing District needs.

The policy stipulates that for all new building construction and modernization efforts, the schools are committed to meeting the standards for High Performing Schools set forth by the Collaborative for High Performance Schools (CHPS).[11] The policy goes further to establish a number of areas that should be considered higher priorities in applying the standards, and include the following principles related to energy efficiency and program participation:

- Reducing operational cost through increased efficiency and lower energy costs;
- Minimizing the negative impact of District operations on the environment;
- Taking advantage of financial incentive programs; and
- Pursuing third party accreditation of energy conservation through the Environmental Protection Agency’s Energy Star Building Label for CUSD facilities.

[10] Policy No 5201: http://boardpolicies.cusd.com/CUSDDocViewer/bp5201.pdf
[11] www.chps.net

To complement the District's energy management program, the District also runs a preventive maintenance and monitoring plan for its facilities and systems, including HVAC, building envelope, and moisture management.

The energy conservation policy also includes subsections covering Lighting and HVAC systems that stipulate temperature settings, operating hours, and related guidelines to minimize consumption of energy and water while maintaining a healthy and safe environment.

The CUSD Governing Board also compels the administration to develop an Administrative Regulation that outlines the process for accomplishing this effort and to report the progress of this program to the Board each year. The annual report is supposed to reflect the number of new schools and modernization projects designed and the percentage which have incorporated CHPS design criteria, as well as other statistics useful in assessing the progress of this effort.

Project Funding: Bond Measure A

On March 2, 2004, voters within Fresno County approved bond Measure A, which allocated $168 million to improve CUSD facilities. Projects funded through the 2004 bond issue were allocated by the end of 2011, and all projects were completed by the end of 2013. In 2012, Fresno County voters were again presented with a school facilities bond Measure A, and again they approved it. This more recent time, the bond issue supported $298 million of facility improvements designed to maintain excellent neighborhood schools, offset state budget cuts, and retain/attract quality teachers. The 2012 bond measure was constructed to keep tax rates unchanged, and to benefit all 47 elementary and high schools in Clovis Unified School District. The funding authorized by the bond measure was earmarked for facilities improvements only, and was not made available to cover operating expenses.

Project Funding: Proposition 39

The California Clean Energy Jobs Act (Proposition 39) changed the corporate income tax code and allocates substantial projected revenue to California's General Fund and the Clean Energy Job Creation Fund for five fiscal years, beginning with fiscal year 2013-14. Under the initiative, roughly up to $550 million annually was made available for appropriation by the Legislature for eligible projects to improve energy efficiency and install clean energy generation equipment in schools.[12]

In the first fiscal year the proposition was in place, $381 million[13] resulting from the voter-approved corporate tax initiative was made available to update aging campuses with

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[12] http://www.energy.ca.gov/efficiency/proposition39/

[13] http://www.thebusinessjournal.com/news/energy-and-environment/9209-valley-school-districts-to-get-prop-39-energy-funding

energy-saving retrofits. Of this, CUSD received a grant of $1.7 million. The energy upgrades planned under Measure A also qualified for the funding provided by Proposition 39. Thus, the $1.7 million was used to offset Measure A funding, and went toward the District's 5.9 MW photovoltaic systems, which were already in the planning phases at the time that Proposition 39 funding was approved.

Continuous Energy Improvement

In addition to adopting energy conservation policies, and implementing energy upgrades in 2008/2009, 2012, and 2013, CUSD also engaged with PG&E's Continuous Energy Improvement (CEI) program. This program supported a systematic culture change process designed to position CUSD's organizational culture to implement cost effective opportunities to save energy, money, and resources. The CEI program builds on the idea that managing energy consumption through only technical measures (i.e. equipment changes) does not capture the full value of conservation opportunities. Working with the CEI program, CUSD worked to align operational and behavioral practices in all aspects of energy management, such that its organization would transform simple technical improvements into more comprehensive long-term, sustainable savings in both energy consumption and cost.

Mountain View Elementary School

Case Study 1 takes place at Mountain View Elementary School, within the Central Valley's Clovis Unified School District. Mountain View Elementary School was built in 1990 with the primary objective of offering educational services to children in grades K through 6. The site itself is 15 acres in size. The facilities include 25 permanent classrooms and 11 portable classrooms that together can accommodate a maximum student body of 756 (as of the 2015 academic year, the school served about 725 students and employed just over 30 teachers). The school also has an administration building, library media center, multi-purpose room, snack bar, and restrooms; these facilities adequately support the instructional program. Mountain View Elementary School has many athletic fields that are used for recess, sports, and other co-curricular activities during and outside of the school day. Various community groups use the facilities and playfields outside of the school day.

Mountain View Elementary School comprises a complex of buildings including one permanent structure and a number of portable structures. At the time of the retrofits, the complex encompassed a total of 53,000 square feet of interior space.[14]

The energy retrofits that are the primary focus of the discussion that follows took place in 2012, 2013, and 2015.[15] The energy efficiency portion of the project took place first, in 2012. All of these improvements were done as part of the first round of the 2012 Measure A facility modernization projects, and included both energy and non-energy upgrades at Mountain View Elementary.

Energy-related improvements at Mountain View Elementary School include HVAC and lighting retrofits and the installation of a solar photovoltaic system.

Pre-2012 Energy Conservation Improvements

In 2008, CUSD initiated a new energy conservation policy and pilot program[16] designed to reduce energy costs and the District's carbon footprint while keeping students and teachers more comfortable in their classrooms. Energy audits identified a number of steps that could be taken to increase efficiency, and led to participation in PG&E's Retrocomissioning program in eight schools in the District including Mountain View Elementary. The following excerpt is from a series of case studies published by PG&E, which describes the energy program experiences of CUSD—and Mountain View Elementary in particular—back in 2008:

> *"The first major step was the deployment of a new energy management system (EMS) for monitoring and controlling electric lighting and HVAC systems at every school in the district through one central web-based communications port. The EMS enabled the district's energy manager to access real-time energy use data from any individual school or the entire district via a laptop computer and turn electrical systems on and off remotely.*
>
> *Most of those systems operate heating and air conditioning in permanent buildings and temporary classrooms. However, the new EMS relied on a decades-old infrastructure of on-site control points that limited the efficiency of the system. For example, the district control center could only operate the lighting in entire wings of buildings, rather than individual rooms. And before school holiday periods, like Thanksgiving and winter break, staff had to go out to the facilities, particularly the portable classrooms, to make sure the lights and HVAC systems were turned off.*

[14] The campus has grown to 56,000 square feet since then.
[15] At the time of the interview, the 2015 retrofits were not complete.
[16] www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/analyzer/retrocommissioning/RCx_clovis_unified_case_study.pdf

A systematic energy audit of the district's schools and facilities pointed to measures that could be taken to increase efficiency, including upgrading the on/off functions for HVAC and lighting systems and changing out DX units, (the HVAC units that hang on the outside of portable classrooms). To implement these measures, CUSD turned to PGE's Retrocommissioning (RCx) program."

Across the eight pilot schools, the RCx projects produced annual savings of almost 600,000 kWh and 9,000 therms. The District received $105,115 in rebates from PG&E, and with the energy cost savings, the payback period was approximately 1.2 years. Related benefits included a more comfortable environment and enhanced operational control, allowing most problems to be handled remotely, reducing and minimizing maintenance dispatch.

The measures implemented at Mountain View Elementary focused on upgrading the EMSs and tying them to the HVAC system to optimize scheduling.[17] Mountain View Elementary saved more than 100,000 kWh and 1,600 therms annually by focusing on lighting and HVAC, the two most energy-intensive systems.

Key energy efficiency measures implemented with 2008 Retrocommissioning program funding included:

- Installing relays on all 24 pneumatically-controlled unit ventilators, tying them into the EMS and giving the EMS control of individual units for each room. Previously, these ventilators stayed on all day;
- Installing start/stop scheduling controls on three heat pumps (four tons each); and
- Installing start/stop scheduling controls on two package units (four tons each).

A summary of 2008/2009 Retrocommissioning project highlights at Mountain View Elementary follows.

- Project cost: $27,410
- Incentive dollars: $14,850
- Net project cost (to customer): $12,560
- Annual energy savings (dollars): $6,354
- Simple payback (to customer) based on net project cost: 1.97 years

Pre-Retrofit Energy Consumption Characteristics

Prior to the retrofit and facility improvement efforts in 2012, the school's energy consumption was 392,040 kWh and 10,000 therms, at a typical annual cost of about

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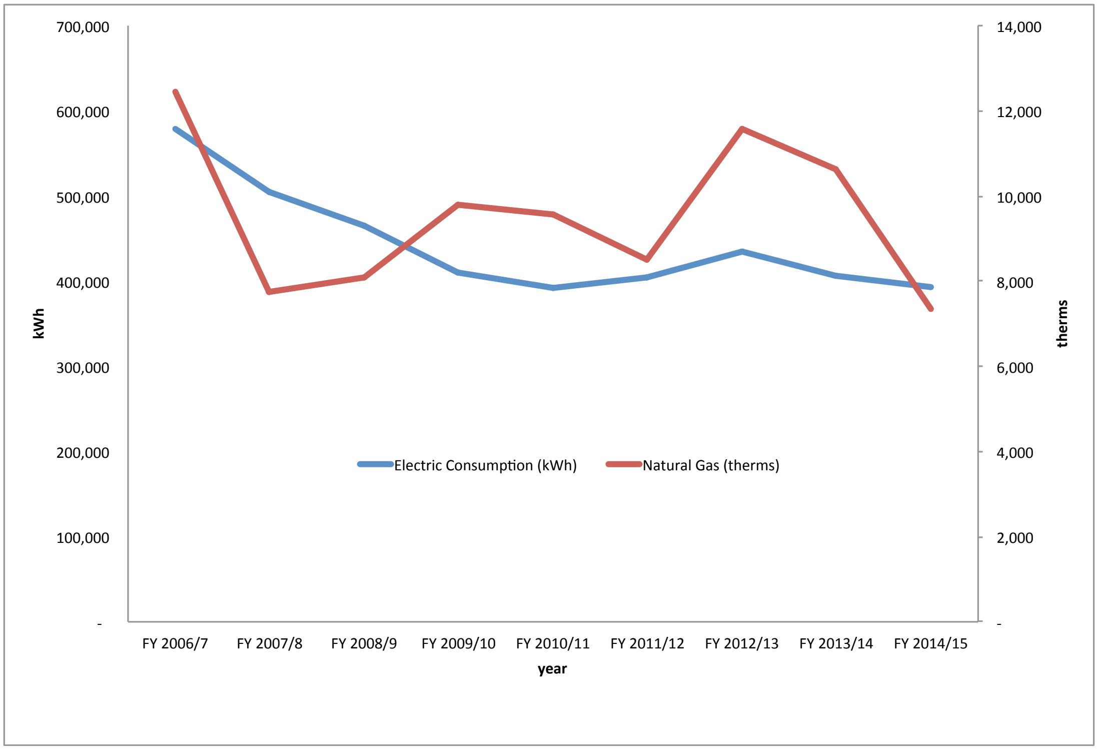
[17] http://apps1.eere.energy.gov/tribalenergy/pdfs/doe_eere_aerg_k12schools.pdf

$75,000. Prior to the installation of solar in 2013, the annual peak non-coincident[18] demand would occur in August, between 3pm and 6pm.

The school district has been emphasizing energy efficiency since the 2007-2008 school year. Its internal tracking of energy consumption at Mountain View Elementary School shows a clear drop in natural gas usage compared to the District's baseline year of 2006-07 and steady decreases in electricity consumption during those years. (See Figure 1.)

Figure 1: Case Study 1 (Mountain View Elementary School) Energy Consumption



IDSM Project Overview

The IDSM project at Mountain View Elementary School began in 2012. As discussed previously, the energy-related improvements were only one component of a broader overall facility modernization effort that included both energy and non-energy related improvements. In this discussion, we focus on the energy retrofit improvements and generation capacity that were included in the modernization, but recognize that there had been prior efforts to optimize building operations.

As noted in Table 1, the facility improvements included energy efficiency improvements in 2012, followed by the installation of photovoltaic generating capacity in 2013. At the time

[18] A non-coincident peak is the maximum kW consumption for the facility at any time, regardless of system conditions, whereas 'coincident' peak is the maximum usage for the facility during the system peak period.

we conducted our fieldwork for these case studies in the summer of 2015, there were also plans for additional energy efficiency work.

Table 1: Case Study 1 (Elementary School) Timeline

2008/2009	2012	2013	2015
RCx, EMS System, Unit Ventilators and HVAC Controls	Energy Efficiency Upgrades part I (boilers chillers, unit ventilators, T5 lighting)	Distributed Generation Installed (Solar PV, capacity of 199 kW)	Planned Energy Efficiency Upgrades part 2 (variable speed pumps, lighting)

Energy Efficiency Improvements, with PG&E's Savings By Design Program

The modernization efforts at Mountain View Elementary School included energy efficiency upgrades that were divided into two phases, with work performed in or scheduled for 2012 and 2015.

The impetus for the project was modernization of the building facilities, but energy efficiency upgrades were included where appropriate. The efficiency components of the first phase of the modernization retrofits included the replacement of boilers, chillers, and unit ventilators, as well as the installation of T5 lighting.

As mentioned earlier, the modernization effort was funded through a $298 million bond measure—"Measure A"—that was approved by voters in 2012. The bond measure followed a similar $168 million measure passed in 2004. The last of the projects funded through the 2004 bond measure was completed during 2013—well after initiating projects funded by the $298 million bond. The bond measure was constructed to keep tax rates unchanged, and to benefit all CUSD elementary and high school campuses. The funding authorized by the bond measure was earmarked for facilities improvements only, and was not made available to cover operating expenses.

The project cost, including the marginal costs for efficiency upgrades, was approximately $2 million. By September of 2012, improvements funded by this bond measure were completed in eight different schools including Mountain View Elementary. Improvements through Measure A at Mountain View Elementary included an upgrade of the HVAC system and classroom lighting. Both of these improvements were also efficiency upgrades and were eligible for incentives through the PG&E Savings By Design Program. The complete list of Measure A improvements at Mountain View Elementary is as follows:

- Expanded and reconfigured library for instructional areas and storage
- Upgraded HVAC system
- Replaced fire alarm

- Expanded and reconfigured main office for storage, waiting area and offices
- Made repairs to door hardware, ceilings, casework, wall finishes
- Replaced interior ceilings
- Made efficiency improvements in lighting for classrooms, multi-purpose room, main office, library
- Improved exterior lighting
- Upgraded technology data network and wireless technology to increase bandwidth and Internet access
- Replaced public address systems, clock, phone system
- Installed a new exterior video surveillance system
- Made various landscaping upgrades to the campus including the replacement of raised or broken concrete
- Replaced restroom plumbing fixtures and upgraded interior of restrooms
- Completed Americans with Disabilities Act (ADA) required upgrades

These upgrades were associated with a total estimated energy savings of 120,368 kWh, 62 kW, and 279 therms per year. CUSD participated in PG&E's Savings By Design Program for an incentive of $30,227. The incentive was based on the overall building design efficiency, which was expected to exceed Title 24[19] requirements by almost 16 percent. Table 2 summarizes the energy-related components of this phase of the modernization project. The calculations of expected savings are based on an annual expected site consumption of 635,000 kWh, which is substantially higher than actual energy consumption, which has been about 390,000 to 434,000 annually since 2012.

The second phase of the modernization project, to include variable speed pumps and additional lighting, was scheduled for the summer of 2015. The timing of the modernization work was based on the availability of funds associated with the bond measure.

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[19] In 1978, the California legislature enacted the Title 24 energy standards as part 6 of the California Code of Regulations. Title 24 energy standards address the energy efficiency of new homes and commercial buildings, as well as those that are retrofitted.

Table 2: Case Study 1 (Elementary School) Energy Efficiency Measures

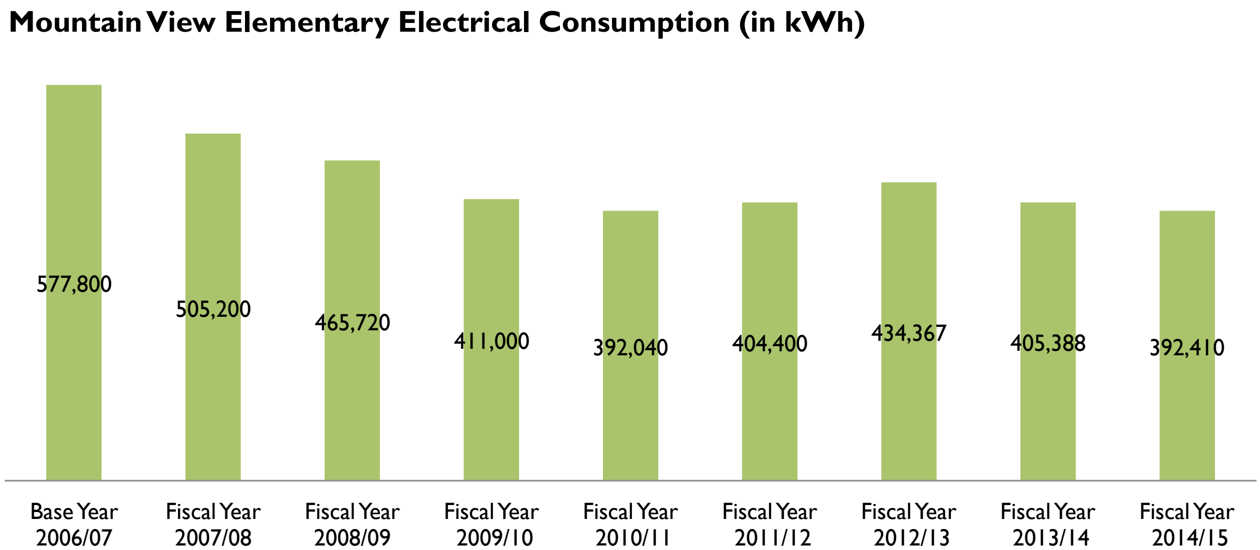
Energy Efficiency Measure	HVAC (boilers, chillers and unit ventilators) and lighting upgrades
Installation Date	2012
Estimated Electric Savings*	120,368 kWh/year
Estimated Peak Reduction*	61.8 kW
Estimated Natural Gas Savings*	279 therms/year
Utility Program	Savings By Design
Percent Under T24 Requirements	15.9%
Utility Incentives	$30,227
Energy Costs Paid in 2012	$0.17/kWh $0.92/Therm
Annual Savings	$20,719
Other Funding/Financing	Bond Measure
Project Cost**	~$2 million

* Post-installation estimates as reported in PG&E CMT report.
** These costs were divided amongst local bond funds and state Proposition 39 funds ($1.7 million). The funds included the costs of system upgrades and were not limited to the marginal costs of efficiency improvements.

Figure 2 shows annual energy consumption beginning in 2006/2007. Consumption shows a marked decline following the 2008/2009 participation in PG&E's Retrocomissioning program. Consumption went from 577,800 kWh in the 2006/2007 base year down to 392,040 kWh in 2010/2011. The modernization improvements that took place in 2012 involved equipment and upgrades that improved the efficiency of lighting and HVAC systems, as well as changes that expanded the main office space, and added new surveillance equipment and outdoor lighting for enhanced safety. Perhaps due in part to the additional equipment and conditioned square feet, the energy savings from the 2012 lighting and HVAC measures are not immediately apparent.

Figure 2 below shows an alternative view of electricity consumption, highlighting the school's clear efficiency improvements starting in 2009, relative to the 2006-2008 period.

Figure 2: Case Study 1 (Elementary School) Energy Consumption



Installation of Distributed Generation, with Help from Proposition 39, Bond Measure A, and the California Solar Initiative Program

Upon the approval of the 2012 Bond Measure A, CUSD began planning for a major installation of solar photovoltaic systems. The project was budgeted at $25 million and included a total of 5.9 MW of capacity installed at 21 different locations in the District. The complete cost of installing the solar array was expected to be recouped (based on simple-payback) in approximately 11.5 years. However, the capital costs were to be paid through Bond Measure A, while the ongoing reduction in operating costs would begin to benefit the District's General Fund immediately. As discussed previously, funds were forthcoming via Proposition 39 that reduced the upfront cost by an additional $1.7 million. At the time these funds were secured, the project had already been scoped and funded, so this funding did not inspire the project to be completed; it simply increased the financial return for the project. Table 3 presents the financial highlights for the District-wide photovoltaic installation project.

Table 3: Clovis Unified School District Photovoltaic Installation Project Overview

General Fund Savings (projected)	
Year 1 – 5 Estimated Net Cumulative Savings	$12,962,778
Year 1 - 25 Estimated Net Cumulative Savings	$59,165,624
Average Savings Per Year	$2,366,625
Project Cost & Financing Sources	
General Obligation Bond Investment – Measure A	$25,000,000
Total Estimated Project Cost	$25,000,000
Technical Info	
Annual Electricity Usage (at 21 "project sites")	10,062,402 (approx.)
Annual Solar Electricity Production (estimated)	8,432,293 or 83.8%
Solar Facility Size (estimated in Megawatts "MW")	5.86 MW

The District hired an independent energy advisor, Terra Verde Renewable Partners, LLC, for the project. During the planning stages, the District worked with its Energy Advisor to carefully assess each alternative site for photovoltaic installation. As a general rule, the solar systems were designed and sized to reduce energy bills but not to generate any excess power beyond consumption. For each site, any annual generation in excess of annual consumption would have zero dollar value.

Energy costs for all District locations are paid in a bundle through the General Fund—which also pays for classroom teachers, curriculum resources, educational programs, and other services. Although electricity bills are assessed at a site-specific level, all District utility bills are paid via the General Fund, and thus all savings are shared District-wide. Thus, there are no site-specific costs or benefits accrued for any of the photovoltaic installations or the other energy retrofit projects, as all costs are paid via a communal General Fund and all savings are shared via the General Fund.

The following steps were taken to perform the analysis that would lead to photovoltaic site selections:

1. For each site, the system size required to yield the highest possible savings (i.e. a size that would offset but not exceed consumption) was determined.
2. The installation cost for each site was then estimated, along with the total expected annual production and avoided electricity costs.
3. Avoided costs varied by site, and were estimated based on the particular site's incurred electricity charges.

4. Operating costs and other site characteristics were also taken into consideration, including:
   - Fire lane access and fire safety codes;
   - Shade assessment;
   - Proximity to the energy meter; and
   - Construction costs.

Ultimately, a list of the 21 sites that would yield the highest possible net savings over the expected useful life of the photovoltaic systems (25 years) was identified. In general, sites with lower annual usage were associated with a higher per kilowatt cost, and therefore offered a higher net benefit, or a greater dollar offset of operating costs, and thus were more likely to be selected for photovoltaic installations.

Photovoltaic System Design: Each system was designed for parking or playground shade structures. This was done for two reasons: the District wanted the photovoltaic systems to be prominent and easy to see, and these locations were expected to have minimal potential for vandalism and ultimately minimize maintenance issues.

Installation: A single solar installation vendor, Cupertino Electric, Inc., was contracted for all the solar sites, and the installations were done in four phases. The first four systems were interconnected and began producing power by May of 2013. Thirteen systems were completed by September of that same year, and all 21 locations were completed and producing energy by December 2013. In aggregate, the installed systems produced approximately 8.7 MWh over calendar year 2014. This level of production is estimated to have saved the District $1.6 million in utility fees. However, the District also received performance-based incentives from the California Solar Initiative (CSI) at a rate of $0.225 per kWh.

Photovoltaic Incentives: The District expects to receive a total of $5.4 million in rebates over five years through CSI. The CSI Performance Based Incentive (PBI) is an incentive payment based on actual system performance over the course of five years. The PBI is paid on a fixed dollar per kilowatt-hour ($/kWh) of generation basis and is the required incentive type for systems greater than 30 kW in size. Government and non-profit entities qualify for a slightly higher payment per kWh than either residential or for-profit non-residential establishments. Systems smaller than 30 kW can opt for a lump sum payment based on expected annual electricity production.

The CSI program was designed to step down over time, providing a lower per-unit incentive as the MW of aggregate capacity across statewide CSI-incented photovoltaic installations rise, as shown in Table 4.

Table 4: California Solar Initiative Performance Based Incentive Payments, by Customer Class, per the Level of Aggregate MW Statewide of Program Sponsored Photovoltaic Installation

Step	Statewide MW in Step	PBI Payments (per kWh)		
		Residential	Non-Residential	
			Commercial	Government/ Non-Profit
1	50	n/a	n/a	n/a
2	70	$0.39	$0.39	$0.50
3	100	$0.34	$0.34	$0.46
4	130	$0.26	$0.26	$0.37
5	160	$0.22	$0.22	$0.32
6	190	$0.15	$0.15	$0.26
7	215	$0.09	$0.09	$0.19
8	250	$0.05	$0.05	$0.15
9	285	$0.03	$0.03	$0.12
10	350	$0.03	$0.03	$0.10

Mountain View Elementary Distributed Generation Installation

In keeping with the District's decision to install the photovoltaic systems on parking lot or other shade structures, the Mountain View Elementary School campus solar panels were placed in the parking lot and near the school's play area structures.

The Mountain View campus photovoltaic system was among the first installations to be completed, and was in operation by May of 2013. Actual production at the site has averaged about 290 MWh annually, which accounts for roughly three-quarters of the building's electricity consumption in recent years. Electricity expenditures went from almost $69,000 in 2011-2012 to just over $8,000 in 2013-2014.

While the individual system installation costs were never specifically calculated, the system installed at Mountain View Elementary is estimated to have cost about $1 million. As discussed above, all systems were initially funded by the school district with funds from the 2012 Bond Measure A, as well as a Proposition 39 grant worth $1.7 million. If we were to allocate the grant funds by installed capacity, the cost of the Mountain View installation would be reduced by $57,000.

In addition, the District is compensated via the program's performance-based incentive, which provides 22.5 cents per kWh as the system generates power over the first five years of operation. Thus, the total expected incentive for the Mountain View installation is $326,250.

Prior to the solar system installation, over the 2011-2012 academic year, the electricity cost at Mountain View Elementary was $0.17 per kWh, which came to a total of $68,609 for the year. Using this figure as an estimate of annual electricity cost in the absence of the solar system, the simple payback for the system is 14.6 years without any incentives. Once the Proposition 39 funds and the CSI incentives are factored in, the simple payback is reduced to just nine years.

Table 5: Case Study 1 (Elementary School) Distributed Generation Details

DG Measure	Solar PV
Start Date	May 2013
Capacity (kW)	199 kW
Estimated Annual Production*	290 MWh
Utility Program	CSI, Performance Based Incentive
Utility Program Incentives	$0.225/kWh for five years, or $326,250
Financing	Local Bond Measure A and Proposition 39 grant funding ($57k)
Other Funding	Proposition 39 grant funding (~$41.7M for District Project, or ~ $57k for site)
Simple Payback without Incentives	14.6 Years
Simple Payback with Incentives	9.0 Years
Total Cost	~$1 million

*Approximate actual post-installation production

Demand Response

Mountain View Elementary School does not participate in any demand response rates, although some other campuses in the school district are on PG&E's peak day pricing rate, which gives the utility the option to impose substantially higher rates for short periods with one day notice in exchange for reductions in the rates the customer pays most of the time. The school district also has some accounts on an Aggregator Managed Portfolio.

PG&E representatives explained that accounts with net metering are limited to a small set of demand response programs that are not offered directly to small or medium-sized customers.[20] More importantly, demand reduction is measured as the drop in the 'net' electricity taken from PG&E, which means that if solar generation happens to offset demand at the demand response event time, then no incentive is offered for curtailment, even if curtailment might offer more electricity to the grid during the event time.

The base solar generation does not get credited to the account as a demand reduction. Therefore, accounts with substantial solar generation tend to have low base use from

[20] These programs are: Base Interruptible (BIP), Demand Bidding (DBP), Aggregator Managed Portfolio (AMP), and Capacity Bidding (CBP).

which to reduce demand further, making demand response programs less attractive to the customer.

Energy Consumption Patterns

Figure 3 shows total energy costs and highlights the solar offset, which represents the value of the solar generation at Mountain View Elementary, including the incentive payment made by CSI.

Figure 3: Case Study 1 (Elementary School) Energy Costs

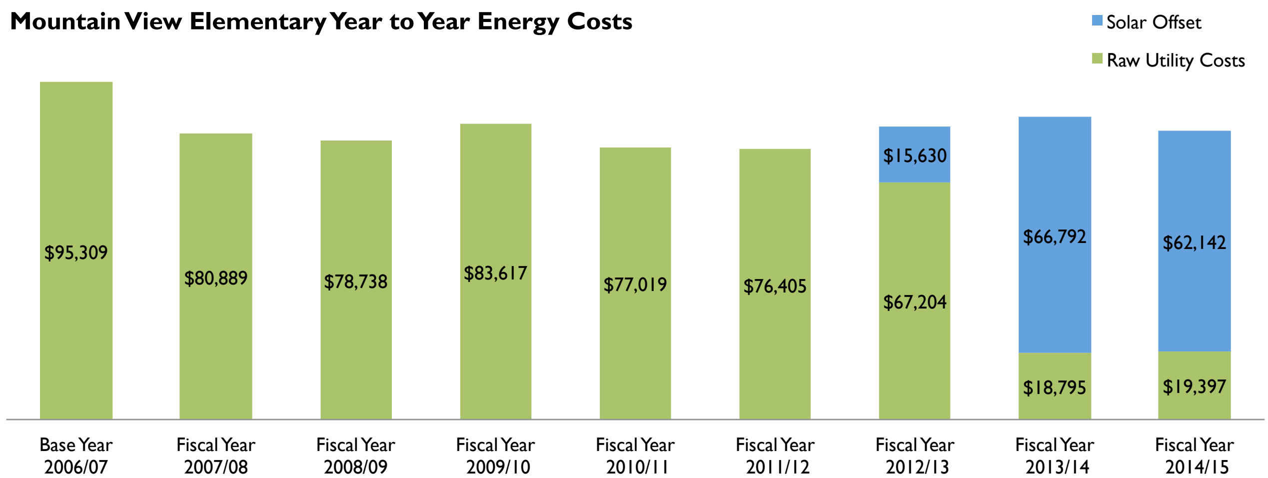
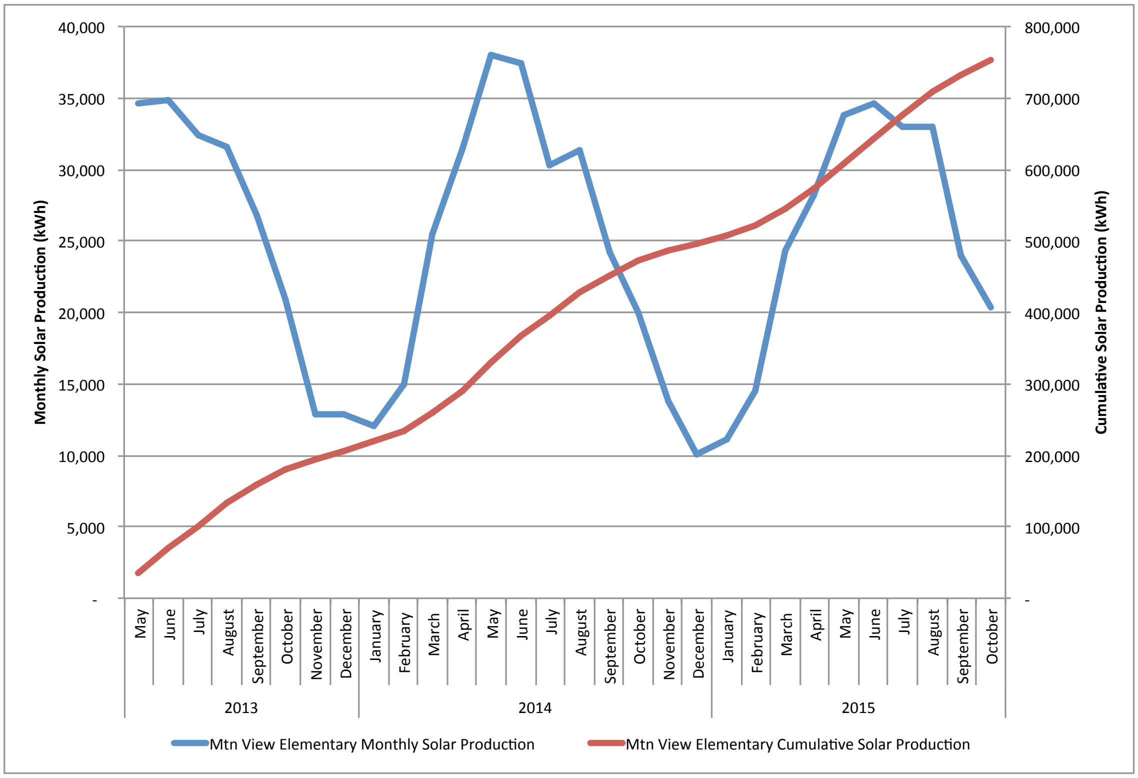


Figure 4 shows the solar energy production for the system installed at Mountain View Elementary. The figure shows both monthly and cumulative values. There is a wide range of generation amounts by season, with monthly solar production nearing a low of 12,000 kWh for winter months and a high of nearly 38,000 kWh during the summer. There was also somewhat higher overall generation in 2014 versus 2013 and 2015, most likely due to experiencing more sunny days during the 2014 calendar year.

Figure 4: Case Study 1 (Elementary School) Solar Energy Production - Monthly and Cumulative



3.2.2 Case Study 2: Senior Center

Case Study 2 is a retrofit of a municipal building in the City of Hawthorne, in Los Angeles County. This building received a variety of energy-related upgrades between 2010 and 2014, including the installation of a solar photovoltaic system and a lighting efficiency upgrade. The facility also began participating in a demand response rate during this time.

City of Hawthorne

Incorporated in 1922, the City of Hawthorne[21] currently has a population of nearly 87,000. The city is approximately six square miles in size and is located near Los Angeles International Airport. The city is centrally located and connected via rail and freeway to the Port of Los Angeles, downtown Los Angeles, San Diego, and San Diego Harbor.

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[21] http://www.cityofhawthorne.org/about-hawthorne/

City of Hawthorne Energy Policy

The City of Hawthorne maintains a green initiative that includes an emphasis on energy efficiency.[22] The City describes its efforts on both energy efficiency and environmental sustainability as influencing the City's decisions across all types of projects and activities. At the same time, as noted below, the City is budget constrained and needs to approach facility upgrades cost-consciously.

The broader context behind the City's work on sustainability includes local and regional activities by the South Bay Council of Governments, coordination between local governments and Southern California Edison's energy efficiency programs, and an increased focus on climate change after passage of the California Global Warming Solutions Act of 2006.

The City's efforts have resulted in a "Gold Level" designation in the Southern California Edison (SCE) Energy Leadership Partnership to recognize a 10 percent reduction in overall energy use among other requirements. In addition to energy retrofits to Hawthorne's Memorial Center (described in more detail below), the City has:

- Completed LED retrofits on all traffic signals;
    - City replaced traffic lights at 45 intersections in 2007, saving an estimated 500,000 kWh per year.
- Retrofitted all city hall outdoor lighting;
    - The induction lighting recently installed in the outdoor areas surrounding City Hall uses 50 percent of the energy of the previous lighting and will last five times longer, thus reducing both energy and maintenance costs.
- Replaced a boiler system and lighting at its swimming pools;
    - In addition to constructing two brand new swimming pools, this 2008 project installed a more energy efficient boiler system as well as induction lighting that uses one third the energy of the existing lights.
- Joined ICLEI[23] and established a carbon footprint and corresponding climate action plan; and
- Completed numerous other projects focused on water conservation, waste reduction, and recycling of materials.

Building Characteristics

The subject of this case study is a complex that houses the City's senior center, its Memorial Center, and the Betty Ainsworth Sport Center. The single-story facility

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[22] http://www.cityofhawthorne.org/green-initiative/

[23] Local Governments for Sustainability, founded in 1990 as the International Council for Local Environmental Initiatives.

encompasses approximately 70,000 square feet of interior space. The building operates during regular business hours during both weekdays and weekends. Its main energy uses are for space cooling and lighting; water heating, office equipment, and kitchen equipment round out the main end-uses. Prior to recent energy-related retrofits and measures described below, average annual energy consumption was approximately 450,000 kWh, with an annual electric bill of about $85,000. Annual peak demand typically occurs in late summer. Following installation of a solar photovoltaic system in 2010, peak demand ranges from 200kW to 300 kW.

Technical Details

The municipal building implemented all three demand side management strategies—energy efficiency, demand response, and distributed generation. As shown in Table 6, these recent energy projects originated with the installation of photovoltaic generating capacity in 2010, followed by enrollment in a demand response program in 2013 and energy efficiency upgrades in 2014.

Table 6: Case Study 2 (Senior Center) Timeline

2010	2013	2014
Distributed Generation Installed (Solar PV)	Enrollment in Demand Response Program (Automatic Powershift Rate)	Energy Efficiency Upgrades (Linear Fluorescents, LED, exterior HID)

Distributed Generation: Distributed generation at the building consists of solar photovoltaic panels with a total rated capacity of 260.7 kW. The photovoltaic system was connected to the grid and net-metered in October of 2010. The photovoltaic system is connected to the grid through both of the facilities' two energy meters—that is, the photovoltaic system generation is portioned across two electric meters, each of which measures net consumption for different components of total facility generation and consumption. The system's expected annual electricity production at the time of installation was 350 MWh; city officials report that they have observed consumption and bill reductions of about 30 percent since the solar system went online.

The solar installation cost $1.1 million,[24] of which the initial funding was provided out of a federal Energy Efficiency and Conservation Block Grant from the American Reinvestment and Recovery Act.[25] The City also used general funds to support the project costs, but

[24] See here for the distribution of the total project costs into its component parts: http://hawthorne-ca.granicus.com/MetaViewer.php?view_id=&clip_id=49&meta_id=4472
[25] The total grant amount was $769,900.

those funds are being recovered through the California Solar Initiative over time through performance-based incentives as the system generates power.[26] Based on the expected production (350 MWh) and average electricity costs in 2010 ($0.20/kWh), the photovoltaic system had an expected simple payback of 15.6 years without any rebate.

Table 7: Case Study 2 (Senior Center) - Distributed Generation Details

DG Measure	Solar PV
Interconnection Date	October 2010
Capacity (kW)	261 kW
Estimated Annual Production	350 MWh
Customer Cost (after all incentives paid)	$0
Utility Program	CSI, Performance Based Incentive
Utility Incentives	$0.32/kWh blended rate or ~$111,786/yr
Other Funding	ARRA Energy Efficiency and Conservation Block Grant
Total Cost	$1,099,999

Demand Response: In 2013, the municipality enrolled this facility in SCE's Automatic Powershift rate, which provides an incentive to non-residential customers for allowing SCE to cycle their air conditioning compressors for up to 180 hours each summer. The incentive is based on the connected tonnage of air conditioning and the cycling level. In both 2013 and 2014, SCE cycled off the building's air conditioning system during each month from June through October.

Table 8: Case Study 2 (Senior Center) - Demand Response Participation

DR Program	Automatic Powershift rate
Date of Enrollment	April 2013
AC Cycling Events	1 per month from June-Oct, in 2013 and 2014

[26] The total incentive amount through the California Solar Initiative is listed as $558,929. See https://www.californiasolarstatistics.ca.gov/search for more details.

Annual peak demand ranged from 211 kW to 275 kW between 2010 and 2014, but was noticeably lower after the photovoltaic system was installed in the fall of 2010. (See Figure 5.)

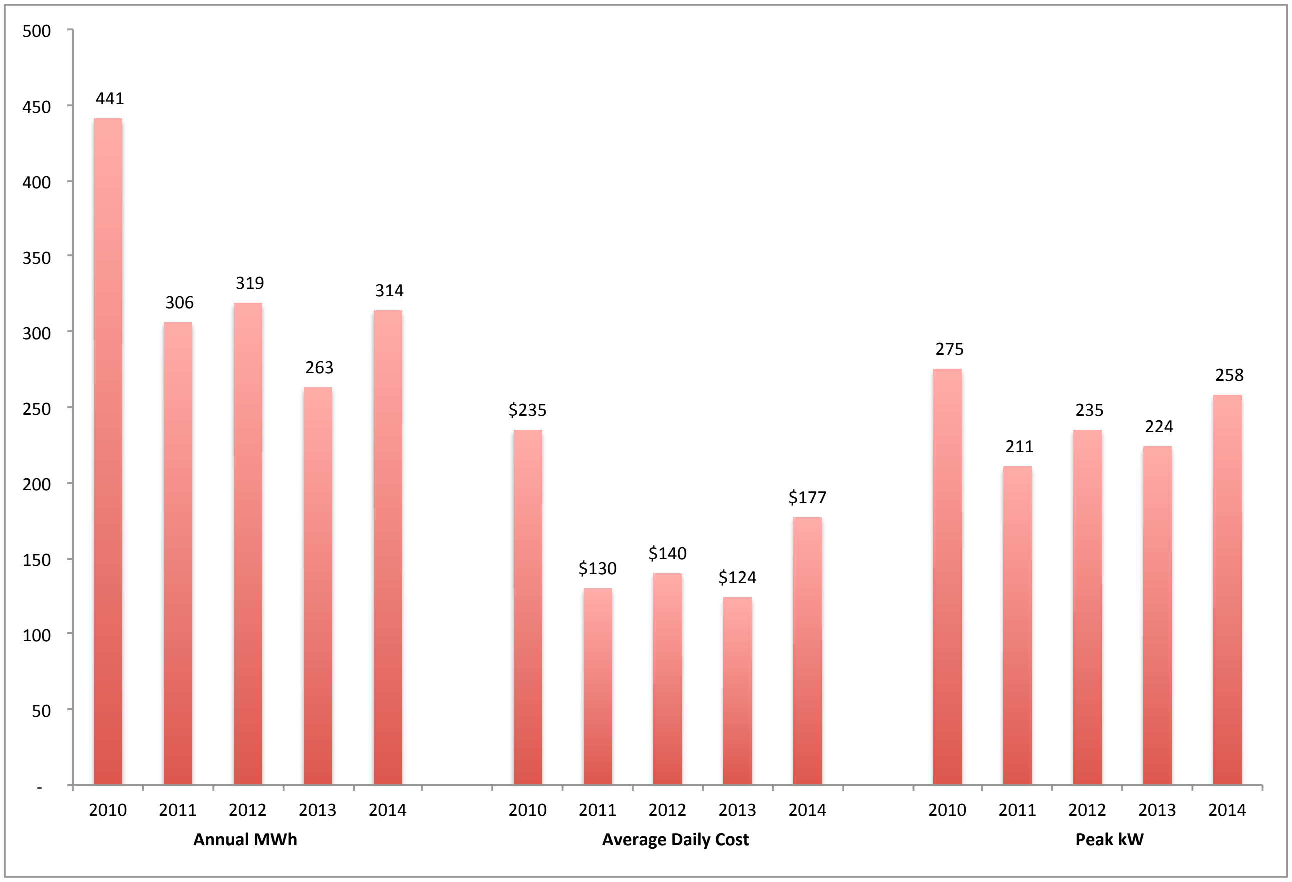
Energy Efficiency: The most recent component of this building's energy upgrade work was the installation of energy efficiency measures. The municipality installed energy efficient linear fluorescent, LED, and exterior high-intensity discharge (HID) lighting through SCE's Energy Leader Partnership program in 2014 at a total project cost of about $35,000. These upgrades had total estimated energy savings of 54,000 kWh and 13 kW of peak load reduction. Hawthorne qualified for an incentive level that offset the full cost of the lighting replacements. Similar lighting upgrades were offered and installed at other Hawthorne-owned facilities under the same program.

Table 9: Case Study 2 (Senior Center) - Energy Efficiency Measures

Energy Efficiency Measures	Lighting: (Linear Fluorescents, LED, exterior HID)
Installation Date	February 2014
Estimated Electric Savings	54,000 kWh
Estimated Peak Reduction	13 kW
Utility Programs	SCE Energy Leader Partnership
Utility Incentives	$35,000
Customer Cost	$0
Total Cost	$35,000

Immediately prior to completing these IDSM projects, this facility consumed 441 MWh, and consumption dropped to between 263 and 319 MWh annually since 2010. Bills decreased correspondingly. The peak demand dropped from 275 kW in 2010 to 211 kW in 2011, and increased to 258 kW between 2011 and 2014, as shown in Figure 5.

Figure 5: Energy Consumption and Bill Summary, 2010-2014



3.2.3 Case Study 3: Maintenance and Operations Building

We also initiated a third case study. We were able to obtain technical and other project information from SCE, and were also able to assemble some pertinent details surrounding the project funding and decision-making from secondary/public information sources. However, we were not able to conduct interviews directly with the project sponsor, Irvine Unified School District (IUSD); thus, the findings presented here are more limited than the previous case studies, as they are missing direct input from the project sponsor.

Building Characteristics

The facility that is the focus of Case Study 3 is a building used by the Maintenance & Operations Department of IUSD, which is a school district located in Orange County, California. The school district lies within the service territory of SCE.

The retrofit building is a large, square, detached structure with very few windows and is surrounded by parking lots. In 2010, and prior to completing energy upgrade projects, the building's total annual consumption was 230,000 kWh and the maximum demand was 88 kW. Its maximum annual demand in 2010 was 88 kW, which typically occurred in July as a result of hot weather and the use of air conditioning equipment.

Case Study 3, IDSM Project Overview

The school district engaged in all three demand side management strategies—energy efficiency, demand response, and distributed generation—since 2010. As noted in Table 10, recent energy projects began with the installation of photovoltaic generating capacity, followed by energy efficiency upgrades and enrollment in a demand response program.

Table 10: Case Study 3 (Operations and Maintenance Building) Timeline

Pre-2010	2011	2013	2014
In 2008/09, school district personnel attended an energy conservation conference, launched energy conservation campaign	Distributed Generation Installed (Solar PV)	Energy Efficiency Upgrades (part 1) Enrollment in Demand Response Program	Energy Efficiency Upgrades (part 2)

Irvine Unified School District Energy Conservation Activities – 2008/2009

Similar to Clovis Unified School District and the City of Hawthorne, the energy conservation efforts of IUSD can be traced back to events of 2008. For IUSD, its energy conservation focus was inspired initially by the State budget cuts of 2008, which forced the school district to make difficult financial decisions.[27]

Faced with the possibility of making cuts to school supplies or teacher salaries, other budget items were scrutinized that might have offered less painful paths to cost savings. The District's Director of Maintenance & Operations reviewed operating budgets and reported that the District was spending approximately $4 million annually on electricity. Furthermore, the Director thought it was possible that conservation efforts resulting in a 10 percent reduction in electricity consumption could generate $400,000 in savings and successfully avoid the need to make other spending cuts. As a result, in 2008, IUSD launched an ambitious energy conservation initiative it hoped would save hundreds of thousands of dollars for 2008-09, while promoting environmentally sound practices.

[27] http://www.iusd.org/district_news_information/IUSDToday_issues/IUSDToday0408.pdf

"Some of our strategies for energy conservation are simple things each of us can do every day, such as turning off lights where they're not needed, keeping doors closed when the air conditioner is running and shutting down equipment that's not in use.

Others require a little more sacrifice. In addition to asking staff to remove small refrigerators, space heaters, microwaves and other personal appliances, we've consolidated our high school summer courses at Irvine and University high schools, giving our Northwood and Woodbridge campuses the summer off."[28]

However, the Director did not champion this idea without garnering support from the community. The District offered an online survey to its constituents to gather input on how to adjust its budget to conform to the state's cutback requirements. More than 300 surveys were completed and submitted, and energy conservation-related strategies ranked number one on the list of ideas that were offered for consideration. Energy conservation was viewed as a way to realize significant savings with little negative impact on instruction or operations. Moreover, it went further than offering an acceptable way to cut spending; it also offered positive educational value, as stated in this quote from a school district representative in the District's "News and Notes" publication of May 2008:

"In a sense, it's simple: We go green, we save green, and we promote the environmentally responsible values that today's students will carry with them into the future."[29]

To assist with the launching of the energy conservation efforts, a nonprofit called "The Energy Coalition" paid to send a few District employees to a conference in Norway, where they learned about energy conservation strategies and opportunities.[30] After attending the conference in 2008, Irvine employees returned home with many new ideas for trimming energy consumption and costs.

The Energy Coalition paid for the District employees to attend the conference. The Energy Coalition is a non-profit organization founded more than 40 years ago by John Phillips, who is considered by his organization to have been an "early energy-efficiency pioneer". He developed and managed some of the first energy cooperatives of building managers working together to collectively reduce energy demand. Today, the Energy Coalition partners with communities, public agencies, businesses, educational institutions, and utilities across the state of California to design and implement a broad range of energy-saving strategies, including energy retrofit project turnkey services, engagement and education, and energy policy leadership.

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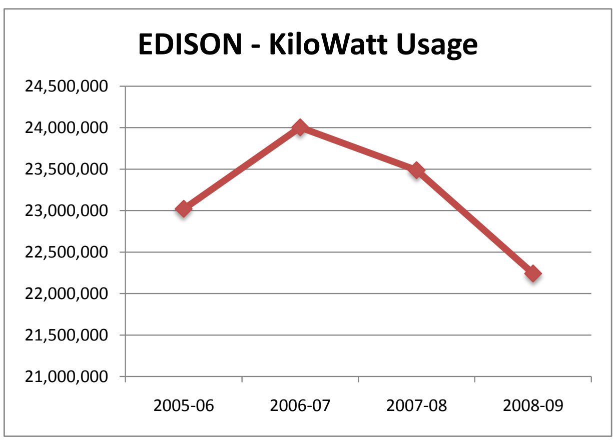
[28] http://www.iusd.org/district_news_information/IUSDToday_issues/IUSDToday0408.pdf
[29] http://www.iusd.org/district_news_information/IUSDToday_issues/IUSDToday0408.pdf
[30] http://newsflash.iusd.org/category/solar-power/

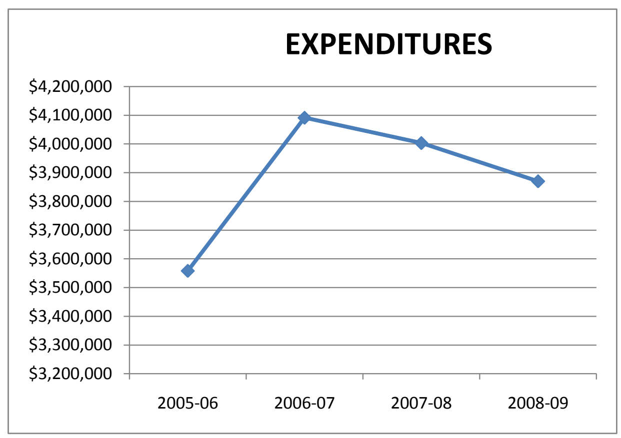
IUSD staff, along with the student body, worked diligently over the 2008/2009 academic year to capture as many dollars as they could through energy savings and conservation efforts. The resultant strategies and day-to-day actions of students and staff were very successful in generating measurable savings, setting a positive precedent for looking to energy conservation as a way to meet budget demands.

From 2007-08 to 2008-09, IUSD was able to reduce its kilowatt usage from nearly 23.5 million to 22.2 million, yielding a monetary savings of nearly $133,000[31]—despite a concurrent utility electricity rate hike. Figure 6 below shows the conservation achievements associated with electricity savings from these early energy efficiency efforts.

Figure 6: Irvine Unified School District Electricity Expenditures, 2005 through 2009[32]

EDISON	2005-06	2006-07	2007-08	2008-09
$$	$3,558,280	$4,091,152	$4,003,098	$3,870,133
EDISON - KiloWatt Usage	23,021,534	24,005,184	23,488,716	22,242,184





Importantly, conservation efforts saved more than electricity—they also saved natural gas and water. Including all three resources, estimates are that IUSD generated nearly $300,000 in savings on its utility bills in 2008-09. Moreover, the conservation efforts and associated curriculum grew even further and went on to include campaigns for expanded recycling, site-based "Green Teams" that promote conservation to the student body, and a "green" curriculum focused on energy and sustainability, including renewable energy resources. A school district representative stated:[33]

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31 https://www.iusd.org/district_services/fiscal_services/BudgetFAQ.html
32 https://www.iusd.org/district_services/fiscal_services/documents/4yrutility-Edison.pdf
33 http://www.sunedison.com/sites/default/files/file-uploads/resources/irvine_usd_case_study_012114_s.pdf

> *"We have developed our own fifth and sixth grade curriculum that lets students learn about a variety of types of renewable energy. We discuss the pros and cons of different types of renewable energy. We are hearing that kids are more aware of things like conservation, recycling, and global warming. And the community appreciates the nonpartisan way we present the education."*

Distributed Generation

At the time that Irvine employees returned from their energy conservation conference in Norway, they did not have any specific plan to pursue solar power. Irvine employees anticipated that installation of photovoltaic systems would require a major capital outlay, which was beyond the school district's means. However, through additional research, they learned of an opportunity to partner with a solar energy company (SunEdison) such that the solar systems could be installed with zero up-front capital costs for the District.

Under this partnership opportunity, SunEdison retained ownership of all the solar equipment and also took responsibility for the system installation and ongoing maintenance. In return, IUSD agreed to buy all the power generated from the solar systems at a rate that was guaranteed to be significantly reduced compared to pre-existing utility costs. Each system was installed with no upfront costs payable by the schools and no maintenance costs through a 20-year power purchase agreement. SunEdison and its financing partners, including subsidiary TerraForm Power, would be the owner-operators of the systems.

Irvine employees decided to bring the idea to the school board for approval. It was at this juncture that they initially developed the plan to work the solar project into the District's curriculum. The idea was to raise awareness of the environment and to build a positive educational component based on the natural world. When Irvine employees and others working on the project went to the school board with their idea, they included 18 specific lesson plans for upper-grade elementary students; suggested lessons included topics such as experimenting with changing the angles and shapes of wind turbines, making solar cookers, and racing solar-powered cars.

A school district representative stated:[34]

> *"We have developed our own fifth and sixth grade curriculum that lets students learn about a variety of types of renewable energy. We discuss the pros and cons of different types of renewable energy. We are hearing that kids are more aware of things like conservation, recycling, and global warming. And the community appreciates the nonpartisan way we present the education."*

[34] http://www.sunedison.com/sites/default/files/file-uploads/resources/irvine_usd_case_study_012114_s.pdf

The proposal won strong approval from the board. The first phase of the project included installing solar panels on 13 rooftops and two parking lot shade structures throughout the District, and was completed in February 2010. Phase 2 included nine additional sites throughout the District, including the installation on the Maintenance & Operations Department building that is the focus of Case Study 3. Overall, the solar installations enabled the District to reduce energy spending by about $9.6 million over the projected 20-year lifetime of the solar system. Savings generated by a reduced utility bill are 'unrestricted', meaning they can help offset any other operational cuts, or increased demands on budget.

Furthermore, the projects were so successful that solar has become an integral part of IUSD's planning process for the construction of new facilities. The school district reports that it is looking forward to extending renewable energy solutions to both newly constructed locations, as well as more existing locations in the years ahead. The Director of Maintenance & Operations stated:

> *"We have set up a master agreement with SunEdison for existing sites and future sites. As new schools come online, it's now easier to bring solar into these new sites."*

IUSD's solar panels generate about 25 percent to 60 percent of the electricity that each campus consumes, but the school district believes the benefits go beyond the utility bill savings. The installations also serve as the basis for standards-based instruction, allowing students to learn about photovoltaic technology on their own campuses as they track energy production and consumption in real time.

The solar system installed at the Maintenance & Operations building that is the focus of Case Study 3 consists of photovoltaic panels with a total capacity of 50.4 kW that were connected to the grid in February 2011. The expected annual production prior to installation was 75 MWh, or about one-third of the building's pre-solar consumption. The solar installation and equipment costs were estimated to be about $250,000, per the CSI program tracking system information.

Table 11: Case Study 3 (Maintenance & Operations Building) - Distributed Generation Details

DG Measure	Solar PV
Interconnection Date	February 2011
Capacity (kW)	50 kW
Estimated Annual Production	75,000 kWh
Utility Program	CSI, Performance Based Incentive
Utility incentives	$82,000
Total Cost	$243,000

Energy Efficiency Retrofits

The school district improved the efficiency of the building's lighting system in 2013. The lighting changes consisted of the installation of occupancy sensors, delamping, and the replacement of existing 32 watt T8 lamps with 28 watt bulbs. These changes were prompted by an audit conducted as part of SCE's Schools Energy Efficiency Program. In 2014, the school district also installed a heat pump. The utility program incentives paid the majority of the equipment installation costs.

Table 12: Case Study 3 (Maintenance & Operations Building) - Energy Efficiency Measures

Energy Efficiency Measure	Lighting: Occupancy sensors, delamping, high efficiency T8. HVAC upgrade (heat pump)
Installation date	February 2013, March 2014
Estimated electric savings	55,000 kWh
Estimated peak reduction	16 kW
Utility Incentives	$37,000
Customer Cost	$1,000
Total Cost	$38,000

Demand Response

In 2013, the school district also enrolled this building in SCE's Automatic Powershift rate. The school district participates at the 50 percent cycle level, which means the air conditioning system cycles on and off in 15 minute increments during demand response events. The school district chose not to participate in SCE's automated demand response, which would have required load reductions by 30 to 35 percent

3.3 Project Processes, Influences, and Resources

The processes that led to the execution of IDSM projects for our case studies share some important common characteristics. All three case study projects were inspired to take initial energy conservation actions in 2007/2008 as a result of a combination of legislative policies, budget demands, and funding opportunities.

Legislation and Support

Clovis Unified School District (CUSD) participated in the Federal Energy Education Program, and responded to AB 32[35] by adopting substantial new energy conservation policies and taking steps to save energy via PG&E's Retrocommissioning Program. The City of Hawthorne was also motivated by AB 32. In response to the legislation, the City was motivated to work with South Bay Cities Council of Governments (SBCCOG) to conduct a greenhouse gas emissions inventory and to develop a Climate Action Plan that stipulated plans for energy saving retrofit projects.

The Irvine Unified School District's demand side management investments were further enabled by an educational conference sponsored by The Energy Coalition, where it acquired initial informational and policy material to begin its conservation campaign.

Funding Needs and Opportunities

Each project was selected for implementation in response to external offerings of substantial financial support that arose and were able to offset cost through program incentives. Both utility and non-utility programs played a role in each project. Non-utility energy-related programs and incentives play a particularly important role in the distributed generation installations, where they appear to have in fact provided the primary inducements for action.

Both CUSD and the City of Hawthorne were beneficiaries of the American Recovery and Reinvestment Act (ARRA) Energy Conservation Block Grants. These funds were instrumental in reducing costs for the distributed generation elements of the IDSM projects, but also more generally acted to focus the attention of local agencies on the importance of energy conservation and distributed generation projects.

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[35] Assembly Bill 32 (AB 32) is the California Global Warming Solutions Act of 2006. It requires by law a substantial reduction of greenhouse gas (GHG) emissions, such that the state achieves 1990 levels of GHG by 2020. AB 32 was the first program in the country to take a comprehensive, long-term approach to addressing climate change, and its design reflects the state's desire to improve the environment while maintaining a robust economy.

While CUSD and the City of Hawthorne had access to capital to fund their solar system investments, the more capital-constrained IUSD found a very different solution. IUSD worked closely with SunEdison to complete more than 22 solar installations throughout its area. The deal offered by SunEdison allowed IUSD to sponsor these photovoltaic installations without any out-of-pocket capital expense. SunEdison was able to leverage tax advantages that IUSD could not, which helped spurn this deal structure to succeed from all parties' perspectives. In return, IUSD was able to lock in a reduced rate for electricity generated by the photovoltaic systems through a power purchase agreement.

IUSD was motivated to launch energy conservation efforts in 2008 by the need to accommodate state budget cuts and reduce spending. The District's constituents viewed energy conservation as a way to save operating expenses without sacrificing their educational quality—in fact, they viewed conservation to have quite the opposite effect on education; IUSD viewed energy conservation efforts as a way to augment and improve its overall curriculum.

CUSD's facility modernization efforts were supported by a substantial influx of state and local funding. State funding totaling $11.2 million for the District was provided through the California Clean Energy Jobs Act (also known as Proposition 39), which allocated $550 million annually beginning with fiscal year 2013-14 for eligible projects to improve energy efficiency and expand clean energy generation in schools. CUSD was among the early school districts that received allocations from these funds. Its early access was enabled by the District's proactive planning for facility and energy needs.

The local funds were made available by a bond measure passed by Clovis County voters in 2012 that allocated $268 million for the modernization of the school district's facilities, and an additional $25 million for the installation of solar photovoltaic systems. The amount dedicated to solar was based on an analysis by a solar developer of the locations and size of solar systems that would make sense for the school district. Criteria were based primarily on financial calculations of the optimal combination of utility meters yielding the highest possible 25-year net savings. These calculations took into account the avoided costs at each meter given the rate paid per kilowatt-hour at that meter, the optimal system size for the meter, and the installation and operating costs of the resulting solar system attached to that meter. Physical factors, such as fire lane access and fire safety codes, shade assessment, and proximity of a potential solar system to the energy meter were also considered.

The City of Hawthorne was spurred to install its solar generation by the availability of federal funds from ARRA and the California Solar Initiative (CSI). ARRA stressed "shovel-ready" projects that could be implemented right away, and the City of Hawthorne had a large amount of roof space available at the senior and memorial center we discussed as Case Study 2. The availability of additional funds from CSI presented Hawthorne with a solar installation that would be essentially fully funded and offer long-term energy generation to offset part of the complex's usage. Proceeding with the project (which predated the recent energy efficiency upgrades and participation in a demand response program) availed itself, and the City proceeded. It appears that the availability of the federal funds were the primary stimulus that resulted in the installation of a solar photovoltaic system on the senior and memorial center.

Engaged Energy "Champion"

All three case studies involved building owners and operators who were committed to their facilities and sought to operate them efficiently and sustainably. All three case studies involved public sector building owners with an engaged champion of energy conservation and/or sustainability.

CUSD employs an energy management coordinator whose role also includes energy education. He is very involved in energy-related facilities choices and works closely with outside contractors and PG&E's account representative. At IUSD, the Director of Maintenance & Operations played a major role in getting the initial conservation work launched in 2008, and then received support from other faculty in putting together the distributed generation proposal and accompanying curriculum. The City of Hawthorne has a staff member assigned lead responsibility for energy management and coordination of energy improvements for the city's buildings.

Energy Policy

All three organizations formalized their energy policies in 2008. CUSD adopted an energy conservation guideline into its Governing Board policies. The policy assigned responsibility and created a mechanism for accountability, which helped to ensure the policy would be carried out. The City of Hawthorne formalized its energy policy through the development of a Climate Action Plan that encouraged the use of renewable energy and implementation of conservation efforts. IUSD formalized its energy policy in a number of ways. First, under pressure to reduce operating costs, IUSD staff put together a set of measures and actions that it felt could reduce energy costs by a measurable margin. Then, in subsequent steps, the District incorporated energy conservation and renewable energy into its curriculum. It did so in conjunction with the decision to adopt distribution generation, finding the two went hand-in-hand to offer financial benefits and educational value.

Preparation and Energy Audits

Both the City of Hawthorne and CUSD had conducted energy audits and analysis and so were prepared to take advantage of funding opportunities as they arose. At the time that ARRA and Proposition 39 opportunities presented themselves, CUSD had already undergone analyses of both energy efficiency and generation opportunities. It completed facility audits in 2009 and identified energy-related projects in every school. Furthermore, it analyzed net metering opportunities at each school and identified the best opportunities for solar generation (based on cost savings). The City of Hawthorne had completed citywide energy audits as part of its Climate Action Plan and participation in both the South Bay Council of Governments and SCE's Energy Leader Program.

3.3.1 Utility Relationships and Programs

The utilities' respective programs played a role in the case studies' energy projects, but their influence on the specific retrofit efforts we examined differed.

CUSD coordinates with PG&E's account representative on all of its energy-related projects to determine whether applicable programs and incentives are available. For the building modernization efforts at Mountain View Elementary School, the District participated in the Savings By Design Program, which offers performance-based incentives based on estimated post-retrofit efficiency levels compared to Title 24 energy codes. The design yielded expected performance of 16 percent over Title 24, which translated into a relatively modest incentive of about $38,000.

The District's participation in this program was shepherded by the customer relationship manager, who serves as a one-stop-shop for all of the District's interactions with PG&E. The District had reached out to the account representative about six to nine months before the project. In this case, the incentive was a modest share of the total project cost and effort and did not influence the project design, although at other times, the built-in incentives in the utility programs do result in revisions in the school district's project.

While the utility programs did not have a substantial direct influence on the modernization efforts, the utility-customer relationship appears to have helped build awareness and capacity within the school district. PG&E's customer relationship manager credited CUSD staff with having internalized California's loading order in response to her efforts to explain why following the loading order is good for customers in the context of utility rates, services, and program offerings.

The City of Hawthorne participates in SCE's Energy Leader Partnership and is active in the South Bay Cities Council of Governments, through which it receives program support and elevated incentives. The Energy Leader Partnership is a joint effort of SCE and Southern California Gas (SCG) to recognize and reward cities for their conservation efforts. As participants engage more in energy efficiency, demand response, and community involvement and outreach, they move up to higher tiers of participation that provide greater incentive levels. For example, Silver Level participants receive incentives of 11 cents per kilowatt-hour of lighting savings instead of 8 cents for basic participants at the Valued Customer Tier.

Program representatives from SCE and its implementation partner indicated that they encourage participants to move up in the tiers through energy related projects. They indicated that they encouraged participation in SCE's demand response offering because demand response is a requirement for Gold Tier program participation.

More generally, the program results in dialogue with the participating government entities and amongst the energy managers at each. The program involves meetings of participating energy managers every other month to allow for information sharing in addition to one-on-one contact between program representatives and the local governments.

Indeed, a City of Hawthorne representative credited the Energy Leader Partnership and its participation in the South Bay Council of Governments with several important elements that were key contributing factors in the City's work on energy-related improvements:

- The City completed audits of all of its buildings through the partnership. These audits would not have happened otherwise, and they provide the City with an inventory of energy efficiency opportunities at their facilities, thereby enabling informed choices. For the senior and memorial center, for example, the program has already helped the city identify an HVAC upgrade and develop conceptual plans for the nature of the upgrade when system performance requires it or funds become available.
- The Tier levels embedded in the partnership motivate further action. The City was surprised to find out that it had qualified for Gold Tier status when it reached this level, but this accomplishment encouraged it to look more deeply into what it would take to reach the next level—Platinum.
- The City's participation in a demand response rate for the complex was prompted, at least in part, by the Energy Leader Partnership's requirement that customers in the Gold Tier participate in a demand response offering.

The combination of information, technical support, and incentives offered by the utility programs clearly had an effect on the considerations of the case study decision-makers, as well as their capacity to take action.

IOU Customer Service Representatives

In both Case Study 1 and Case Study 2, we found the utility to have an active relationship with the customer. The nature of the relationship comprises frequent contact and occasional consultations by the utility account representative with the customer and engagement by the customer with efficiency programs offered by the utility. More detail on these relationships and relevant programs follows.

PG&E's Relationship with Case Study 1 (Elementary School)

PG&E has a good working relationship with CUSD that involves frequent contact between the utility's customer relationship manager and the school district's energy management coordinator. The utility customer relationship manager is the point person for all matters related to PG&E, ranging from rates, bills, and service issues to energy efficiency programs. In this capacity, the customer relationship manager serves as a single point of contact who navigates the internal departments and programs on behalf of the customer.

PG&E's customer relationship manager for CUSD emphasizes communications about California's loading order in her interactions with customers, both "preaching" the hierarchy of the energy resources (efficiency, demand response, and distributed generation) in her interaction with customers, but also explaining why following that sequence is in the customer's best interest. In doing so, she explains the current utility rate structures and the direction rates are going in California. She indicated that getting customers to pay attention to the loading order is a challenge because many customers do not understand the rate structures, and solar companies' marketing is leading customers to believe their need for the utility will disappear with sufficient generation. However, she complimented CUSD for having understood and internalized the loading order in its internal decision-making.

When efficiency projects are under consideration—as was the case for Mountain View Elementary School—the customer relationship manager serves as the interface between the school district and PG&E's programs to identify and communicate utility program offerings and rebates that are available, which sometimes help shape the project details.

One of the resources available to the customer relationship manager and the school district is PG&E's Schools program, which seeks to serve as a trusted energy advisor for school districts by offering energy assessments, funding school district planning activities for participation in Proposition 39, and encouraging participation in utility efficiency programs that provide incentives to go beyond code.

Furthermore, PG&E has an IDSM manager, who described the utility's approach to IDSM this way:

> *"[We deliver] IDSM products and services via customer segment strategies that:*
>
> - *Are based on customer and channel intelligence*
> - *Address customer needs and programmatic gaps*
> - *Combine energy efficiency, demand response, and distributed generation offerings all at once, or over time, as it makes sense from a customer needs perspective.*
>
> *We always take an integrated approach when offering our products and services to customers, but different customers have different needs. We package and customize energy efficiency, demand response and distributed generation solutions for our customers in multiple ways every day. If a customer decides not to participate today, we try again with a new approach in the future. The point is, we never stop improving our offerings and marketing.*
>
> *The comprehensiveness and continuity of PG&E's energy efficiency, demand response and distributed generation programs is critical to meeting the needs and desires of the thousands of*

market players who help us achieve our ambitious state energy and environmental goals. This is what makes us the best entity to serve our customers' needs."

SCE's Relationship with Case Study 2 (Senior Center)

Both SCE and the City of Hawthorne spoke of a good relationship in which the utility and the South Bay Council of Government brings valuable information, technical expertise, and services to the City. Furthermore, the Energy Leader Program provides incentives that spur energy projects and encourage both energy efficiency and demand response.

Furthermore, the City also spoke of Los Angeles County's Enterprise Energy Management Information System as a valuable resource. This system allows cities in the county to track and analyze their individual buildings' energy consumption over time at various levels of resolution.

3.3.2 Project Process

In this section, we discuss the observable factors and processes that led to the energy-related work at the two primary case studies.

As noted, CUSD's renovation work at Mountain View Elementary School was part of an extensive effort to modernize all of the District's facilities. While the effort was not motivated primarily by energy concerns, energy-related opportunities were an important component of the upgrades and were carefully considered and incorporated into modernization projects wherever possible. The energy components comprised both functional and efficiency improvements with an emphasis on the former.

The school district led the project's development and definition of needs, and then worked with its architectural consultants. For the energy components of the project, the school district's energy management coordinator was intricately involved and worked through its building design consultants to develop the technical details of the work to be done. In this iterative process, the energy management coordinator also discussed the project with PG&E's customer relationship manager.

Among the improvements at Mountain View Elementary School, revisions to the HVAC system improved the space conditioning and ventilation for the classrooms, while also providing some improvement in the building's energy efficiency. The solar installation provides electricity and is also visible from the street level. Other components of the project included expanding the school's library and office, upgrading an aging HVAC system and its fire alarm, improving landscaping and security features, improving accessibility, and improving ventilation.

The City of Hawthorne is guided by the availability of funding and the effect of efficiency projects on its costs. The City takes a pragmatic approach to energy-related improvements, "chipping away" at opportunities when money becomes available. The City upgrades equipment as needed upon failure and when technology changes. For example, the City of Hawthorne has upgraded lights in the senior and memorial center over time. However, budget constraints are prevalent, so funds for extra projects and accelerated equipment replacements sometimes need to come from external sources. If a project makes sense and funds are available, the City will proceed with the work. Given the City of Hawthorne's pragmatic approach and funding constraints, the energy-related work we describe was not part of a strategic plan, but came about as opportunities availed themselves.

Integrated Demand Side Management Strategies

Two of the principles of IDSM are that (1) efficiency, demand response, and distributed generation are considered and traded off against one another in an integrated fashion and (2) these resources are sequenced primarily according to California's established loading order. While the two case studies showed some elements of IDSM by virtue of incorporating multiple energy resources, neither case study embodied the full elements of an ideal IDSM project.

CUSD approached the energy resources per the loading order at Mountain View Elementary School and considered its energy work holistically. That is, the energy efficiency efforts—and the entire modernization effort—were planned in a comprehensive fashion, and the sizing of the solar generation was considered with the energy efficiency improvements in mind. Energy efficiency improvements were based on an energy audit, while the solar installation was based on considerations of the school's energy consumption and energy efficiency projects, as well as an analysis of the solar potential among all of the school district's campuses.

For PG&E customers, net metering occurs separately for each meter, and the rate benefits diminish if net consumption is negative. Hence, the customer has a built-in incentive to take into account any planned energy efficiency improvements when sizing solar photovoltaic systems.

Mountain View Elementary School—and other CUSD campuses that have photovoltaic system installations—do not participate in demand response rates, due to their on-site solar generation. PG&E representatives clarified that accounts with solar generation are not eligible for some demand response rates because the generation already mitigates the load reduction potential. Furthermore, load reduction is computed from the electricity supplied to the customer by PG&E, so solar generation diminishes the credit customers receive. District officials indicated that they have tried demand response rates and peak day pricing at some facilities. This participation helped to reduce its total energy bills by $110,000 annually, but the District has observed increases in the number of demand response events called in 2015—an issue of potential concern if the trend continues.

The City of Hawthorne sequenced the solar installation to come first, followed by participation in demand response, and finally energy efficiency. These efforts were independent decisions by the City and not part of a coordinated plan. Rather, the three energy interventions we discussed were done as part of regular building maintenance and upkeep. The City has an ongoing interest in energy improvements and in managing costs, and upholds a responsibility to maintain functional and safe facilities.

While the particular energy upgrades we examined were installed in the reverse order of the ideal sequence for IDSM, the City is aware of the California loading order and the desirability of pursuing cost effective energy efficiency before distributed generation. In this building's case, the opportunities and funding happened to present themselves in reverse.

Nevertheless, it seems unlikely that there was any negative effect from the reverse sequencing. The solar generation was designed to maximize the use of available roof space and does not exceed the total load of the building, or impede the realization of remaining potential for savings from energy efficiency or demand response, and therefore did not change the distributed generation cost-effectiveness from the perspective of the City or ratepayers. The issue of whether the allocation of available funds across distributed generation, energy efficiency, and demand response opportunities was optimized never came up for the customer, because they were not viewed as fungible opportunities.

Whether opportunities were optimized from a societal perspective may depend on how one values the economic benefits of the American Recovery and Reinvestment Act.

Interestingly, in our case studies, the distributed generation dwarfed the efficiency and distributed generation efforts in scale, as measured by total investments. Even with the entire cost of an HVAC system replacement at Case Study 1 (Mountain View Elementary) included as an efficiency cost, the total spent on distributed generation exceeded the investments in energy efficiency across the three facilities. For the two case studies at which efficiency costs can be clearly delineated, the ratio of the dollar investment in solar generation to that in efficiency was about 18:1. While this may not be the case universally across non-residential building retrofits that include the elements of IDSM projects, it is a noteworthy characteristic for our case studies.

Some of our interviewees working on behalf of utility programs commented on the challenge of implementing IDSM when funding comes from different sources and cannot be comingled, and utility engagement with customers on solar power is limited in comparison to the role of private sector solar developers and energy service companies.

These barriers create scenarios in which customers move forward with distributed generation before energy efficiency. However, the utility representatives we interviewed do believe that people understand IDSM better than they did, so integration is considered more frequently now. Some of our interviewees believe that getting in front of the decision-makers at the utility customers is key to continued progress.

3.4 Implications for Integration of Demand Side Management

The case studies we presented above were intended to present depth rather than breadth and thus may not be representative of the larger population of building retrofits that address (or could address) the full range of energy resources. Nevertheless, the case studies suggest some dynamics and implications for the integration of demand side management that may warrant further consideration and exploration. In particular, we identified factors that seem to facilitate use of integrated energy resources, the importance of the utility relationship, presence of utility and external forces at play that complement and sometimes conflict with the integration of energy resources, and unique attributes of distributed generation.

3.4.1 Facilitating Factors

The case studies we examined share many characteristics:

- An interest or public mandate to minimize operating expenses;
- An organizational commitment to sustainability, as evidenced by:
    - A formalized energy policy, or Climate Action Plan
    - An assigned energy manager
    - Completion of energy audits and analysis in anticipation of making energy improvements;
- Interactions with non-profits, utilities, and government programs that support and encourage energy conservation in a variety of ways;
- Funding opportunities that provide significant cost savings for energy improvements, such as ARRA and Proposition 39, as well as CSI and utility programs; and
- An active relationship with their utility, either through an account manager or an energy-related program.

We believe that none of these factors are independent of the others, but that each facilitating component enables the others—and together they support comprehensive energy retrofits.

It is less clear to us why the case study sites nominated by the utilities featured primarily publicly owned facilities. It may be worth considering this dynamic further to understand whether those happen to be the customer types utilities know the best (and thus are the ones they think of), whether it was being positioned to perceive a greater direct responsibility to implement policies of AB 32, or whether they were in the advantageous position of receiving greater support from federal and state funding and energy programs versus private organizations. Perhaps it was all of these factors.

3.4.2 Utility Relationship

While the totality of the incentives provided to customers through the combination of rate structures and program offerings matter greatly, the utility's relationship with its customer is a key to promoting integrated and wise use of energy resources in the current program structure. The utility's account manager or other interactive contact through program initiatives—as in the case of the City of Hawthorne's participation in the South Bay Council of Governments—offers a vehicle by which utilities can provide a holistic view of the customer's options and incentives. This vehicle provides an opportunity to present California's loading order not as a state policy goal, but in a way that presents to customers the benefit of looking first to efficiency, then demand response, and finally to distributed generation.

3.4.3 Utility and Non-Utility Forces

Utility rate-based incentives and rebates to offset the cost of efficiency upgrades have the power to spur action among customers, especially when the scale of the incentives is significant. As of now, rate-based incentives and rebates still appear to be largely distinctly focused on demand response and energy efficiency, respectively. Utilities administer a variety of energy efficiency programs—some cross-cutting and some for specific customer sectors—as well as demand response programs. Internal integration appears to come in the form of communication within the utilities and presentation of the utility's services by the customer's account manager who serves as a one-stop shop. As such, customers with a dedicated account manager who takes the initiative to present utility offerings in an integrated fashion probably receive a more holistic overview across the various energy resources than unmanaged customers who face a wide array of program offerings across efficiency, demand response, and distributed generation. Nevertheless, programs internally still are distinct and operate in parallel rather than as integrated programs.

There are—or have been—substantial drivers toward energy-related projects at customer facilities from sources *external to the utility-customer relationship and the regulated energy arena*. As shown in our case studies, federal and state grants and local bond funding drove our case study sites to install solar generation that may not have happened otherwise. As noted, ARRA, CSI, and California Proposition 39 all had substantial influence on the energy-related work at our case study sites. True integration of demand side management activities would need to encompass coordination or alignment of incentives and resources provided to customers within and external to the utility-customer relationships. While that might be difficult with federal initiatives, such as ARRA, state-level policies and programs could be coordinated more closely.

3.4.4 Unique Market Dynamics for Distributed Generation

In contrast to energy efficiency and demand response, distributed generation does not fall primarily within the utility paradigm. External funding sources, such as federal and state grants, and a seemingly growing industry of solar developers compete for the customer's attention on issues related to customer-sited power generation. As noted in our case studies, these external forces were influential in spurring large solar generation installations at the case study sites, while the efficiency and demand response activities were comparatively small. Efforts to promote IDSM need to account for external forces such as third-party grants and market actors encouraging organizations to sponsor installation of distributed generation (mostly photovoltaic arrays). Private vendors are continuing to promote a variety of solar offerings—both customer owned and third party owned—and are even venturing into energy storage. These factors complicate the integration of distributed generation with energy efficiency and demand response. Indeed, coordination across regulated and unregulated industries as a matter of policy may be difficult. An alternate approach to promoting integration is to ensure that rate-based incentives provide the proper signals to customers and third party market actors.

Indeed, the seemingly disproportionate ratio of investments in solar generation over investments in efficiency or load-shifting at our case study sites was marked and warrants more investigation.

Appendix A: Data Request in Support of IDSM Research, Case Study Project Candidates, and Related Data Memorandum

MEMORANDUM

November 11, 2014

To: PG&E, SCE and SDG&E

From: CPUC

Re: Data Request in Support of IDSM Research; Case Study Project Candidates and Related Data

This memorandum specifies a request for information from the California Investor Owned Utilities (IOU) in support of 2013-2014 evaluation, measurement and verification (EM&V) research within the area of Integrated Demand Side Management (IDSM).

We ask the IOUs to respond to this data request within 15 working days of the date of posting, or November 27, 2014.

As indicated in an email dated October 27th and distributed to the IOU IDSM EM&V leads, the CPUC is requesting information in support of a study consisting of in-depth examination of costs and benefits of a small selection of recent IDSM retrofit projects (IDSM Case Study Project). The Case Study Project is designed to explore and illustrate the benefits of an integrated approach to DSM. The project will also explore the strengths and challenges of applying current protocol compliant DSM cost effectiveness measurement protocols in their application to IDSM projects. In order to highlight the benefits of integration and the appropriateness of various CE methods we want to select relatively typical building and occupancy features. A relatively intuitive and prototypical IDSM project will allow for a clear representation of project benefits and the ways they are reflected in CE calculations. Ideally, the selected projects will have fairly typical building and business features making the cost and benefit data easily accessible to a broad audience and offer project particulars that can be assumed relatively typical and applicable to a swath of potential IDSM retrofits.

Furthermore, we are interested in exploring the more complicated interactions of IDSM benefits and costs, for example:

- Is the value of energy saved during a demand response (DR) event changed if the site has distributed generation (and moves from being a net-exporter of energy to being a greater net exporter of energy during an event)?
- The energy resource loading order deploys demand response before distributed generation. How does this policy interact with protocols for program credit at sites with distributed generation (DG)?

- What is the difference in the value of benefits to various stakeholders, between energy savings at a site with grid-connected DG versus a site without DG?
- What is the value of load shifting that aligns generation and consumption, eliminating energy transmission and distribution costs? Where are these benefits accounted for?

IDSM Case Study Request

- From PG&E and SCE, the CPUC requests a list of at least five IDSM projects that meet the criteria described below, and the associated project and site data described in the remainder of the document.
- From SDG&E, given its smaller service territory, the CPUC requests at least two IDSM projects that meet the criteria described below, and the associated project and site data described in the remainder of the document.

Required Characteristics of Candidate Projects:

- Includes all three DSM technology types (EE, DR, and DG). Note that for small commercial and residential sites we understand the DR options are limited and may include only AC Cycling programs in some cases. Participation in Permanent Load Shifting programs or any type of Energy Storage utilized on site would fulfill the DR requirement. Also, if necessary, we will accept projects that include a demand management component, such as an EMS system that diversifies load to control demand, or a combination of time-of-use rates in conjunction with monitoring /controls technology that assists the customer in managing peak load.
- Project is complete and has a completion date after January 1, 2010.
- Project took place at an existing building (i.e. a retrofit project).
- Single Building Project: Either project was a single site or cost/benefit records are available that reflect implementation at a single site. The project site can be part of a larger building/site, such as a floor of an office building if there is separate IOU metering for billing purposes. Project can also be a single building among a larger set of buildings managed by a single organization, such as a building on a college campus or a municipal building.
- Distributed generation is Grid-Connected.
- Distributed generation is renewable (PV and wind—e.g. no gas powered fuel cells. Biomass maybe ok). DG should be "behind the meter".

- Site has under 200 kW annual peak load (to represent small commercial and residential).

Desirable Characteristics of Candidate Projects (*not required*):

- Project includes EE, DR, DG and *an energy storage* component (e.g. battery or thermal storage like Ice Bear).
- The EE measures include some that were part of an *IOU program*.
- Project site is an active DR participant and/or has pro-active load management strategies. E.g. Auto DR, EMS or similar controls equipment used for load management and/or facility has a load shifting strategy for bill management or DR participation.
- Annual generation is a substantial portion of annual consumption, i.e. about 65% or more of annual consumption and/or facility is typically a net exporter of energy during summer weekday afternoons/peak (around 4:00 to 6:00 pm).
- All three DSM components were *installed within a 2-year period*.
- Has a project completion date after *January 2012*.
- Project site is small commercial or residential—under 100 kW annual peak load.
- Not looking for large industrial /processing facilities. Wastewater okay, institutional buildings like university, schools, government are all good. Residential and multi-family are good candidates. Low income projects also good.

Project Sponsor/Customer Requirements

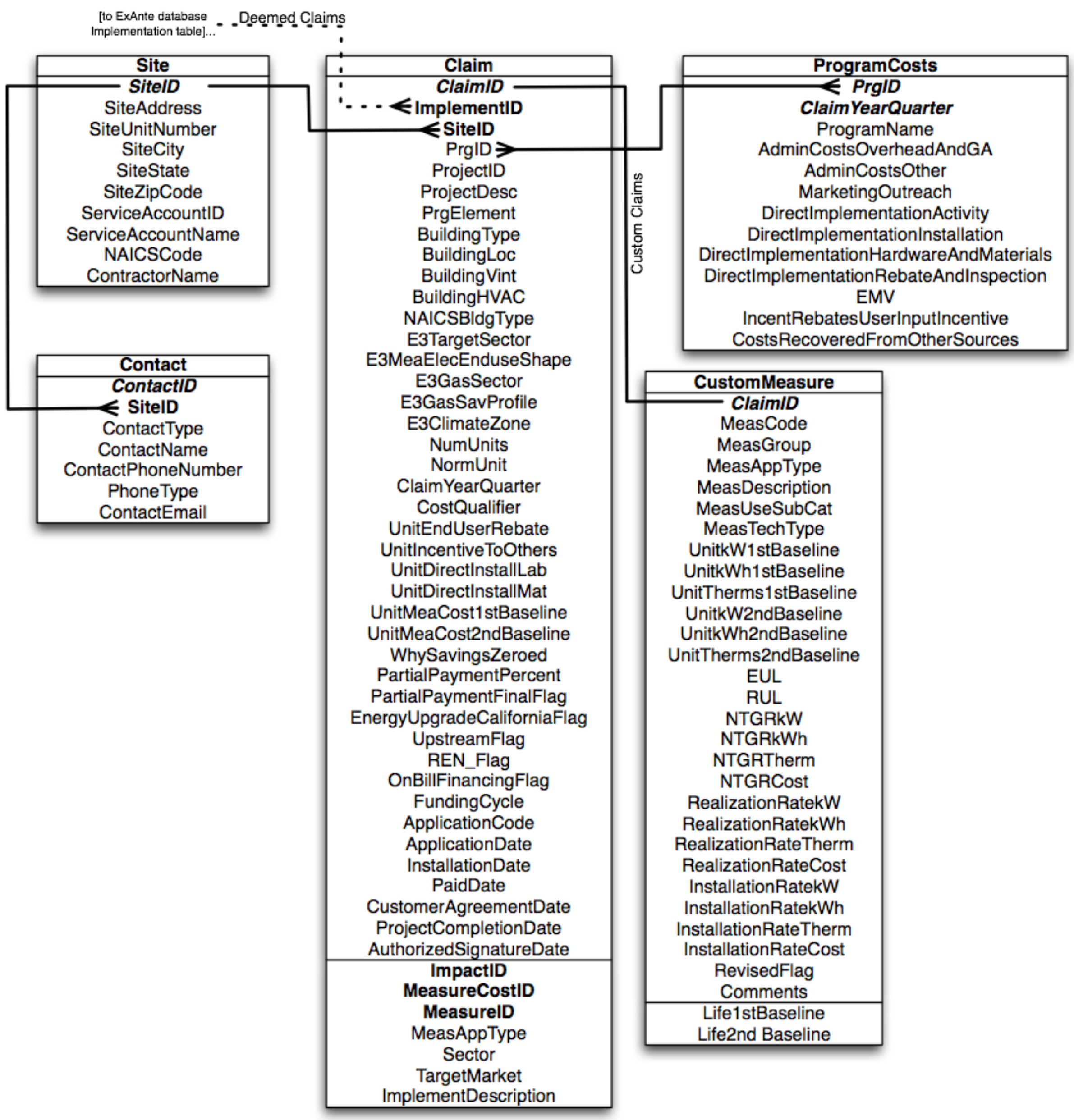
- We require that the customer sponsoring the IDSM project be willing to share information on costs and benefits for all 3 + DSM components of the project. For example, the ideal customer has cost and benefit estimation records and is willing to share them; cost and benefit estimation records may include: audit reports, contractor cost estimates, program application, project feasibility studies.
- Customer has and is willing to share: actual cost data, actual net-metered data (via IOU AMI/billing history). Although it is not an absolute requirement, it would be very useful to have generation records.
- Customer would be willing to share the names and contact information of design/contractor firms (or internal staff) involved in project planning, management and installation activities.
- The customer, or appropriate staff-member of the sponsoring organization would be willing to participate in an interview to discuss project details.

For each IDSM project candidate, please supply the following information:

- A description of the building that was the site of the IDSM project.
- A description of the organization that owns the building that was the site of the IDSM project.
- A description of the occupants of the building that was the site of the IDSM project.
- Provide a description of the business activities and key features of equipment and occupancy at the IDSM project site.
- Provide copies of all available project documentation related to potential and realized savings from energy using equipment, distributed generation equipment, and demand management equipment, including but not limited to:
    - Integrated and/or single DSM Audit Reports,
    - Retrocommissioning Audits and Reports,
    - Project Feasibility Studies,
    - Rebate program applications for DG/EE/DR as applicable.
- IOU Account Executive name and contact information.
- Customer contact name and contact information.
- All gas and electric account numbers active for the site.
- Site service address.
- Comprehensive billing histories for all accounts active at the site for the period extending one year prior to the initiation of the project and ending no less than one year following project completion:
    - Provide full descriptions for all applicable Rate Schedules and Tariffs for both gas and electric service in effect during the period.
    - Provide monthly gas charges in dollar terms.
    - Provide monthly gas charges in dollar terms.
    - Automated Metering Infrastructure (AMI) records where available, as well as monthly kWh, kW and therm usage data for all accounts applicable to the site of the IDSM project.
- Information about all programs providing rebates, incentives or supporting services, including annual values covering the period from one year prior to project initiation and extending through one year following project completion:
    - Program name
    - Program ID
    - Program cycle
    - Administrative cost for the program
    - Rebate costs for the program
    - Marketing cost
    - Other implementation cost
- Complete EE, DR, and DG program tracking records, as applicable. This includes all elements of quarterly program CPUC filings.

- For Energy Efficiency Programs these elements are illustrated below in Figure 1. Please include all elements in the Figure, as well as
  - Sizes, capacities
  - Efficiency rating
  - Make and model numbers
  - Full description of removed equipment
  - Description and source for baseline equipment used for impact claims – and 2nd baseline, if dual baseline measure
  - Source material for determining annual and lifecycle measure impact, e.g. workpapers, codes and standards documents, DEER

Figure 1: Requested Energy Efficiency Tracking Data



For Distributed Generation equipment rebated through SGIP or CSI, please provide all elements included in SGIP and CSI/PowerClerk program tracking databases.

For sites with Demand Response Program participation, please provide all data described above as well as the following:

- Names of all DR programs the site was enrolled in over the period

- The date of enrollment for each program. Date of exit if applicable.
- Documents describing DR program rules, program planning, program design.
- Please provide DR event data:
  - For a period extending from one year prior to IDSM project initiation to one-year following project completion, or for the period the site was enrolled (whichever is shorter) and for all DR programs enrolled in by the site, please provide the following event-related data:
    - Event dates and times
    - Interval of event, number of sites/devices controlled during each period, and sub-LAP (Load Aggregation Point) regions controlled
    - Event triggers – i.e. test vs emergency
    - Indicate which dates/times the IDSM project site was controlled
    - If applicable, indicate customer compensation or penalties resulting from the event

Appendix B: IDSM Case Studies, Analysis Plan, and Interview Guides Memorandum

MEMORANDUM

May 15, 2015

To: IDSM PCG

Re: IDSM Case Studies, Analysis Plan and Interview Guides

This memo provides an updated analysis plan and interview guides for developing the case studies for the "Bottom Up Assessment of Impact from IDSM Projects". This study is part of the 2013-2014 EM&V Research planned under the IDSM Research Roadmap.

1 Case Study Sites

We will begin with two sites and make final decisions about a potential third site and whether any substitutes are needed as we proceed.

The sites we have selected to develop initially are:

Site	IOU	EE	DR	DG
School district M&O bldg	SCE	Lighting, controls 2013	APS 2013	PV 50kW 2011
School	PG&E	We have selected a school district with extensive projects across many buildings. We plan to discuss four buildings with PG&E staff before making a final selection. Two of the schools appear to have received performance-based incentives for displacing or generating electricity. None of the schools was able to participate in DR because of rules or logistics.		

These initial sites meet most of the requirements we had set forth for the case studies, except that they are buildings owned and operated by the same type of customer – school districts – and the candidate in PG&E's service area does not participate in a demand response program. This latter issue may actually add an interesting component to the case study, as the school district apparently needed to scale back its involvement in demand response programs due to its development of distributed generation.

The choice of the final number of sites to be developed will depend on the depth of relevant information we obtain about the two initial sites and the level of additional analysis that seems appropriate at that point in time. Whether any substitutions in our initial selection are needed will depend on our early contacts with the sites we have selected. We will vet the availability of sufficient information in those initial contacts. (Note that we have already examined extensive data provided by the utilities about each site. The screening with utilities will supplement the vetting we did as part of the selection process and our review of data already provided.)

2 Intended Case Study Process

We intend to begin the case study interview process with conversations with the applicable utility staff. The diagram below illustrates our intended approach and a rough timeline. (Actual timing will depend on people's availability. We will move on to the next step immediately upon completing each prior one.)

Case study process

Get referral(s) from utility PCG contact (May 18-22)

Introductory call with applicable utility staff (May 26-29)

- conference call with program rep(s) and/or account manager
- introduce the case study
- vet the selected site (brief screening conversation/questions)
- set up time for an interview with utility rep(s)
- get introduction to customer contact

Introductory call to customer (June 1-5)

- introduce the case study, answer any questions
- if needed, vet the selected site (brief screening conversation)
- identify appropriate people to interview (if more than just main contact)
- set up time for interview

Interview utility staff (June 8-12)

Interview customer representative(s) (June 15-19)

Analysis, synthesis (throughout)

(if needed) Follow-up questions (June 22-26)

- third party interviews, if any, would occur here

The deliverables will follow the general outline presented in our memo to the PCG dated April 25, 2015, but final contents and organization will be guided by the results of our inquiries and analyses.

3 Interview Guides

The discussion guides for interviews with utility and customer representatives are shown below. They are modified and slightly expanded versions of the guides presented in the memo to the PCG dated April 25. We will develop a finalized discussion guide for third party interviews if any are required.

3.1 Utility representatives

Introduction/purpose

[Standard interview protocol – description of the project, interviewer role, degree of anonymity/confidentiality, interviewee title and role]

Customer background and history

Q1. Please tell me about the relationship between [utility] and [customer].

Who leads the relationship on both ends? What kind of interaction had there been before the projects?

Q2. Please tell me about the recent (energy-related) history of the building at [address/location]. We're particularly interested in the past three to five years.

Project history

Q3. What led up to the utility involvement in the building projects at that location?

At what point did [utility] get involved in the conversation?

Who contacted whom? Why?

What needs/issues did [customer] want to address?

What services, programs, and suggestions did [utility] offer?

What ultimately ended up being done and why?

In what ways do you think [utility] influenced the nature or design of the project(s) and [customer's] choices?

Q4. How did [utility] decide what programs to offer / discuss with [customer]?

Which programs did they ultimately end up participating in?

Q5. Were the offers presented to [customer] for each of these programs the standard offer you usually provide, or was there anything unique or customized?

What was different?

Project details

Q6. [As needed, confirm or supplement details on the summary rows of our partially pre-completed project summary sheet (attached).]

Q7. What else was done at the building or what other utility involvement was there that we haven't already discussed?

Project integration

Q8. In what ways were the program efforts connected, and in what ways did they occur independently of each other?

Probe on:

- decision-making stage
- implementation stage
- funding

Q9. In an ideal world, would there have been value in integrating or combining these program efforts or the work that [customer] did further?

What might that have looked like?

How would the work at the customer's location have needed to be different?

How would [utility's] programs have needed to function differently?

How would the customer have benefited? What would the drawbacks have been?

How would the utility have benefitted? What would the drawbacks have been?

Costs and benefits

Q10. [As feasible, work through the cost/benefit rows of our partially pre-completed project summary sheet (attached). Ask only about cells that the respondent would be able to answer. Verify #s that are pre-completed; obtain applicable #s that are missing.]

Q11. What does the cost-benefit calculation for the various programs in which [customer] is participating at this building look like from the perspective of [utility]?

Q12. Were there interactive or cumulative benefits or cost reductions from having done energy efficiency, demand response, and distributed generation together? In other words, was the total bigger than the sum of the parts in some way? How?

Q13. Were there counterproductive effects from having done these things together? In other words, was there a cost or benefit hit from the totality of the projects compared to what you would have gotten from each one individually?

Q14. In retrospect, would there have been ways to take advantage of cost and benefit advantages of integration across efficiency, demand response, and distributed generation? If so, how?

3.2 Customers

Introduction/purpose

[Standard interview protocol – description of the project, interviewer role, degree of anonymity/confidentiality, interviewee title and role]

Customer and building background

Q1. Please tell me about your organization and its facilities.

Q2. Can you tell me more about the recent history of the building at [address/location]? Have there been any major building construction or changes in the use or occupancy of the space in the past five years?

Probe on anything that would have affected the energy use of the building (without the EE/DR/DG work).

Q3. What changes did you make at that location since 2012 to reduce energy consumed, reduce energy costs and peak usage, and generate your own electricity?

Probe to identify which are part of the EE/DR/DG projects we have already identified and which are not.

What brought about those projects?

Q4. What led up to the building projects at that location?

(a) Were the energy projects part of something bigger?

(b) What need was being addressed?

(c) Who initiated the process?

(d) What else was being considered?

(e) What ultimately ended up being done and why?

(f) When and how did the utility enter the picture?

(g) Did the utility programs influence the nature or design of the project(s)? If so, in what way?

Q5. What were your decision-making criteria for deciding what was going to be part of the effort? (financial, functional, other)

How do these criteria compare to similar efforts you have initiated elsewhere in your building portfolio?

Project details

Q6. [As needed, confirm or supplement details on the summary rows of our partially pre-completed project summary sheet (attached).]

Q7. Was anything else part of your building work at that time that we haven't already discussed?

Project integration

Q8. In what ways were the energy projects we've been talking about connected in some way, and in what ways were they independent of each other?

Note: As needed, narrow the discussion to the utility-related EE, DR, DG efforts unless there were similar stand-alone efforts by the customer that did not involve utility programs.

Probe on:

- decision-making stage
- implementation stage
- funding

Q9. In an ideal world, would there have been value in integrating or combining or integrating any of the utility-assisted efforts further?

What might that have looked like?

How would your projects and efforts have needed to be different?

How would [utility's] programs have needed to function differently?

What would the benefits have been? The drawbacks?

Costs and benefits

Q10. [As feasible, work through the cost/benefit rows of our partially pre-completed project summary sheet (attached). Ask only about cells that the respondent would be able to answer. Verify #s that are pre-completed; obtain applicable #s that are missing.]

What were the benefits of each?

Probe on energy savings, demand savings, natural gas savings, bill reductions, non-energy benefits. Take quantitative data, where applicable and available, qualitative responses elsewhere.

What were the costs of each? [See attachment.]

Q11. Were there any ways in which the combination of the utility-assisted projects gave you greater or lesser net benefits cumulatively than if you had done that same work separately from the other components, say for different buildings? In other words, was the total benefit from those projects bigger or smaller than the sum of the parts in some way?

Probe to understand how.

Q12. [if applicable] Did you get any cumulative increases or reductions in the net benefit you received from all of your energy projects, including those that did not involve the utility at all?

Probe to understand which and how.

IDSM Case Study – Project Summary Sheet and Data Sources

Note: Actual data sheet will be formatted to allow more measure/action columns

Utility:
Customer:
Location / Building:

			Sources	Measure/Action 1	Measure/Action 2...
Summary	Type of Intervention	EE/DR/DG			
	Description	ex: replaced HVAC system under utility's XYZ program	a, b, c		
	Date	year completed	a, b, c		
kWh	expected savings	ex ante expectations -- based on program records / customer project data[36]	a, b, c		
	adjusted savings	ex ante expectations with adjustments, if any, typically made by evaluators to the gross savings for this type of measure	c, d		
	experienced savings	any obviously identifiable savings seen in the billing data (but not a full billing analysis)	c		
	interactive effects	notes on any interactive effects	c, d, e		
therms	expected savings	ex ante expectations -- based on program records / customer project data	a, b, c		

[36] Show separately if customer and program data show different expected savings.

	adjusted savings	ex ante expectations with adjustments, if any, typically made by evaluators to the gross savings for this type of measure	c, d		
	experienced savings	any obviously identifiable savings seen in the billing data (but not a full billing analysis)	c		
	interactive effects	notes on any interactive effects	c, d, e		
kW	expected savings	load reduction expected when invoked or at peak times (only for installation of measures/devices)	a, b, c		
	adjusted savings	not applicable…			
	experienced savings	load reduction credited as part of bill (if peak event) or demand savings visible at peaks on billing data	c		
	interactive effects	notes on any interactive effects	c, d, e		
Benefits	bill savings to the customer – measure only[37]	quantified - based on expected savings and rates	a, b, c		
	bill savings to the customer -- interactive effects[38]	quantified - based on net impact of the combination of measures, demand response, generation, and rate plan changes	a, b, c		
	other customer benefits (non-energy and unquantifiables)	discussed qualitatively in interview	a, e		

[37] Considering measure/action by itself, but assuming prior condition for all other conditions. For example, if rates changed due to DR program participation, an EE measure would be assessed based on the prior rate.
[38] Considering added net savings or costs of interactive effects only. For example, if rates changed due to DR program participation, an EE measure's net interactive effect might be the changed bill amount because a new rate is applied to the new level of energy (electricity) consumption.

	utility & societal benefits	discussed qualitatively - based on our assessment and utility interviews	a, b, e		
Costs	customer direct costs	quantified - based on program records (if incented) and customer interviews	a, b, f		
	utility / program incentives	quantified - based on program records (if incented), verified with customer interviews	a, b, f		
	other costs (internal to customer)	discussed qualitatively - will obtain categories of costs and high level estimates in customer interviews	a, e		
	other costs (internal to utility / program)	discussed qualitatively - will obtain rough estimate in utility interviews	b, f		
Measure life		if applicable, from standard measure life assumptions for energy efficiency projects or renewable system lifespan; duration of demand response participation	d, e, f		

Sources:

a) Customer interview / project documentation
b) IOU program staff/ account representative interview
c) IOU tracking data / billing data
d) Program evaluation reports
e) Secondary sources – technical documents
f) IOU program budget reports and program documentation