



# **FINAL REPORT**

## **Integrated Demand Side Management <sup>Text</sup>**

### **A Study of Preferences and Patterns of IDSM Uptake in California's Residential and Small Commercial Markets**

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# 1. Executive Summary

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## 1.1 Introduction and Background

This study is one of two studies implemented under the CPUC 2013-2014 IDSM Research Roadmap. This customer research study is concerned with understanding drivers and barriers to integrated demand side management (IDSM) solutions in California’s residential and small commercial mass markets.

At the direction of the California Public Utilities Commission (CPUC), the four California investor-owned utilities (IOUs) are providing distribution of and access to IDSM solutions to their customers—that is, the IOUs are providing energy saving solutions that draw from programs and technologies that span energy efficiency, demand response (DR), and distributed generation (DG). The shared objective of both the CPUC and the IOUs is an effective coordination across these proceedings to deliver comprehensive, optimized energy solutions to customers. Integrated program design, implementation and marketing approaches maximize the value of customer touchpoints, and help to ensure customers are provided information on all available technologies and incentives when they are considering a DSM investment; in addition, integrated approaches help to ensure that customers are educated, supported and encouraged to consider all available DSM solutions.

The primary objectives of this study are to:

1. **Provide feedback to inform and potentially improve the integrated content and delivery of the online toolkit.** The various energy management tools, services and information offered online by the IOUs (i.e. the “integrated toolkit”) are designed to provide greater access and improved uptake for integrated solutions in the small commercial and residential marketplace. Through an analysis of online toolkit use, we seek to find patterns of preferences across measures, bundles of measures and DSM strategy combinations. We seek to highlight attributes that are associated with measurable distinctions in IDSM-related preferences. We examine the usage patterns for evidence of continuous engagement with the toolkit and associated differences in preferences and/or rates of DSM measure uptake.
2. **Characterize key features and attributes of residential IDSM adopters, as well as provide the context and particular processes leading to IDSM adoptions. This effort will refine our understanding of primary drivers and barriers related to the uptake of IDSM solutions.** These objectives offer a foundation from which to build and evaluate alternative IDSM program designs, implementation strategies and marketing efforts. The information offered here is intended to facilitate IDSM program strategies that are effectively timed and directed to leverage high levels of customer receptivity, and relevant messages; the overarching goal is to support the CPUC and the

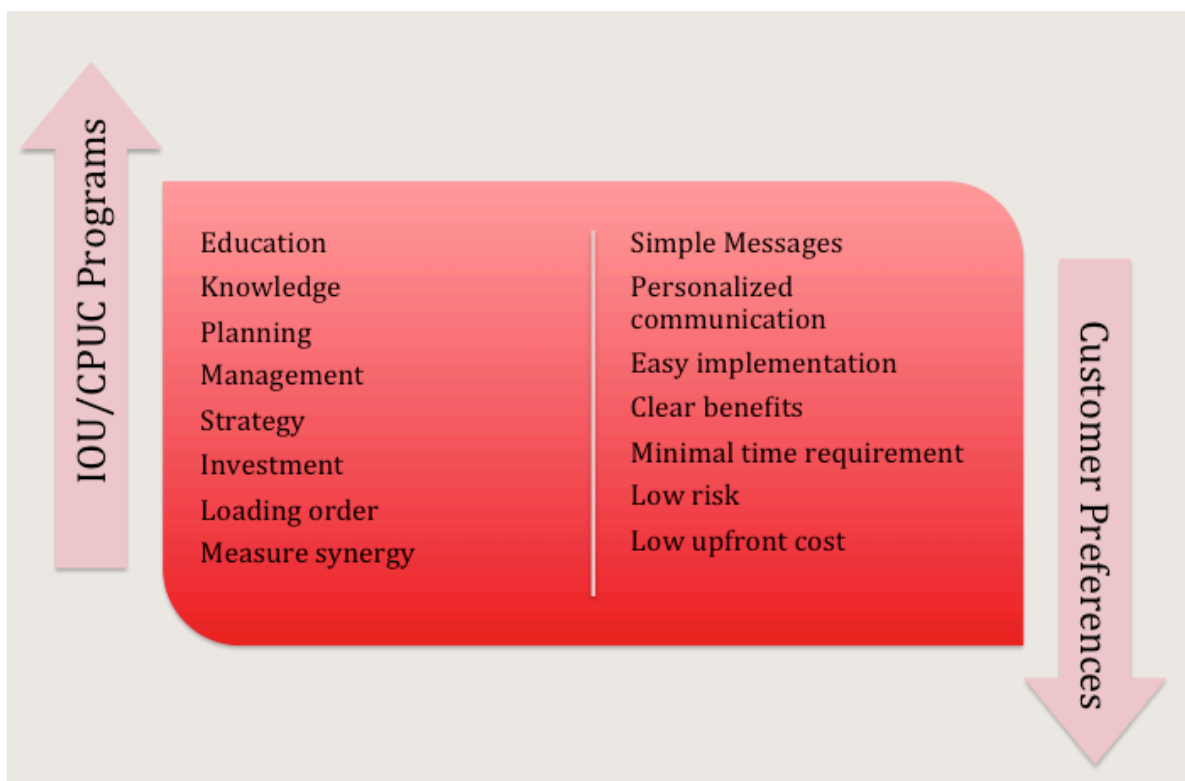
IOUs to be more effective in promoting IDSM uptake among their respective residential customer populations. The 2013-2014 IDSM Small Commercial and Residential Market Characterization Study<sup>1</sup> collected supply-side data and conducted interviews that provide a snapshot of current IDSM trends and offerings. This study uses primary research and analysis methods to build on this snapshot; we investigate and test the reliability of selected market-related hypotheses arising from the previous study, including:

- a. **Investigation of need states as IDSM driver:** The market characterization study found evidence that highly effective targeting of marketing messages can draw from “need states” of customers which may offer much greater market opportunity versus the static demographic or attitudinal characteristics that typically define market segments. The term “need states” refers to life events or circumstances that change an individual’s interest in information and the likelihood they will act on it. For example, a customer encountering an unusually high energy bill, or a customer facing the need to replace a failed major appliance in their home may be much more receptive to IDSM information than other customers with similar geographic, demographic, attitudinal and electricity use patterns.
- b. **Barriers to IDSM and customer preferences for IDSM information and marketing.** The recently completed IDSM market characterization study found that residential customer preferences with respect to information are largely at odds with the goals of IOU and CPUC IDSM initiatives. Per Figure 1 below, the CPUC/IOU goals around IDSM encourage comprehensive knowledge of DSM strategies and IDSM solutions; optimized and integrated planning; strategic and pro-active management of energy solutions; and finally, consideration of IDSM as an investment, adhering to the principles embodied in the loading order and the advantages of measure cooperative benefits. This dichotomy has required the IOUs and CPUC to be creative in the way they engage with residential customers to promote IDSM and strategic approaches to residential energy management. This study seeks greater resolution surrounding residential customer preferences for IDSM information and marketing, to refine current assumptions and to potentially identify alternative effective approaches to addressing barriers to IDSM uptake.

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<sup>1</sup> A statewide study managed by SDG&E and implemented by Evergreen Economics. Published August 2014 and available on CALMAC: [http://www.calmac.org/publications/IDSM\\_MarketStudy\\_SmComRes\\_Final.pdf](http://www.calmac.org/publications/IDSM_MarketStudy_SmComRes_Final.pdf)

**Figure 1: IDSM Program Goals versus Customer Preference**



## 1.2 Key Findings

This section reviews key project findings over all data collection and analysis efforts completed for this study.

### 1.2.1 Demographic Characterization of DSM Adoption Patterns

We found demographic characteristics of net-energy metered (NEM) participants, DR participants, energy efficiency adopters and IDSM adopters to be distinct. Our set of surveyed participants (i.e. customers adopting both energy efficiency and DG) have a number of distinct features compared to non-participants, as shown in Table 1 below.

**Table 1: Statistically Significantly Different Demographic Characteristics: Participants versus Non-Participants**

<b>Characteristic</b>	<b>All Participants (n=203)</b>	<b>All Non-participants (n=99)</b>
Have central air conditioning	81.8%	64.6%
Have a hot tub, pool or spa	61.1%	27.3%
Home over 3,000 square feet	34.0%	24.2%
Has a tank-style water heater, rather than tankless	84.2%	75.8%
All or most screw-in light bulbs are energy efficient, CFLs or LEDs	70.5%	60.6%
Have Nest or other smart thermostat	20.7%	11.1%
Lived in residence for more than 10 years	84.7%	58.6%
Live in a recently remodeled home (less than 5 years)	31.5%	13.6%
Has five or more household members	12.9%	5.0%
Has one or more members over 64 years of age	51.5%	31.3%

Differences are statistically significant at a 95 percent confidence level. See section 2.4.2 Hypothesis Testing for a complete discussion of statistical testing methods.

Essentially, participants are more likely to live in larger and more recently remodeled homes. They have been living in their current homes for a longer time than their non-participant counterparts. Their households are typically larger in number, and have more members over the age of 65. Participants also more likely to have central AC equipment, use a smart thermostat, and have a pool, hot tub or spa.

Online audit tracking data also yielded some demographic distinctions related to participation in NEM or DR—as well as the combination of the two. NEM participants are characterized by a greater likelihood of having central AC, using gas heat, owning their homes, living in single-family dwellings, living in larger homes and having larger households with a greater number of adults over age 65.

In contrast, DR participants are characterized by a greater likelihood of being a renter and living in a multi-family home relative to non-DR participants. They also are more likely to have electric heat and central AC equipment.

Those who participate in both NEM and DR generally mimic the characteristics of NEM participants, but with greater extremes. They are even more likely to live in single-family homes and to own their homes. They have the largest average house size of all DSM participation segments, and have bigger households. They are also more likely to have central AC and to use gas fuel to heat their home.

## 1.2.2 Customer Experience Using an Integrated Approach

We found that just under one-third (28%) of surveyed participants implemented an integrated approach to their energy efficiency and DG installations—meaning that they either made their energy efficiency and DG investment decisions simultaneously or one DSM decision influenced the other in a meaningful way. However, it is notable that the proportion of customers endorsing an integrated approach is larger than the proportion that implemented one. Thirty-seven percent of participants surveyed would recommend an integrated approach to a friend, while 28 percent report implementing such an approach.

Table 2 below summarizes responses to the survey question prompting participants to report whether or not they would recommend an integrated approach to a friend that was considering investing in an energy upgrade project. We asked this question of *all* participant respondents, even those that did not report an integrated element to their decision making.

**Table 2: Recommendation of Integrated Approach**

Segment	Would Recommend Integrated Approach
All Participants (n=203)	36.9%
PG&E Participants (n=67)	38.8%
SCE Participants (n=68)	38.2%
SDG&E Participants (n=68)	33.8%
Integrated DG/EE Decision (n=57)	57.9%
Integrated DR/EE/DG Decision (n=12) <sup>2</sup>	33.3%
No Integrated Decisions (n=139)	27.3%

About 60 percent of those that made their energy efficiency and DG investment decisions simultaneously reported that their approach offered tangible benefits; another 20 percent were neutral, and 20 percent found the approach had drawbacks. Looking more closely at the reasons all participants would recommend or not recommend an integrated approach, we see that respondents view the benefits of an integrated approach to be general ease (37%), project costs (20%) and bill savings (16%). Project cost is also given as the top reason that people would *not* recommend an integrated approach (32%). Other reasons why respondents would not recommend an integrated approach include that they were inherently separate decisions (30%), the hassle/timing/slowness of the process (11%), and that energy efficiency impacts the size of DG required (10%). The latter is an interesting finding, indicating that customers have absorbed the message underlying the loading order—but that their

<sup>2</sup> A “DR with EE/DG integrated decision” is when a respondent made the decision to enroll in the DR program at the same time as they decided to implement their energy efficiency or DG, or the decision was not made at the same time but their experience with one or more of the energy upgrades (the energy efficiency, DG, or both) influenced their decision to enroll in the DR program. Some people who did not make an integrated energy efficiency/DG decision did make an integrated DR/energy efficiency or DR/DG decision.



interpretation is that energy efficiency should be done separately and first. The solar sizing issue was also cited as a reason for recommending doing both at the same time (5%).

### 1.2.3 Drivers and Barriers

#### 1.2.3.1 Overall Project Drivers

There are a couple of notable statistically significant differences between participants and non-participants in terms of the primary drivers for their DSM projects. Of course, participants, having installed both energy efficiency and DG, were motivated to invest more time and money relative to non-participants that invested in energy efficiency only.

- Participants' larger DSM investments are associated with greater concern over saving money long term and in bill reduction when compared to non-participant adopters.
- Non-participants' energy efficiency-only adoptions were more likely to be motivated by a desire to increase home value.

Non-participants' energy efficiency adoptions are also associated with moving/purchasing a home, and are often done in conjunction with remodels or the need to replace a major appliance.

#### 1.2.3.2 Barriers

When considering energy upgrades investments, the primary concern of all non-adopters is the upfront cost. Almost 40 percent of non-adopters that considered DSM investments, and 30 percent of those that never seriously considered DSM, cited cost as a primary concern.

Non-adopters that reported a continued interest in DSM, expressed concern about whether they had a big enough energy bill to substantiate a DSM investment, as well as concern over length of payback. Another common response among this group was "don't know"—indicating simple inertia may be a barrier for some customers.

We asked both participants and non-participant adopters about any concerns that they might have had as they considered their DSM upgrade opportunities before making their final decisions. In general, participants had more concerns and more 'serious' concerns than did non-participant adopters as they considered their DSM upgrades. However, both groups had the same top three concerns, consistently reported as concerns by a greater proportion of participants than non-participants:

- Reliability of equipment/quality (68% versus 60%)
- Upfront cost of installation (63% versus 43%)
- Payback/actual bill savings (63% versus 40%)

Participants and non-participants are similar across both the frequency and the issues reported as being 'not at all a concern'. The planning burden is ranked lowest on the list of concerns by both participants and non-participant adopters (59% and 63%, respectively).

## 1.2.4 Project Planning

We found that participants had a longer than average planning horizon for their DSM projects than did non-participants. The majority of participants planned their DSM projects for a period of between two months and two years (64%), and almost half planned their projects for a period of longer than one year. In contrast, more than one-third of non-participants reported a planning period of less than one month, and nearly three-quarters reported a planning horizon of less than one year.

### 1.2.4.1 Information Sources Used in Planning

Participants consulted a greater variety of information sources than did non-participant adopters. Participants were more likely to report consulting 10 of the 12 information sources asked about in the survey more frequently than did non-participants. On average, each participant used about five information sources and non-participants used about three. At a high level, there are three primary information sources reported by nearly all DSM adopters:

- Online research (85% of participants, 80% of non-participant adopters), including utility (57% of participants, 45% of non-participant adopters) and/or non-utility websites (81% of participants, 70% of non-participant adopters);
- Interaction with contractors (86% of participants, 58% of non-participant adopters); and
- Call centers or other direct contact with utility (67% of participants, 50% of non-participant adopters).

Online research was the top information source among participants and non-participants alike. Well over half of participants (57%) and nearly half of non-participant adopters (48%) visited their IOU website to collect information in their DSM planning process. The great majority (over 80%) of all adopters used internet research tools to collect DSM-related information.

Another notable feature of our investigation of DSM project information sources is the role of direct sales efforts on the part of contractors. About 43 percent of participants were contacted directly by a contractor, versus only 25 percent of energy efficiency-only adopters.<sup>3</sup> These data suggest that being a recipient of direct, personalized sales efforts is a feature that distinguishes energy efficiency/DG adoptions from energy efficiency-only adoptions, and thus it appears likely that direct sales efforts are a driver of IDSM adoptions.

Another meaningful difference between participants and non-participant adopters is in their propensity to contact utility representatives for information about DSM programs and rebates. Participants were nearly twice as likely to report engaging in this information collecting activity (43% versus 22%). This result suggests the IOUs are well positioned to

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<sup>3</sup> This difference is statistically significant at 95 percent confidence, 5 percent precision.

provide key information about integrated solutions to IDSM adopters during their planning process.

### 1.2.5 Need States

Table 3 below shows the frequency of various ‘need states’<sup>4</sup> among participants and non-participants that were relevant during the analysis period. Note that the section under the heading "Applied (Not Necessarily Relevant)" reflects the rates at which each circumstance was applicable to the respondent over the analysis period, regardless of DSM adoption activity. The section under the heading "Applied and Was Relevant" shows the frequency of need states that were reported to have applied *and* been relevant to DSM adoption decisions; thus, that section does not include responses from non-participant non-adopters.

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<sup>4</sup> An event or circumstance associated with higher rates of uptake and greater interest/receptivity to IDSM marketing information.

**Table 3: Circumstances that Inspired Respondents to Seriously Consider Home Energy Upgrades**

Need States	Applied (Not Necessarily Relevant)			Applied and Was Relevant	
	All Participants (n=203)	Non-participant Adopters (n=54)	Non-participant Non-Adopters (n=44)	All Participants (n=203)	Non-participant Adopters (n=54)
Change in home occupancy	23.1%	18.5%	34.1%	10.3%	11.1%
Change in employment	9.8%	16.7%	25.0%	3.9%	1.9%
Experienced unusually high energy bill	68.5%	27.8%	20.5%	61.6%	24.1%
Preparing for change in season	29.1%	24.1%	36.4%	19.7%	14.8%
Installed new energy intensive equipment <sup>5</sup>	12.8%	5.6%	4.5%	10.3%	3.7%
Time to replace a major appliance	40.9%	55.5%	36.4%	28.6%	29.6%
Learned about rebates/incentives/financing	70.5%	59.2%	36.4%	60.6%	29.6%
Increased concern about impact on environment	66.0%	38.9%	0.0%	51.2%	27.8%
Home renovation/remodel	31.5%	25.9%	13.6%	13.3%	22.2%
Moved/purchased home	8.9% <sup>6</sup>	22.3%	9.1% <sup>7</sup>		

Several of the need states as shown in the table have high rates of applicability among participants, with the top three ranging from 66 percent to 71 percent. These same top three need states were also highly likely to be characterized as relevant to DSM investments, ranging from 51 percent to 62 percent. These need states, and their self-reported relevance to DSM adoption decisions, are as follows:

- Experienced an unusually high bill (69% applied, 62% relevant);
- Learned about rebates/incentives/financing (71% applied, 61% relevant); and/or

<sup>5</sup> All of the non-participants who installed energy intensive equipment reported that the equipment was a pool, hot tub or spa. Participants who installed energy intensive equipment reported that they installed a pool/hot tub/sauna (65%), air conditioning equipment (23%), an electric car charger (12%), pool pump/motor (8%), other appliances (8%) and/or something else (16%).

<sup>6</sup> Moving/purchasing home is counted as applicable for participants and non-participants installing DSM projects after January 2010 if they report planning their DSM project within two years of moving. Non-participant non-adopters that moved into their homes during the analysis period are counted as applicable.

<sup>7</sup> Moving/purchasing home is counted as applicable for non-participant non-adopters if they reported moving/purchasing their homes during the analysis period.

- Experienced increased concern about issues related to energy use and the environment (66% applied, 51% relevant).

The installation of new energy-intensive equipment has a lower rate of participant-reported applicability (13%) but was highly likely to be relevant if present, as 77% of those to whom it was applicable reported it was also relevant to their DSM adoption decision. Furthermore, this circumstance was almost three times more frequent among participants as non-participant adopters (13% versus 4.5%).

Data suggest that receiving an unusually high bill or experiencing increased concern for ones' impact on the environment are stronger drivers for IDSM adoptions than for DSM adoptions.

- 'Receipt of an unusually high bill' was reported as applicable by nearly 70 percent of participants but by only about one-quarter of non-participants.
- 'Increased concern about their impact on the environment' was reported as applicable by 66 percent of participants but only 39 percent of non-participants.

Home purchase and home renovation projects are found to be drivers of energy efficiency upgrades, but not multi-DSM investments.

- Overall, home renovation was found to be applicable and relevant for over 20 percent of energy efficiency (only) projects but closer to half that rate among participant IDSM projects.
- A total of 22 percent of non-participant adopters planned their DSM projects shortly after moving into their homes, a rate over twice that of non-adopters.

### **1.2.6 Online Audit Recommendation Uptake Rates**

Multi-visit users have higher overall implementation rates relative to single-visit users, for all the IOUs. Measure recommendation implementation rates for segments that include DR participants are also higher than those for segments not including DR.

- Multi-visit users are not notably different in their recommendation preferences versus single-users. However, other segments do exhibit preferences.
- DR participants show a penchant for peak-load reducing efficiency upgrades, including HVAC, refrigeration and lighting.
- NEM participants exhibit greater interest in recommendations that offer low cost energy savings, and/or those that relate to having greater control over time-of-use, (when compared to those not enrolled in DR or NEM);
- Customers who received Home Energy Reports gravitate toward low cost/no cost solutions that reduce their bill.

### 1.3 Study Recommendations

- **The IOUs and CPUC should work together toward enhancing the supply chain for IDSM, including increased direct sales marketing efforts. We recommend the IOUs provide tailored one-on-one support for IDSM where requested by customers, and also initiate targeted direct marketing efforts via third parties, contractors and IOU customer representatives.**

We heard about the importance of a strong supply chain from interviewees, and observed the impact of one-on-one marketing within the participant population, where direct contact and personalized advice and support stand out as a strong driver for IDSM uptake. Survey results confirm that customers considering IDSM adoptions have more concerns and have more serious concerns compared with those considering energy efficiency only. They consult more information sources and are highly likely to seek one-on-one input from contractors and their IOU. Moreover, one-on-one contact from a contractor is a driver of IDSM uptake—43 percent of participants reported they were contacted directly by a contractor versus just 25 percent of energy efficiency-only adopters.

- **Furthermore, we suggest one-on-one IDSM direct marketing efforts would best be targeted to single-family customers with longer tenure in their homes and with higher than average energy bills. Targeting unusually high bills with personal contact follow up may also prove effective.**

Given the high cost of direct marketing and one-on-one contact, we suggest that targeting households with demographic characteristics consistent with IDSM uptake, as well as leveraging applicable need states, may increase the effectiveness of such efforts. Survey findings indicate that IDSM adopters tend to be established, larger households, with substantially-sized homes and relatively older occupants. These homes also tend to have major electricity-consuming equipment such as pools, spas, hot tubs and central AC, leading to higher energy bills. As noted previously, almost 70 percent of participants surveyed experienced an unusually high bill, and almost 90 percent of those experiencing an unusually high bill reported it was relevant to their decision to adopt DSM solutions.

- **The IOUs should consider targeted efforts to offer IDSM information and support to customers seeking information via call centers.**

We found a meaningful difference between participants and non-participant adopters in their propensity to contact utility representatives for information about DSM programs and rebates. Participants were nearly twice as likely to report engaging in this information collecting activity (43% versus 22%), suggesting the IOUs are well positioned to provide key information about integrated solutions to IDSM adopters during their planning process.

- **We recommend timing marketing efforts to follow months where higher bills are more likely, and that marketing materials be designed to raise awareness of IDSM incentives and rebates, as well as benefits to the environment associated with DSM investments.**

Integrated adoption in the residential sector is not associated with home purchases/remodels or the need to upgrade major appliances—IDSM adoptions are oriented toward energy savings, and motivated by concerns over bills as well as the environment. Participants were highly likely to report that the following three need states were applicable and relevant to DSM investment decisions:

- Experienced an unusually high bill (69% applied, 62% relevant);
  - Learned about rebates/incentives/financing (71% applied, 61% relevant); and/or
  - Experienced increased concern about issues related to energy use and the environment (66% applied, 51% relevant).
- **The number one barrier for non-participants considering DSM solutions is upfront cost and concerns related to length of payback. We suggest the IOUs and CPUC work together to develop additional low-cost options for expanded participation in IDSM, such as shared solar investments and/or or additional DR program options.**

Regardless of any current interest or past consideration of DSM, the primary concern of all non-adopters is the upfront cost. Almost 40 percent of non-adopters that considered DSM investments, and 30 percent of those that never seriously considered DSM, cite cost as a primary concern. Among non-adopters that are still interested in DSM, in addition to upfront cost, this group expressed concern about whether they had a big enough energy bill to substantiate a DSM investment; another concern was time of payback (19%). An effective way to address these barriers would be to develop financially attractive IDSM solution options to customers with smaller energy bills, that require smaller upfront investments.

- **The IOUs should focus on ways to continuously engage customers with online tools, i.e. encourage multiple-visit usage of the audit tool.**

The data suggest that participants returning to the tool multiple times are more likely to implement recommendations. This finding holds true for all the IOUs and for all types of recommendations. Continuing to encourage and support multi-visit use of the tool may correspond to higher rates of recommendation uptake.

- **The Southern California IOUs should consider emulating PG&E by adding recommendations to the tool that cover all available residential DR programs and solar technologies (solar PV, solar hot water and solar lighting).**

Audits were found to be relatively common among all DSM adopters surveyed (41%), and just under 60 percent reported they were somewhat or very helpful. Moreover, audits with integrated content were much more likely to be reported as somewhat or

very helpful than those offering energy efficiency information alone. The greater majority—at 70 percent—of integrated audits were reported as helpful, versus 27 percent for energy efficiency-only audits.

- **The IOUs should consider further customizing online tools and audit recommendations by DSM participation segment to best meet the unique needs of NEM and DR participants.**

Generally, participants in NEM and DR programs have higher recommendation uptake rates than customers not enrolled in these programs. Moreover, we observed some distinct needs and preferences in terms of recommendations among the various DSM participation segments. We suggest it would be worthwhile to consider offering customized recommendations or slightly modified tools oriented to the needs of NEM participants and DR participants.

The PG&E online audit tracking data allowed us to examine recommendation refusal rates. We observed that refusal rates for DR recommendations across DSM participation segments range from 25 percent to 32 percent (excluding the DR participant segment) but are much higher among NEM participants, at 46 percent. Similarly, recommendations for solar PV are rejected by DR participants more often than by other customer segments. NEM and DR participants may find the prospect of adding another DSM strategy daunting or potentially complex to manage, or they may find the incentives for dual participation insufficient. These data do not offer conclusive evidence with respect to these hypotheses, but do suggest that NEM and DR participants need additional support or encouragement to pursue other DSM opportunities outside of energy efficiency.

Examining recommendation uptake rates show that DR participants generally gravitate to recommendations that will support their ability to control time-of-use and reduce peak time loads. NEM participants exhibit greater interest in recommendations that offer low cost energy savings, and/or those that relate to having greater access to monitoring and control over time-of-use.

- **Future research is needed to better understand the drivers of supply and the key features of successful IDSM delivery, for both residential and small commercial customers.**

We found that in the residential sector integrated DSM adopters have more concerns in general, and more concerns they characterize as serious relative to single DSM adopters. We also found a strong correlation between direct contact marketing from contractors to residential customers, and the subsequent uptake of integrated solutions. It would be worthwhile to better understand the dynamics behind the role of the supplier, given their clearly prominent role, and the knowledge that these adoptions require greater customer support (given greater levels of concern). Further,



it remains unknown what economic factors are necessary—and what factors are drivers—for contractors and other suppliers to want offer individualized support and direct marketing. It would be useful to know how often and under what circumstances single DSM vendors (particularly DG vendors) will market integrated solutions to customers.

In the commercial sector we found markedly different rates of uptake for integrated solutions across business types. This likely reflects high variation in building stock and economic features across commercial business types, and could also be a function of the supply chain active in those markets. Vendors that have experience marketing DSM to specific commercial business types have likely built a body of knowledge related to the particular needs and wants of the different business types, and can help to unravel some of the key factors driving uptake. Assembling and documenting this body of knowledge held by vendors involved with DR, EE and/or DG would be highly valuable in creating market support and intervention strategies for reaching different business types.

## 2. Introduction

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This report presents the findings of our investigation and analysis of integrated demand side management (IDSM) uptake in California’s residential and small commercial mass markets. We focus on homeowners living in single-family detached dwellings and on IDSM solutions that involve grid-connected renewable distributed generation (DG) systems, which is almost entirely comprised of solar photovoltaic (PV) systems. The purpose of this study is to improve our understanding of customer preferences and behaviors in the markets for integrated solutions, such that DSM resources can be targeted to best facilitate and encourage the uptake of IDSM solutions in mass markets.

The major objectives of this study include the following:

- Identify customer types that are more likely to adopt an integrated solution;
- Identify and prioritize drivers behind customer purchasing decisions for integrated solutions, including ratepayer-funded programs;
- Identify and prioritize customer barriers to adopting integrated solutions for both commercial and residential markets;
- Document the decision-making process behind customer adoption of integrated DSM measures and improvements; and
- Identify channels or marketing efforts and messaging that have the highest potential to effectively promote uptake of integrated DSM solutions.

### 2.1 Evaluation Approach and Methods

This section provides an overview of our approach to addressing the project objectives and the key research questions associated with this evaluation. Our approach is comprised of the following data collection and analysis tasks:

1. In-Depth interviews with IOU staff;
2. Analysis of residential online toolkit (UEAT) usage patterns; and
3. Analysis of small commercial data assembled for the 2010-2012 Commercial Saturation Survey<sup>8</sup> (CSS) and Commercial Market Share Tracking Study (CMST),<sup>9</sup> which include data reflecting patterns of IDSM uptake as well as data characterizing IDSM-related attitudes and awareness.
4. Computer assisted telephone interviews (CATI) surveys of residential customers that have recently adopted IDSM solutions, as well as a group that has not, for purposes of comparison.

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<sup>8</sup> [http://calmac.org/publications/California\\_Commercial\\_Saturation\\_Study\\_Report\\_Finalv2.pdf](http://calmac.org/publications/California_Commercial_Saturation_Study_Report_Finalv2.pdf)

<sup>9</sup> [http://calmac.org/publications/California\\_Commercial\\_Market\\_Share\\_Tracking\\_Study\\_Reportv2.pdf](http://calmac.org/publications/California_Commercial_Market_Share_Tracking_Study_Reportv2.pdf)

## 2.2 In-Depth Interviews

For this task, we conducted in-depth interviews with IOU staff at each of the utilities familiar with IDSM marketing to the mass market sectors (residential and small commercial) and familiar with the online IDSM toolkit (online audit, solar calculator, demand response (DR) program information and alternative rate analysis, Home Energy Reports and other AMI-enabled information programs (e.g. “Energy Alerts”). A call was held with EM&V staff at each IOU to confirm the list of appropriate staff to be interviewed and to review the interview guide that can be found in Appendix B.

Findings from these interviews were used to inform the survey instrument for the telephone survey, presented in Appendix A. Additional objectives of this effort are to understand what new strategies exist for continuous engagement and promoting IDSM, what is working better and less well than expected in terms of the program objectives that specifically work to promote IDSM, recent or upcoming changes (as applicable) to the online toolkit, and data access with regards to opportunities and challenges for analysis.

## 2.3 IOU Online Toolkit Usage and Participation Characterization

For this task, we analyze IOU online toolkit usage and use-pattern data for the residential sector. We examine available demographic, geographic and other data reflecting the physical attributes of user dwellings. The centerpiece of this analysis is the examination of patterns in recommendation uptake, particularly where bundles of recommendations span multiple DSM strategy areas (DR, DG, energy efficiency).

The objective of this section of the report is to provide a better understanding of the characteristics and patterns related to the likelihood of completing an energy plan, differences in measure uptake between single-visit customers and multi-visit customers, patterns of preference related to uptake of IDSM measures and recommendations, and the role of the Home Energy Reports in supporting UEAT usage.

### 2.3.1 Online Toolkit Tracking Data

Each IOU was able to provide some of the data requested, but none were able to provide all of the data requested. Reasons for gaps and differences in submissions relate to differences in the tools themselves and in some cases, in the stage of tool-related software development.

PG&E was able to provide the most detailed dataset, and SCE data was most limited. We note that the SCE data reflects software that is no longer in-service, nor is vendor still contracted for the tool development. At the time we received the dataset, SCE was working with a new vendor on a new version of the online audit tool.

PG&E’s recommendation dataset included three possible customer responses to recommendations: ‘done’, ‘will do’ and ‘not interested’. SDG&E provided a binary response, which indicated if the customer received the recommendation and either has ‘done’ the recommendation or has ‘not yet done’ the recommendation. SCE data was even more limited,

as the data did not reliably indicate which customers had received which recommendations, though it did indicate which were marked as ‘done’ by each participant.

PG&E recommendations include three different solar measures and one demand response. SCE and SDG&E offered only one measure recommendation that was not energy efficiency, – solar water heat.

PG&E records indicated which online tool users participated in NEM, DR, the Energy Alert program, and which had received Home Energy Reports. SDG&E data also indicated NEM and DR participation, but did not indicate AMI-enabled behavior program enrollments or Home Energy Reports. With SCE data we could identify only the subset of tool users that were enrolled in the NEM program.

## 2.4 Survey of IDSM Adopters and Non-Adopters

This study conducted a telephone survey with residential customers in February and March of 2015. Surveys were conducted with “participants”—defined as customers that implemented both energy efficiency and DG projects between January 2010 and October 2014—and a comparison group of “non-participants” consisting of a randomly selected group of residential customers that may have done energy efficiency but did not install DG. We elected not to exclude all energy efficiency adopters because we wanted to identify and highlight the characteristics of *integrated* adopters. Excluding all energy efficiency and DG adopters from our group of adopters would confound any distinction to be made between DSM adopters and IDSM adopters. We elected to exclude DG from our control group frame because DG adoptions typically involve a larger financial investment. Thus, excluding DG adopters helped widen the difference between participant and non-participant groups by assuring participants generally completed higher cost, higher savings DSM projects versus those of non-participants.

The IDSM Project Coordination Group (PCG) discussed the possibility of assembling DR participation data from the IOUs. However, during much of the analysis period, there was only one DR program available to residential customers, and it was only available to the subset of customers that own and operate a central AC system in their home. Thus, not only would obtaining and analyzing these data be taxing on study resources, but filters applied to select DR participants would result in a geographically-biased sample of households, as it would over-represent hotter climates where central AC is more common. DR participation and program awareness was collected during the survey and used as a key segmentation variable for the analysis.

The survey was designed to collect demographic and attitudinal data, as well as physical attributes of respondent dwellings. It also focused on understanding the events, context and process leading to the energy efficiency and DG adoptions. The survey investigated:

- Influential factors such as integrated audits and marketing messages;
- Information sources, such as interactions with contractors and IOU websites; and

- The role of certain “need states” i.e. events or circumstances hypothesized to prompt greater levels of interest and willingness to invest in IDSM projects.

Our investigation of “need states” was prompted by the findings of the 2013-2014 Small Commercial and Residential IDSM Market Characterization Study.<sup>10</sup> That study determined high potential value for obtaining a good understanding of the various types, prevalence, and influence of need states as they relate to IDSM project uptake.

### 2.4.1 Sample Design and Disposition

The sample frame for this survey was developed from the population of residential net-energy metered (NEM) customer accounts within the service territory of California’s electric IOUs, Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E). We were able to obtain interconnection dates for current NEM accounts, as well as statewide energy efficiency tracking databases for the period of January 2010 through September 2014. We combined these two sources to create a sample frame of recent DG/energy efficiency adopters—or “participants” —for the purposes of the study. More specifically, we keyed off of interconnection dates and energy efficiency program participation dates to identify customers with both DG and energy efficiency installations within the period of January 2010 through the third quarter of 2014 (the most recent date available). Our resources did not indicate DR program participation. However, until fairly recently, DR options available to residential customers were limited to AC Cycling, and thus applicable only to those with central air conditioning. We chose not to limit the sample frame to those implementing energy efficiency/DG *and* DR to avoid any potential bias in the frame that would under-represent customers adopting deep/integrated retrofits in more temperate climate zones.

This section presents the sample design for the customer telephone survey effort. In total, as shown in Table 4, our goal was 300 survey completions with 201 (67 for each IOU) coming from customers who installed at least one distributed generation measure and energy efficiency measure, and 99 completions (33 for each IOU) for other customers who did not install a distributed generation measure.

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<sup>10</sup> A statewide study managed by SDG&E and implemented by Evergreen Economics. Published August 2014 and available on CALMAC: [http://www.calmac.org/publications/IDSM\\_MarketStudy\\_SmComRes\\_Final.pdf](http://www.calmac.org/publications/IDSM_MarketStudy_SmComRes_Final.pdf)

**Table 4: Overall Sample Design**

IOU	Participant		Nonparticipant	
	Quota	Achieved	Quota	Achieved
SCE	67	68	33	33
PG&E	67	67	33	33
SDG&E	67	68	33	33
<b>Total</b>	<b>201</b>	<b>203</b>	<b>99</b>	<b>99</b>

Table 5 notes the number of net energy metered new construction and existing buildings by IOU and building type.

**Table 5: Sample Frame Characteristics**

IOU	New Construction and NEM	Existing Buildings and NEM			Existing Buildings and NEM and EE		
		Multi-Family	Single Family Detached	Mobile Home or Other	Multi-Family	Single Family Detached	Mobile Home or Other
SCE	14,143	1,405	67,238	653	209	16,781	148
SDG&E	4,372	4,293	32,783	476	106	4,227	68
PG&E	117,832	6,089	116,816	0	234	8,404	0
<b>Total</b>	<b>136,347</b>	<b>11,787</b>	<b>216,837</b>	<b>1,129</b>	<b>549</b>	<b>29,412</b>	<b>216</b>

Table 6 through Table 9 summarizes key characteristics of the sample frame, first by IOU (Table 6 Table 7 and Table 8) and then statewide (Table 9). Each table notes the location (by Title 24 climate zone) of single family, net energy metered, existing buildings by a variety of criteria including whether or not the participant:

- Installed an energy efficiency measure;
- Installed energy efficiency measures of two or more end uses;
- Installed energy efficiency measures summing up to at least 500 kWh in ex ante savings,
- Enrolled as a net energy metered customer and installed an energy efficiency measure within three months of the NEM install date;
- Enrolled as a net energy metered customer and installed an energy efficiency measure within six months of the NEM install date;
- Enrolled as a net energy metered customer and installed energy efficiency measures summing up to at least 500 kWh in ex ante savings within three months of the NEM install date;

- Enrolled as a net energy metered customer and installed energy efficiency measures summing up to at least 500 kWh in ex ante savings within six months of the NEM install date; or
- Completed a whole house retrofit within one year of enrollment of net energy metering.

**Table 6: Sample Frame Characteristics - PG&E**

<b>Region (by Title 24 Climate Zone)</b>	<b>Central Valley - 11-13</b>	<b>Mountain -16</b>	<b>North Coast - 1-5</b>	<b>Total</b>	<b>Total Usable Sample<sup>11</sup></b>
1. Adopted EE	3,901	24	4,479	8,404	5,763
2. EE, 2 or More End-Uses	83	1	86	170	138
3. Ex-Ante EE Annual Savings >=500 kWh	1,378	8	1,173	2,559	1,548
4. EE and DG Within 3 Months	285	2	257	544	384
5. EE and DG Within 6 Months	661	3	624	1,288	914
6. EE >=500 kWh: EE & DG Within 3 Months	115	1	61	177	117
7. EE >=500 kWh: EE & DG Within 6 Months	251	1	168	420	284
8. Whole House Retrofit <= 1 Year of DG	57	0	66	123	65

**Table 7: Sample Frame Characteristics - SCE**

<b>Subpopulations from all Residential Single Family Homes Built After 2005 and Net-Energy-Metered</b>	<b>Central Valley - 11-13</b>	<b>Desert - 14,15</b>	<b>Mountain - 16</b>	<b>South Coast - 6-8</b>	<b>South Inland - 9,10</b>	<b>Total</b>	<b>Total Usable Sample<sup>11</sup></b>
1. Adopted EE	471	2,039	570	5,346	8,355	16,781	12,523
2. EE, 2 or More End-Uses	48	262	66	600	1,187	2,163	1,766
3. Ex-Ante EE Annual Savings >=500 kWh	213	1,137	251	2,440	3,951	7,992	5,499
4. EE and DG Within 3 Months	104	367	108	1,082	1,774	3,435	2,532
5. EE and DG Within 6 Months	155	574	161	1,619	2,652	5,161	3,752
6. EE >=500 kWh: EE & DG Within 3 Months	38	194	46	450	824	1,552	1,009
7. EE >=500 kWh: EE & DG Within 6 Months	66	310	72	705	1,314	2,467	1,609
8. Whole House Retrofit <= 1 Year of DG	5	11	5	31	64	116	57

\*\*usable sample includes valid phone numbers and contact names.

<sup>11</sup> Usable sample includes valid phone numbers and contact names.

**Table 8: Sample Frame Characteristics - SDG&E**

<b>Subpopulations from all Residential Single Family Homes Built After 2005 and Net-Energy-Metered</b>	<b>Desert - 14,15</b>	<b>South Coast – 6-8</b>	<b>South Inland - 9,10</b>	<b>Total</b>	<b>Total Usable Sample<sup>11</sup></b>
1. Adopted EE	54	1,797	2,376	4,227	3,264
2. EE, 2 or More End-Uses	34	123	184	341	293
3. Ex-Ante EE Annual Savings >=500 kWh	30	1,111	1,554	2,695	1,973
4. EE and DG Within 3 Months	6	282	422	710	460
5. EE and DG Within 6 Months	8	457	712	1,177	785
6. EE >=500 kWh: EE & DG Within 3 Months	4	208	323	535	328
7. EE >=500 kWh: EE & DG Within 6 Months	5	330	532	867	552
8. Whole House Retrofit <= 1 Year of DG	0	7	9	16	1

**Table 9: Sample Frame Characteristics - Statewide**

<b>Subpopulations from all Residential Single Family Homes Built After 2005 and Net-Energy-Metered</b>	<b>Region (by Title 24 Climate Zone)</b>						<b>Total</b>	<b>Us-able<sup>11</sup></b>
	<b>Central Valley - 11-13</b>	<b>Desert - 14,15</b>	<b>Moun tain - 16</b>	<b>North Coast - 1-5</b>	<b>South Coast - 6-8</b>	<b>South Inland - 9,10</b>		
1. Adopted EE	4,372	2,093	594	4,479	7,143	10,731	29,412	21,550
2. EE, 2 or More End-Uses	131	296	67	86	723	1,371	2,674	2,197
3. Ex-Ante EE Annual Savings >=500 kWh	1,591	1,167	259	1,173	3,551	5,505	13,246	9,020
4. EE and DG Within 3 Months	389	373	110	257	1,364	2,196	4,689	3,376
5. EE and DG Within 6 Months	816	582	164	624	2,076	3,364	7,626	5,451
6. EE >=500 kWh: EE & DG Within 3 Months	153	198	47	61	658	1,147	2,264	1,454
7. EE >=500 kWh: EE & DG Within 6 Months	317	315	73	168	1,035	1,846	3,754	2,445
8. Whole House Retrofit <= 1 Year of DG	62	11	5	66	38	73	255	123

In order to maximize the success of the phone survey, we selected the best possible sample points by assigning three scores to each project. The scoring criteria assigned a score rewarding a) recent DG installation date, b) close proximity of DG installation and energy efficiency measures, and c) greater total kWh ex ante savings for program energy efficiency measures. More specifically Table 10 below presents the scores assigned to each sample point based on key IDSM criteria.



**Table 10: Scoring Guideline**

Score	Installation Date	Installation Proximity	EE Measure Substance
-0.5	Before Jan 2011		
0	Default	Default	Default
0.5	January 2011 or Later	Less than 9 months	More than 200 kWh
1	January 2012 or Later	Less than 6 months	More than 300 kWh
1.5	December 2012 or Later	Less than 3 months	More than 500 kWh

Table 11 and Table 12 present the results of applying this scoring activity, as well as the distribution of combined scores by IOU (where the combined score for each project is defined as the sum of all three individual scores).

**Table 11: Survey Sample Scores, Participant Sample**

IOU	Score	Installation Date		Installation Proximity		EE Measure Substance	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
PG&E	-0.5	169	25.2				
	0.0			100	14.9	164	24.5%
	0.5	298	44.5	88	13.1	15	2.2%
	1.0	202	30.1	237	35.4	36	5.4%
	1.5	1	0.1	245	36.6	455	67.9%
SCE	0.5	55	8.2	17	2.5	0	0.0%
	1.0	347	51.8	157	23.4	7	1.0%
	1.5	268	40.0	496	74.0	663	99.0%
SDG&E	0.0			221	33.0	1	0.1%
	.5	156	23.3	59	8.8	6	0.9%
	1.0	169	25.2	128	19.1	9	1.3%
	1.5	345	51.5	262	39.1	654	97.6%

**Table 12: Survey Sample, Total Scores by IOU**

IOU	Total Score	Frequency	Percent	Mean Score
PG&E	1.50	61	9%	2.45
	2.00	284	42%	
	2.50	139	21%	
	3.00	66	10%	
	3.50	85	13%	
	4.00	35	5%	
SCE	3.50	115	17%	4.01
	4.00	425	63%	
	4.50	130	19%	
SDG&E	3.00	280	42%	3.44
	3.50	224	33%	
	4.00	126	19%	
	4.50	40	6%	
Total	1.50	61	3%	3.30
	2.00	284	14%	
	2.50	139	7%	
	3.00	346	17%	
	3.50	424	21%	
	4.00	586	29%	
	4.50	170	8%	

## 2.4.2 Hypothesis Testing

Throughout much of the survey analysis, we refer to statistically significant differences between various populations and segments. Unless otherwise specified, all statistical hypothesis tests are based on the assumptions that underlying data is normally distributed, and begin with the null hypothesis that two means are equivalent—i.e. drawn from the same population. In the simplest case, we compare the 95 percent confidence intervals around each mean by multiplying the standard error by the t statistic for a two tailed test, or 1.645. If the confidence intervals overlap, then we accept the null hypothesis that there is no difference in the means of the two populations.

Let  $Y_1$  be a simple random sample of size  $n_1$  from a binomial distribution with unknown success probability  $p_1$ . Let  $Y_2$  be an independent simple random sample of size  $n_2$  from another binomial distribution with unknown success probability  $p_2$ . Thus,  $Y_1$  and  $Y_2$  are the number of successes. The two sample proportions are given by  $\hat{p}_1 = Y_1/n_1$  and  $\hat{p}_2 = Y_2/n_2$ . If the sample sizes are sufficiently large, it follows that the sampling distribution of  $\hat{p}_1 - \hat{p}_2$  is approximately normal with mean  $p_1 - p_2$  and standard deviation of:

$$\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

The population parameters  $p_1$  and  $p_2$  are population are unknown. We replace them by the sample proportions  $\hat{p}_1$  and  $\hat{p}_2$ , respectively. The standard error of  $\hat{p}_1 - \hat{p}_2$  can then be expressed as:

$$SE = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

It is also valid to replace both  $\hat{p}_1$  and  $\hat{p}_2$  in the denominator of  $Z$  by a pooled sample proportion. The pooled sample proportion is given by

$$\hat{p} = \frac{\text{total number of successes in both samples}}{\text{sum of sample sizes of both samples}} = \frac{Y_1 + Y_2}{n_1 + n_2}$$

Thus, to test the hypothesis that the two proportions are equal, that is,  $H_0 : p_1 = p_2$ , we use the observed value  $Z$  as the test statistic:

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

We accept the null hypothesis if the value of the test statistic falls outside of the critical value for a two-tailed test with 95 percent confidence interval, i.e. the value  $Z$ , such that the area between  $-Z$  and  $Z$  under the normal density curve is .95.

### 2.4.3 Small Commercial Analysis, Using 2010-2012 CSS/CMST Data

In support of the 2010-2012 Commercial Saturation Survey (CSS) and the Commercial Market Share Tracking Study (CMST), Itron assembled data reflecting the non-residential population and its recorded participation in DR, DG and energy efficiency programs that were available through the four IOUs. These data include information on the business type and size of facilities participating in these DSM strategies through the end of 2011. In addition, as part of the study research activities, telephone surveys were conducted with 7,041 non-residential customers. The survey questions cover IDSM-related attitudes, knowledge and awareness. Together, these data provide a foundation from which we are able to build the characterization of IDSM patterns and preferences within the small commercial sector that is presented in Section 6.

## 3. In-Depth Interviews

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This section presents findings from the in-depth interviews conducted for this study. Interviews were conducted with utility staff who have expertise in the residential online audit and other online demand side management (DSM)-related tools, integrated demand side management (IDSM) marketing, and investor-owned utility (IOU) IDSM products, services and data management. We also interviewed a number of other stakeholders, including employees of energy services companies (ESCOs), IDSM product vendors and other stakeholders.

### 3.1 In-Depth Interview Findings

This section summarizes the content and findings of the in-depth interviews conducted in support of this study of residential customer IDSM patterns and preferences. The focus of our interviews was on IOU staff with experience delivering IDSM information and online tools, as well as marketing and outreach campaigns. We also interviewed industry stakeholders, including vendors of various IDSM-related products and services, including Energy Service Providers (ESCOs), third party program implementers, and independent IDSM policy advocates.

#### 3.1.1 Customer Needs and Wants

This section presents interview findings related to understanding customer needs and wants with respect to implementation of IDSM.

##### *Understanding Bills*

IOU staff emphasized that customers are highly interested in understanding their bill and their own energy use. PG&E shared results of its recent IDSM customer research, which was related to preferences and perceived value of various online tools, such as the rate analyzer, the “my account” consumption viewer, and energy audit. PG&E staff were not surprised to find that residential customers want information about their bills; they found that customers using the tools are likely to be seeking facts and information about what contributes to their bill—for example, understanding the different tiers and usage categories. In addition, residential tool users reported wanting to see how they are using energy and when they are using it at the greatest intensity. Customers expressed interest in having access to these details in a flexible format, like a spreadsheet, that could provide support for individual tracking and management.

##### *Saving Money*

The IOUs also understand that their customers are very interested in saving money. PG&E shared with us more about their customer research related to this topic. They report that the second group of features in which customers were very interested are related to money savings. Customers reported interest in all money-saving strategies: learning about available rebates, low-cost measures and no-cost measures; estimates of cost and savings for more

substantial measures (i.e. return-on-investment); rate options; and participating in programs offering rewards for energy savings.

Residential customers want data and tools to help them understand how they can save money and manage their utility bills. They want solutions more than products, and they want the data, tools and solutions offered to them to be highly customized to their situation. The customization should reflect both high levels of knowledge and a good understanding of the customer's particular issues. The standard for customization in the online marketplace today is high, with companies like Amazon and Netflix providing customized suggestions and direction built on customer characteristics and preferences. Utility customers want their information to reflect the same level of personalization.

### *Return-on-Investment and Payback Time*

Residential and small commercial customers need the period for energy investment payback to be less than five years. We learned from IOU staff that their internal data resources suggest residential customers move every seven years. Thus, they surmise that residential customer investment payback needs to generally be under seven years, and their research has indicated that five years is generally an attractive/acceptable payback period.

### *Time and Money*

IOU staff members are very clear and consistent about the need to be sensitive to the time and financial constraints typically faced by residential and small commercial customers. SCE reported this often leads customers to pick and choose from a menu of DSM options—even if all of the options are attractive—rather than electing to execute all of them at once. We also heard from interviewees that annual budget guidelines may keep some customers from making multiple DSM investments in a single year, regardless of the financial/payback properties of those investments.

### *Simplicity*

IOU staff noted that project complexity is a barrier. This is related to limited time and money discussed above. Simple and easy projects take less time to plan and execute, and are typically less worrisome overall, making them generally more attractive than complex projects. This is particularly true of DSM projects, since DSM expertise is typically not within the scope of customers' core business. SDG&E staff noted that for its customers, energy is not at the front of their minds.

*“Customers typically pay for it and move on; they are focused on running their business and not on their energy use, and SDG&E does everything that they can to support customers, and hold their hands, to the extent possible.”*

PG&E noted that when customers use online tools to look for ways to save money or reduce their bills, the options need to be clear, prominent and easy to understand. The bottom line is that in order to get customers to engage with the tools, absorb information and take

subsequent actions, the online experience must answer the questions that are most compelling to them.

SCE reported that its small to medium business sector customers often ‘wear all the hats’ or do all the jobs related to operating the business.

*“...they do everything. It is hard to get them to focus on energy.... (research shows) that customers think about us for 15 minutes each month...enough time to look at a bill, review it, send a check. In contrast, (our staff) think about energy 40 plus hours a week. “*

### *Cost Effectiveness*

IOU staff reported that successful DSM projects must be highly cost effective to be successful in the residential and small commercial markets. More generally, participant cost effectiveness is a necessary element to tap into the mass market. IOU staff point out that without very attractive payback, DSM projects are typically perceived as a burden. There are many retailers, service providers and product vendors in the marketplace trying to sell their wares to small commercial and residential customers, a process which easily becomes overwhelming. On top of that, many customers do not understand the ins and outs of saving energy. In the end, they easily find energy projects to be ‘not worth the hassle’.

*“The proposed project has to be very cost effective, that’s how you tap into mass market. Otherwise it can be a burden. A lot of people out there (are telling business customers) ‘we can help you’, and businesses get overwhelmed, and (on top of that) they don’t really understand how they can save energy; (in the end, they easily find it) not really worth the hassle.”*

### **3.1.2 Non-IOU IDSM Perspectives**

As part of our interview efforts, we held discussions with stakeholders and interested parties. We were able to glean insight through discussions of interviewee experiences in a variety of IDSM-related roles, including independent energy regulatory advocates, IDSM vendors, ratepayers and program participants—and were able to glean some insight from interviewee experiences both within and outside California.

Interviewees shared observations about what types of program strategies had been proven outside California, and which had been shown not to work. In particular, we heard testimonials to the success of a residential IDSM program that had been originally funded through the American Recovery and Reinvestment Act (ARRA) that provided individualized support via a single point of contact. The single point of contact helped each customer navigate the findings from their integrated audit, energy efficiency and distributed generation (DG) equipment options, rebate programs, tax incentives and financing.

We learned of the importance of a strong on-the-ground presence and the momentum that can be gained via conducting a major door-to-door outreach effort. Attributes of successful outreach efforts include in-person (i.e. one-on-one contact) and consistent and clear branding.

One program we discussed with interviewees was a multi-family program oriented toward building owners that was comprised of a rigorous set of efficiency requirements combined with the offering of substantial support services to building owners to help them comply with the requirements. Support services offered through the program included personnel assigned to assist building owners through the process of hiring contractors and filling out paperwork. In reference to this program, one interviewee relates:

*“You have someone who...helps you figure out who you are going to hire and helps you with the entire process. There’s a lot of hand holding, but I think that is how it gets done.”*

*“It is very confusing in general. You may have one contractor installing weather stripping and another installing water measures, and others offering both services. It helps to have someone to hold your hand through it all.”*

Another point made by interviewees relates to the timing of energy-related investments. Specifically, one interviewee noted that if energy efficiency and DG investments are done together, the package can be more palatable to customers than if a staggered approach is taken. More specifically, energy efficiency investments yield a payoff that can be used to offset the longer payoff and higher capital requirements of DG investment, making the whole package more attractive. This is particularly important for multi-family—or split incentive—situations.

*“...I’m a landlord...and I’ve gone through the process...My tenants thought it was impressive how much we saved—between 20 and 25 percent! I ask my tenants to pay a higher rate to subscribe to (a) renewable (energy) rate, and those that experienced this reduction are fine with it. The downside is that if I get a new tenant, their bill is reduced but they don’t know that it used to be high. Some of these tenants refuse to pay the higher rate for renewable energy, so I end up paying the premium.”*

We also heard from interviewees about the need to offer renewable options that are not behind the meter—that is, the value in offering green-source purchase options broadly and branding them. Not everyone can do rooftop solar.

*“In my mind the real way to green up your supplies is not just solar, it’s also wind, biomass...If you could subscribe to a local energy program where you could drastically decarbonize your energy, communities would likely show interest and participate.”*

This interviewee also pointed out,

*“An advantage of community solar is that IOUs do not need to know details or rely on individual generation at each home or dwelling. They can monitor and understand community-sized solar more easily. Many people do not have the rooftop real estate to support solar. Community solar can be placed strategically to meet grid needs.”*

### 3.1.2.1 Supply Chain Barriers

Some of our interviewees emphasized the need to strengthen the supply side of the IDSM market—that a weak sales and installation force may be responsible for hindering IDSM project uptake. This observation is generally corroborated by findings from the telephone survey that indicate direct sales efforts play a substantial role in IDSM project uptake. For example, an interviewee states:

*“If you’ve got that supply chain, a good one, there will be contractors going door to door and hang out at Home Depot and doing all kinds of direct sales efforts to generate business. If there were mechanisms in place that would enable them to do that, they would be out there selling.”*

Similarly, interviewees cited the success of DG contractors:

*“Why are solar contractors so successful at selling projects? I think it is because the contractors are well equipped to sell and install solar systems...The main reason solar is so strong is that there is a strong supply mechanism within that market. Solar contractors are effectively motivated and equipped to move product. They are out there pounding the pavement and getting the products in front of people and actually selling it.”*

Along these same lines, we also heard that the effort and cost of sales are often undervalued—or under-compensated.

*“Consider that 40% of costs are associated with direct sales to customers; the effort it takes to get them moving forward on projects. If suppliers don’t have adequate support and compensation for the sales efforts, projects will not get installed.”*

In addition, the degree of skill required and the complexity is generally much higher for energy efficiency than DG or demand response (DR). It takes a high level of both skill and effort to complete an energy efficiency feasibility study or a retro-commissioning audit. On the other hand, scoping a solar project requires very little site-specific information about the building’s equipment or operations. The solar contractor may not want to slow down a project by incorporating more complex features, or jeopardize their momentum for a project by performing an energy efficiency audit or discussing DR options with customers.

Another important barrier reported by interviewees is the high cost per kWh saved.

*“Consider the Energy Upgrade California Program. Part of the problem that program faces is that it requires an engineer to go out to the home with specialized equipment like an AC flow meter. These kinds of complex and involved services are very expensive. I think that having a program that a supplier can sell and make money at is just as important as having a program that a customer perceives to have value.”*

There were also positive reports regarding the strength of the IDSM supply side. For example, we heard,



*“There is supplier interest now. For example, a lot of the residential AC contractors are getting into solar now because they are already out there at the house and want to leverage different products into the mix.”*

### *3.1.2.2 Single Point of Contact Programs Outside California*

We interviewed a third party service provider that specializes in energy advising. In particular, the program model this provider utilizes offers a single point of contact for residential and commercial clients that are interested in anything from deep energy retrofits to minor/low cost/no cost changes. The intent of the program design is to reduce customer acquisition costs by eliminating redundant acquisitions, and to make information regarding energy investments available and easy to get. They offer an assigned individual Energy Advisor to each customer, who serves that customer as their personal ongoing point of contact. This model allows the Advisors to establish themselves as an ongoing resource for the customer, available at any time to support any energy-related interests and to answer questions. Moreover, as a result, when life events occur that create an energy “need state”—for example, if a water heater breaks—customers know where to turn to find information about equipment and efficient options.

*“Customer acquisition is expensive and it is just lunacy that we acquire folks in an isolated way. (There is) no reason to do it that way anymore. (Customers) should have one point of contact....I see that there is an industry emerging (offering) ‘one face’, to help people connect....The other thing that is critical is the long-term relationship. It is true we want to have a long term relationship with people - if they call us, and the first time (we talk) we aren’t able to convert them...we can send them to a website to show them the (information) they are interested in and keep the conversation going with them. And eventually they are going to need a new water heater and they are going to come back to us.”*

There are no goals or financial incentives provided to the third party implementing the advisory services. As outsiders, we observe that this construct would likely be effective in ensuring that the advisors’ approach would be truly impartial, but we also observe it may create accountability issues for the administrator. Despite not having direct compensation for sales or uptake of DSM measures, the Energy Advisors do active marketing and closely track the completion of audits and measures. They follow up with customers using marketing ‘lead-lists’ with the names of customers who have received an audit or have one scheduled. They report that it takes about six months from the time of the audit to project implementation.

We heard from interviewees that customers almost always want to consider more than just energy efficiency; they are almost always interested in considering all types of conservation opportunities including water, DG and energy efficiency.

*“(We) experience the hurdles firsthand (with our clients)...We are there (with them) and we become their ‘go to’ resource; and what often spills out of that is water conservation, DG, and distributed energy resources. Happens all the time, regardless of whether it is initially in our scope. When people are considering one project, they are usually considering them all, and*

*nine times out of ten they are more likely to want more than just energy efficiency. Even if it is just a standalone energy efficiency project, we typically advise on all of them...”*

We asked interviewees how the advisors manage differences between the recommended DSM loading order and customers preferences, when they arise. We learned that the approach of this advisory is to allow the customer interests to be primary. That is, they support the individual’s personal sequencing needs and wants, though they do provide information on the costs and benefits of different DSM investments, and recommend completing energy efficiency before DG.

*“If someone wants to go after (retrofits) in the wrong order, we will educate them about (loading order benefits) but ultimately it is ‘client first’. We would never try and dissuade them from windows, for example, but would put (the issues) in context of their goals. “*

Although their services are marketed as energy efficiency advising, customers are interested in and attracted to solar as a solution to their energy needs. Interviewees report that customers are very interested and willing to invest in solar:

*“...(There is a) phenomenal conversion (i.e. sales) rate on solar....a lot of customers are trying to solve problems at the house and want answers.”*

We asked interviewees whether differences in program cycles across DSM strategy options affected their sales or customer satisfaction. They reported that there are program cycle issues in Colorado, but that they are not as pronounced as in California. They feel the one-stop shop offered by the Advisors is pivotal in circumventing those issues. The customer relationship helps information stay current and relevant; the customer does not have to work from a bid they got three months ago from an implementer or program that may no longer be relevant. The Advisor navigates the changes for the customer and will assist them in understanding how or if the programs have changes, and to complete any relevant paperwork required by changes.

We also asked about suppliers and whether contractors are qualified to implement multi-DSM projects. The interviewee noted that with the increased demand, there is an emerging class of contractors that are able to do energy efficiency and DG.

### *3.1.2.3 Third Party Notes on Demand Response*

One of our interviewees with ESCO experience reported generally being able to identify DR opportunities for commercial customers in California, but encountering substantial barriers to DR participation. We heard about experiences with the Technology Assessments program, a program offering funding to third parties for performing DR cost studies and feasibility assessments. One interviewee reported completing between 75 and 100 of these DR Technology Assessments and finding some very compelling opportunities, but that they were nonetheless unable to close a single one of those potential DR projects.

In particular, interviewees reported finding opportunities in the retail sector, where customers could curtail load by cutting back on air conditioning and some lighting. Retailers generally said they would consider it, but in the end it came down to the fact that they did not want to risk a compromised store environment, so declined to participate.

We also heard about opportunities for DR in food processing plants, with high demand and high turnover freezer operations. These facilities could not do load shifting, but in a DR event, they could pre-cool down below a certain set point and let refrigeration drift at a little bit higher set point before bringing it back down to keep it compliant with food laws.

Interviewees shared experiences performing Technology Assessments for commercial buildings between 50,000 and 500,000 square feet in size and across all types of industries: education, commercial real estate, etc. We heard there were notable opportunities to upgrade HVAC and use zone control and thermodynamic analysis to demonstrate how temperatures would be managed—and how they would change during a DR event. However, reports were that customers almost always declined the DR proposals, mostly due to concerns about their own customers' comfort or business operations.

One example stood out in an interviewee's memory:

*"The other (missed opportunity) blew me away, a 7 million kW opportunity. It was huge. A manufacturing plant (in southern California), where we found opportunities in the manufacturing process. In these processes, the highest energy user was an 8MW molding machinery. They make plastic bottles and fill them with (product), and always had a one to two week inventory. They were never going to run out of plastic bottles, so the filling part would not need to shut down. We suggested shutting down projection molding during DR – while continuing to fill bottles and keep production constant - and then replenish inventory when DR was over. They were not going to fall short in production due to these changes in inventory. Savings were expected to be \$500,000 annually. It started going up the ladder and finally someone at the top was worried that if a shipping month were missed because of the DR, he would be fired, and wasn't willing to take the risk."*

Despite substantial barriers to event-based DR, interviewees reported encountering a very different attitude from customers to DR programs offering reduced rates. Specifically, reports were that many industrial customers would not do DR but instead were interested in the Base Interruptible Tariff—or BIP. BIP is essentially a discount on the cost per kWh of 5 to 10 percent in exchange for the right to cut the power to the plant in case a grid stability event was called. Pricing did not play into it, just grid stability. Most DR programs offer customers a payment for curtailing energy during periods when energy is scarce and utilities are forced to pay a high price in the market to maintain supply. Interviewees report customers generally do not find value in payments made for DR event participation, but do find value in lowering their rate on a monthly basis. Reported hypotheses point to the internal structure of companies, which render the perceived value of "lower rates" higher on a dollar-for-dollar exchange, than event-based compensation.

*“(Industrial Customers believed) that they could go to their manager and show them these lower rates and those were the kinds of deals they found attractive.”*

### 3.1.3 Need States

Need states are life events or circumstances that create a very favorable environment for marketing and education of IDSM opportunities. Need states create a greater desire for IDSM knowledge and a higher degree of interest in programs, as well as motivation to adopt measures and practices.

*“It’s about figuring out the right time to communicate with customers about certain solutions. How do we get messages to them right then and there, when they are in that frame of mind about what they can be doing—bulbs, thermostats, pool pumps, etc.”*

*“We need to generate more awareness and getting to folks when they are in the right mind set, when they are receptive to it.”*

PG&E noted that customer response to an occasional high bill provides an important opportunity to improve knowledge and encourage uptake of available DSM options. In general, people do not monitor energy bills every day or every month, but an unusually high bill generally causes customers to take notice, and they want to know why the increase occurred. They often call their utility and ask for explanations. SDG&E staff concur, and report that they also often hear from customers when they receive a high bill:

*“... they go OMG I gotta do something. It is all about the bottom line....Every decision that a business owner makes is because something is impacting their bottom line.”*

IOU staff emphasized to us that if the utility were able to inform customers of the specific day and time that usage spikes occurred, this could help both the utility and customers to pinpoint the equipment or events driving consumption spikes. As of now, the details available to customers using online tools—and to IOU call center staff—do not provide this level of resolution. Customer service representatives have limited ability to provide customized information about what may have caused increased usage. Limitations in technology and information services inhibit the process. Customer service representatives are not able to see beyond total bill amounts, so have trouble explaining the driving factors of increased consumption to customers; and as a result also have trouble providing recommended solutions.

One approach to leveraging need states used by the utilities is to align the timing of certain kinds of outreach with seasonal transitions—for example, using weather-related events or forecasts to inform marketing messages, or leveraging seasonal transitions by sending summer preparedness messages out in late spring, or winter preparedness messages in late fall.

SDG&E reported to us that it often uses seasonal-based approaches in its marketing. For example, it messages higher tiered customers in summer, when they are most likely to receive their highest monthly bill.

*“Higher tier customers often experience higher bills in summer. Starting in June and July, SDG&E does a number of targeted marketing campaigns for customers in these higher tiers.”*

PG&E reported wanting to do more marketing via Internet search tools. That is, when people are searching for LED bulbs or new appliances, PG&E would like the IOU rebates to come up. While Internet search is not a need state itself, it may be an early indicator that a customer is motivated to purchase new energy-using equipment or to make an energy upgrade investment. As shown in the Survey Results chapter of this report, Internet research is one of the most common methods of gathering information used by residential customers planning energy upgrade projects.

PG&E staff also mentioned that the closing of a home equity loan or the receipt of tax returns may be a good time to communicate with customers. Fall may be a good time to communicate as well, when customers are transitioning from summer and starting to think about the upcoming heating season.

### **3.1.4 Drivers and Barriers**

We discussed barriers and drivers to IDSM adoption with interviewees. We heard about IDSM barriers and drivers, as well as differences in barriers and drivers across DSM strategies.

SCE reported there are different drivers in each DSM market, and within a single DSM strategy, there may be different drivers for different DSM strategies and technologies. For DG, the main drivers of adoption might include financing and leasing options, but for energy efficiency, these do not carry the same weight:

*“Some customers may be trying to get off the grid...but they might not understand that a long term lease is just paying a different third party.”*

PG&E shared with us the results of its research into solar photovoltaic (PV) adoption, which customers adopted almost purely for economic reasons. PG&E conducted a survey and found the number one reason customers reported adopting solar PV was to lower their bill. Solar companies market PV systems as a way to provide money savings for all customers whose bill is over \$150 per month; they also pitch increased home sales value as a benefit. Solar companies have an aggressive sales pitch; they offer to take responsibility for the system maintenance and all aspects of the installation and upkeep. It is difficult for energy efficiency and DR to compete with these kinds of DG offerings.

One barrier mentioned by IOU staff is related to equipment knowledge. Customers often do not have a good working knowledge of their equipment, particularly HVAC equipment. IOU staff report that small business customers often do not know what HVAC technology is

installed or how old it is. This is particularly likely if the customer does not own the building, which also introduces a host of other barriers related to split incentives. Commercial customers that rent face a myriad of obstacles when considering energy retrofits. Some of these barriers were described by IOU staff as follows:

*“(commercial customers that rent consider)..If I make changes to this (equipment), is this something I have to go through the landlord for or if I do it myself, are they going to be mad? Am I even going to be here in 6 months to enjoy the benefits?”*

The IOUs report that commercial customers that are good candidates for DSM projects are those that are invested in a property for the long term—such as a customer that has a 30-year lease or mortgage on a building. Those customers are interested in making improvements over time to ensure the property is the best that it can be.

Another barrier reported by the IOUs relates to the importance and difficulty of providing customers with accurate and timely cost estimates:

*“Customers want to understand costs and benefits before making a decision, but often we have to refer them to contractors to get prices, and we recommend they ask three HVAC contractors for a bid.”*

*“If we make an estimate and it is not accurate, this can end up making the customer mad and no longer interested in the project at all.”*

Some of the difficulty in helping customers understand costs and benefits relates to legal cost barriers that prevent IOUs from offering cost and savings estimates. It would be difficult for the IOUs to get an accurate estimate of the specific equipment and labor cost for installation at a particular site without an on-site visit and a detailed inquiry. Such an effort would be costly and would have potentially complicated legal ramifications:

*“.....when customer asked us about costs for a certain HVAC project say, the default answer is ‘no clue—you need to go find three contractors to make a bid.’ We don’t want to estimate (cost) because there’s a lot of implied litigiousness; and if it doesn’t end up being that much (cost) then the customer gets mad and they don’t want to do the project anymore....but if they don’t know the cost they don’t know the net benefits. We can tell them the savings and the incentives value but without a project cost variable we have no reference point to make a calculation on ROI so it is harder to sell the project. “*

IOU interviewees also report that a substantial barrier to IDSM project uptake relates to project complexity and risk. The world offers a vast and complex landscape of IDSM opportunities; there are a myriad of equipment options, monitoring and controls software, service providers, financing packages and available capital. Adding to these complexities are other uncertainties and risks; for example, there is a risk that codes and standards will change and alter the eligibility of a project for IOU rebates and/or will add expense to the project with increased code requirements. Generally, this introduces risk only for projects that have a long

planning horizon. Equipment prices can shift and evolve as well, particularly for emerging technologies. Something that is not cost effective today might be cost effective a few months or a few years down the line.

*“The bottom line is it is risky and complicated to navigate that landscape. An unsophisticated business owner that is not (thinking about energy) on a day-to-day basis needs a cookie cutter solution—something they can just rely on.”*

IOU interviewee emphasized that the risk and complexity of IDSM projects is particularly difficult for smaller businesses to manage, and as such, they are not great candidates for integrated audits or commitments such as continuous energy improvement plans. In contrast, larger businesses are perceived as better candidates for IDSM projects, and the IOUs report that they provide detailed IDSM audits that include estimates of cost, benefit and risk.

Another barrier reported by interviewees is the general population's misconceptions—particularly the small business sector—about what the utility and energy efficiency investments can realistically do for the customer. There is a tendency to expect that there are ample opportunities for energy efficiency projects that require only small investments and that will make a big difference in subsequent bills.

*“A lot of times we cannot identify a low cost investment project—or any investment project—that will make a substantial difference. We used to be able to refer customers to linear fluorescent upgrades (i.e. T12 to T8), but evolving technology and Title 24 have ended that opportunity. Now we are at a point that if a nonresidential customer is going to retrofit more than 10% of their lighting, they are required to comply with many regulatory and code compliance requirements...These are things that small mom and pop businesses do not understand at all and present a real barrier to project implementation. That is just the lighting market—markets in other end-uses have similar or related issues.”*

The IOUs report having difficulty tracking IDSM efforts in terms of money and effort due to administrative silos. The IOUs report that funding streams and cycles continue to be a barrier—though with the advent of rolling cycles, the expectation is that these problems will be substantially remediated. SCE staff also noted there has recently been some positive policy changes in support of IDSM tracking. In particular, regulatory filing protocols changed a bit, allowing for the separate reporting of IDSM activities and expenditures. SCE's IDSM activities (e.g. the integrated audit) are budgeted and reported to the CPUC under a special category, referred to as “category 9”. Thus, unlike the past where IDSM activities were woven in throughout the filing, they are now all reported and accounted for together in one place. Most IDSM activities are non-resource—and so not subject to the same performance standards as resource programs. Still, IOU staff report that the separate ‘category 9’ section of the filing calls greater attention to IDSM activities, which the IOUs report translates to greater perceived accountability and degree of importance.

*“...what’s great is that it puts it under its own umbrella, and I think that brought more focus on IDSM than previous cycles.”*

An important policy barrier to IDSM is the inequality of incentives offered to account and program representatives for DR and DG relative to energy efficiency. Previous regulatory policy did not allow DR and energy efficiency funding to be comingled, so to circumvent this and also meet IDSM portfolio requirements, the co-selling of DR and energy efficiency was funded via energy efficiency dollars. A by-product of this approach was that any projects installed via programs engaging in IDSM sales efforts were compensated only for their energy efficiency savings, under-rewarding DR and DG accomplishments. However, interviewees reported there have been changes on this front as well. One interviewee with first-hand ESCO experience noted that ESCOs operating in SCE’s territory have begun receiving incentives for DR enrollments, in addition to the energy efficiency savings gained from projects.

On the other hand, we also heard many positive comments regarding the business aspects of offering combinations of energy efficiency, DR and DG. Interviewees from third party programs operating in other states report that customers are typically interested in considering all their DSM options before making an investment decision.

### **3.1.5 IDSM Technologies: Synergies and Compatability**

We asked interviewees to think about what the most important technologies are that incorporate multiple DSM strategies; where do they see important ties or synergies?

IOU staff report that the most important integrated technologies right now include variable frequency drives, smart thermostats, home area networks and energy management systems. Many of these technologies are multi-purposed, for both energy efficiency and DR. Energy management systems are also typically used to reduce ongoing (daily) peak kW, lowering the customer’s kW charges and smoothing the utility’s daily peak load. Variable frequency drives allow customers to slow their equipment down drastically when not in use, saving energy and offering a technology option to reduce load during DR events.

Several interviewees reported there have been difficulties selling remotely dimmable ballasts with energy efficiency and DR capabilities; these have not been particularly successful with customers or vendors working with the auto-DR program, as previously hoped. We learned that the newest, most sophisticated and efficient new lighting systems are difficult to adapt to direct load control DR. These systems come with expensive and highly complex control systems, which can be challenging to augment with the tools and software required for direct load control program participation. The high efficiency characteristics of these efficient lighting systems reduce peak load, making it harder to justify costs.

*“Consider a highly efficient and sophisticated lighting system. It is difficult to find value for DR in curtailing the lighting load. Generally speaking, the more sophisticated the lighting, the more expensive and more complex the associated controls. The reductions are not always big enough to justify cost.”*



One interviewee noted that there are some seemingly easy fixes to reduce the barriers to adoption:

*“If manufacturers built controls inside the electrical panels to receive wifi signals from DR dispatch, we would not need any add-ons to existing systems, but the technology is not out there yet. “*

### *3.1.5.1 DSM Technology Compatibility*

We heard some interesting reports from IOU staff on issues related to incorporating DG into energy upgrade audits, as well as interaction between incentivized DR and energy efficiency and the installation of DG. One interviewee noted that her program services group did not include DG assessments as part of their energy audits. Her understanding was that there were rules preventing this, but was not clear on the details. Other IOU interviewees report that they do include all three DSM strategies in their audits: energy efficiency, DG and DR—at least for some of their audit services.

We heard a couple of examples of where DR/energy efficiency had collided with DG. When a customer enrolls in DR, the IOU first assesses the customer’s DR potential by analyzing past usage patterns in summer from the noon to 6 p.m. peak, and then proposes a project with incentives. Of course, when DG is installed, the profile of usage from noon to 6 p.m. may change quite a bit. In one case, a large city building was assessed for DR participation. The IOU reviewed the building’s summer peak usage and then proposed a project with incentives that was subsequently accepted by the city. However, before executing the DR project, the city installed a substantial solar system on the building, which changed the load profile considerably, including bringing net consumption to below zero at certain times that overlapped with peak hours. Given the way DR curtailment opportunities are measured, there was very little load curtailment potential remaining after the solar installation. For this project, the utility had committed money in a signed agreement, but was conflicted over whether to honor the agreement due to the change in consumption profile resulting from the solar installation. The interviewee also noted that the substantial generation capacity also impacted the remaining potential for energy efficiency. In this example, the interviewee also noted that the utility representative had neglected to explain the effects of solar on the eligible DR incentive amount. The interviewee noted there have been other similar cases where the utility invested time and effort in scoping a DR and/or energy efficiency project only to find that a major solar installation had taken place in the interim, substantially altering the landscape for energy efficiency/DR incentives.

### *DSM Technology Interaction Notes*

The following paragraphs summarize key take-aways from interviews related to interactions between DSM technologies and strategies.

**Technologies selected for different DSM strategies can interact to make both more cost effective.** When implementing energy efficiency, there are often capital investments and

upgrades that facilitate participation in DR, making it easier and less expensive for a customer to participate. For instance, air compressor projects involve automation controls, so we set up control protocols to optimize sequencing and flow, among other things. A lot of programming goes into creating optimal controls for the air compressor. Similarly, pre-programmed controls are also needed to participate in a DR event or an auto-DR program. Conversely, it is sometimes the case that controls that are installed for the purpose of DR participation can be used to fine-tune equipment, allowing it to work more efficiently.

**Optimal technology selections for each DSM strategy do not always coincide.** The IOUs report that in some cases there are measures that have both energy efficiency and DR benefits, but the specific version of a measure that is optimal for energy efficiency may not coincide with what would be the optimal selection for DR. An IOU staff person reported an example of this, where they identified a high potential for DR through the use of radio-controlled compressors on pool pumps. However, the pilot tests showed this technology would not be optimal for capturing energy efficiency benefits for pool pumps.

**Implementing one DSM technology can reduce the savings potential for others.** When a building is retrofit for energy savings, the same retrofits likely reduce peak usage kW demand. That is, energy efficiency retrofits reduce the baseline demand for measuring load savings during DR events—and therefore reduce DR-attributable grid benefits and the financial incentives available to the customer for DR participation.

The IOUs report that customers with substantial DG systems (relative to their own load) are not generally considered for energy efficiency/DR programs, due to regulations prohibiting recognition of those savings via the ratepayer funded mechanisms. IOU program goals require that incentivized measures result in a measurable, positive net load reduction. The low load net drawn by a facility with substantial DG generally reduces or eliminates the possibility of recognized savings from DR or energy efficiency program participation. .

**There is confusion over the positioning of energy efficiency and DR in the loading order.** Interviewees note there seems to be a common misconception among customers and utility staff about the meaning of loading order with respect to energy efficiency and DR. They say that a common perception among IOU staff is that the loading order specifies energy efficiency be installed *first*, then DR should be considered second, and DG third. However, some interviewees report that the policy actually says that energy efficiency and DR should be deployed together first, as a pair, followed by DG. They emphasize that the intent of order is for the customers to exhaust the easier and less expensive options offered by both energy efficiency and DR before exploring DG.

**IDSMS enabling technologies have potential for efficiency savings, but such savings are not eligible for IOU energy savings claims.** Monitoring and controls technologies have potential for both energy efficiency and DR. Interviewees reported behavior-related energy savings from implementing monitor and controls technologies, but noted that these savings cannot be claimed in their filings. For example, an interviewee reported a large manufacturing

plant in their territory had many pieces of equipment and only one meter. When the customer added controls, they were able to see how much energy each piece of equipment was using at all times, and were able to refine their operating process. They were able to see that some of their equipment was using much more energy than anticipated, and they could see when this high energy use was happening. This customer used the information to save a lot of energy and money. The IOU was not able to claim these savings because the savings did not arise from incented equipment change-out.

IOU staff reported that they often analyze metered data before going forward with a customer project proposal. This analysis sometimes yields information that provides energy efficiency benefits. Metered data often makes it clear what is causing fluctuations or spikes in energy usage during certain periods. The data offer details of exactly when there are usage spikes and how large they are, which can help customers understand and pinpoint the equipment with greater potential for saving energy.

*“...the data gives you a glimpse into the usage patterns of the existing equipment causing the usage spikes. It’s just a snapshot in time...but it can really help a customer save energy.”*

### **3.1.6 Demand Response (DR)**

Several interviewees offered observations related to DR programs themselves and how they fit into an integrated portfolio strategy.

IOU staff reported to us that DR programs vary in cost and cost effectiveness, as well as in their effects on customer satisfaction and comfort. Programs that call events based on real time changes to wholesale prices offer little lead-time, resulting in more customer comfort challenges, and can be expensive to maintain. On the other hand, a program that calls events on a day-ahead basis or relies on smart thermostat technology is generally less costly to maintain, and can have less impact on customer comfort.

*“...Imagine for example that we have a price event, and we cycle customers’ AC equipment without notice and it is hot (outside), customers will be uncomfortable. (Compare this to) a day ahead or planned event, where customers can pre-cool. Or where we can share the event burden over 100,000 customers, each customer impact might be small but (the overall) benefit is sizeable. (Conversely) if you have to do it in a 15 minute window you have to give them short order and spend a lot of money to keep emergency capacity of energy available.”*

The IOUs also reported experiencing ongoing challenges with respect to residential DR program designs. For example, for purposes of ratepayer equity, the IOUs offer the same compensation and access to AC Cycling programs for all customers. While all customers receive the same annual bill credit, some portion of those may have schedules that yield a zero base load during peak times. Furthermore, those customers would have a tendency to self-select into the programs, resulting in poor use of program dollars and increased risk to the IOUs related to program performance. The IOUs are working on ways to screen customers for AC

Cycling program eligibility, to ensure participants have a positive base load capacity and a higher likelihood of load reduction during events.

Interviewees commented on how recent changes to codes and standards intended to support DR participation are evolving. Recent changes to Title 24 include installation of mandatory “DR capable” lighting in new or retrofit commercial buildings over 10,000 square feet. IOU staff reminded us that “DR capable” means the equipment is present, but it does not mean the customer can be called on during an event or is participating in any DR programs. Customers utilizing the DR capability of their equipment are “DR enabled” – as opposed to “DR capable”. Moving customers from DR-capable to DR-enabled is a challenge, as it involves:

*“...providing customer education, training, (changes in) behavior, and connectivity. That’s the hard part.”*

Several interviewees noted that DR programs can be a more difficult product to sell than energy efficiency or DG. There are substantial barriers to adoption related to the customers’ own internal structures and reward mechanisms, concerns related to comfort and/or core business operations, and general lack of willingness to endure frequent events, such as might be needed to maintain a price-responsive DR program. Interviewees also reported barriers related to communications or difficulty educating customers about the opportunities and the requirements of DR participation.

Several interviewees noted that customers participating in DR tend to be those customers already engaged with energy management and conservation. An IOU staff member noted:

*“The hard puzzle piece to find is the guy that will do DR. If you can find the (customers) participating in DR, odds are good that you are going to find (customers) that have also done energy efficiency and possible some type of DG. “*

An interviewee with experience in the industrial sector sales of DR and energy efficiency projects noted:

*“... if you want to find IDSM projects, find out who is enrolled in DR and who is participating. From there, you will find those customers that are highly likely to use IDSM.”*

IOU staff reported encountering frequent misconceptions among customers related to participating in DR programs, particularly Auto-DR:

*“... customers often do not realize that they need some type of EMS (Energy Management System) or control system that can communicate to the Auto DR server in order to receive the event signal. That has been a communications and logistical hurdle, customers do not understand how DR works...there has to be real-time communication of events, because they are varying, time-specific and temporary.”*

*“Successful sales of DR is a lot about education for customers, it's huge. Even sales people don't know how to sell it...Contractors that replace equipment have a hard time with the concept of selling a program, not a physical object... This is selling a behavior, so it's really different.”*

We heard reports from IOU staff that DR opportunities can be hard to find in the commercial market:

*“(Customers) have to be able to sell DR product back to the utility for a long time. Like anything else, they are weighing capital investment opportunities versus their core business objectives. In the end, the set of interested and eligible customers (is very) small; there are a limited number of customers that can pencil that out and have it make sense.”*

*“It is tough, but some businesses do it well. Take for example a facility with an air separator, that makes oxygen; they can use giant compressors and store the product in a storage tank. If we want them to curtail, they will be happy to build a storage tank to store their product and draw upon that to curtail grid usage, but it has got to be worth my \$20 million investment to do so.”*

*“Power is usually a key component to businesses operations; it takes a lot to get commercial customers to participate.”*

Interviewees noted that customers were more willing to sign up for DR programs offering purely voluntary event participation, such as the Demand Bidding Program. An IOU staffer noted customers generally have a desire and willingness to help out during power emergencies—or extreme peak conditions—and that an occasional event is very acceptable to most customers. This willingness is driven, at least in part, by a desire on the part of customers to ‘do their part’ to support grid stability. This translates into willingness to curtail usage during emergency events, but there is a limit to this willingness and an underlying assumption that such emergency events will occur very infrequently.

*“...most businesses understand (the need for occasional DR events), and programs that call on customers every now and then can work”*

*“...many customers want to help, they know you can have a peak or emergency condition and they want to do their part to help so they can have reliable power.”*

*“We can call upon customers to participate in (involuntary/direct load control) events for a period of time, but when you hit a heat wave or something like that, it gets old real quick. (Customers) don't like having to curtail for more than a day or two. They have a business to run, products and manufacturing commitments; or maybe it's an office building and they don't want to burn their tenants out. (The IOU has to) find ways to do it in little tiny chunks, (sharing the burden) across all customers so that there aren't these big effects on some customers.”*

*“They like to get paid (for event participation) but they don’t like to get called upon if it’s too frequent; then it’s not worth it to them.”*

Furthermore, once enrolled in a voluntary DR program, it has proved challenging to motivate customers to engage with Demand Bidding events or to enroll in non-voluntary price response programs. While customers are generally willing to sign up for voluntary curtailment events, such as Demand Bidding, it was a challenge to gain follow through vis-a-vis event participation. Reports are that most customers would not participate in the Demand Bidding events, and those that did participate did not curtail by very much. One third party interviewee had been enlisted by the IOUs to engage with Demand Bidding Program customers in an effort to enhance event participation, and reported to us that these efforts met with little success.

### 3.1.7 SCE

SCE account managers are responsible for customers with an assigned status. Each manager has a set of assigned accounts and is responsible for knowing their customers’ business model, facilities, services, rate, ability to respond to DR events, opportunities to increase energy efficiency and opportunities for self-generation. Account managers are responsible for helping their assigned customers understand SCE programs and services, and assist the customer in formulating the best strategy for using SCE offerings in the context of their particular financing, budget and business requirements. There is no single way to approach this problem. Customers need to be aware of all of their DSM options in order to make the best decisions for their particular situation.

SCE also has a customer solutions group within the business customer division. This group, which includes IDSM specialists, is in charge of outreach and education for 300,000 small business customers. The IDSM specialists are part of the outside salesforce that complements and parallels work done by the inside salesforce, which is comprised of the account representatives. The customer solutions group works primarily via telephone, and each representative is assigned between 200 and 600 customers. Representatives engage customers about all types of things; they help them understand and avoid high bills, provide guidance regarding DR and energy efficiency programs, and help them understand net metering, regulatory updates, and more. Contact with customers is sometimes proactive and sometimes reactive (i.e. responding to customer inquiries/calls). One of the assignments of the representatives is to incite interest in DSM. Customers that express interest will be referred to an IDSM specialist that is geographically positioned to meet that customer in person and complete an on-site audit. They will meet with customers to discuss specific opportunities and projects and will encourage and assist customers in enrolling in service contracts or incentive programs to help offset retrofit costs. If the efforts of SCE representatives are successful in drawing interest in DSM measures, and this leads to actual installations, then SCE gets closer to meeting its energy savings goals,

*“... and the customers gets a new HVAC, compressed air motor, lighting, or other technology that they might not have thought to do otherwise without our involvement.”*

SCE staff noted that while they incorporate DR programs and DG technologies in their repertoire, the focus remains on energy efficiency because that is how the account representatives and IDSM specialists' performance is measured. That is, the account representatives' goals remain energy efficiency focused, so:

*"We look at DR and DG strategies; however, that has kind of not been our sweet spot because our individual goals are not measured by driving customers to DR and DG technologies. Our primary focus is energy efficiency and (because) that's primarily how we are rated."*

However, we also heard from ESCO employees implementing programs in California that in early 2014 SCE began to offer financial incentives to energy service providers for filing DR applications as well as energy efficiency. We heard that this incentive offering increased third party rates of DR sales and prompted new interest in doing more integrated analysis and feasibility studies for customers that encompass both energy efficiency and DR, though DG remains out of scope.

To achieve goals across DSM strategies, the account representatives work from programs offered across multiple proceedings, not a combined program.

*"We're just picking the measures and technologies and program offerings that make sense for a specific area...trying to find the best bundle of measures that would stick. "*

The following quote is a good reflection of SCE feedback on its own IDSM efforts and recent progress:

*"Our IDSM efforts are still a work in progress...funding is itemized and that is still a barrier, but there is better promotion and recognition now. Previously, we have always done IDSM but never tracked it very well but now it's different. We are now setting up the foundation to track IDSM accomplishments and raise more awareness. "*

We also discussed the online tools with SCE staff. In 2014, SCE contracted with a new vendor to develop an enhanced version of the online tools. The first version, the Universal Audit Tool (UAT), was developed with a previous vendor. SCE encountered complications with this first tool, so changed vendors. With the opportunity offered by the new vendor and development of a new generation of software/tools, SCE sought to increase the scope of the tool. Feedback on the first tool was not all positive, but did help in defining and refining the specifications for the new version.

The new tool will have the same goals and functionality of the previous tool, but will include more behavioral information and feedback options. It will also offer a commercial and industrial audit component online. Of this, one interviewee noted:

*"It's hard to know how that last part will work...(we are) working with Opower and ForceField, which use AMI data and Google maps and other data to try and figure out the*

*parameters of a facility and come up with (efficiency upgrade) options for the facility without actually doing an audit.”*

### 3.1.8 SDG&E

SDG&E describes its service territory as “a unique little island in the corner of the state”. SDG&E finds that its customer base has distinct demographic and geographic characteristics, and SDG&E staffers reported that it does not make sense to treat SDG&E customers in the same way as the other IOUs’ customer populations. For example, for California’s IOU service territories as a whole (i.e. on a statewide basis) there are high estimates of potential energy efficiency savings in the industrial sector. However, this is based on the characteristics of the other IOU territories; SDG&E has very few industrial customers. In fact, SDG&E reported that there are many ways in which the customer makeup of SDG&E’s service territory is different from other IOUs. For this reason, SDG&E constructs its own tailored local marketing and outreach approach and maintains its own strategy for DSM services and offerings.

SDG&E noted that its online tool works well, but may be too demanding for some customers:

*“Our online tool is great, but it will not work for everyone. It can be time intensive to use and...if it takes more than five minutes, a small business owner may not have time for it.”*

Furthermore, SDG&E noted its marketing campaign leverages this customer characteristic, by offering to take on the energy-issues on behalf of the customer:

*“We have a tagline for our slogan that says, “You know your business. We know energy, lets talk” so they know they can come to us. We want to make it as easy and seamless as possible.”*

SDG&E reported that a lot of what it is trying to address is about not just communicating with customers in a way that is convenient for its organization internally, but instead, the intention is to communicate in a way that best matches how customers want to receive information.

SDG&E reported that for purposes of marketing, it segments its nonresidential customers in three ways. The first segmentation, size, is defined by the facility energy use (not square footage or annual revenue). The second segment is business type or industry (e.g. restaurants, nail salons, hotels), and the third segmentation is based on behavioral elements. Behavior segments were developed using a combination of participation data, size and business type segments, as well as SDG&E’s own research and field studies examining motivating factors for program participation and measure adoption. Although the definitions are more detailed, the basic gist of the behavioral segments was characterized by SDG&E as the following:

- Customers who want SDG&E to do DSM for them;
- Customers who want to do DSM for themselves; or
- Customers who want to be left alone.



In our interviews with SDG&E staff, we learned that one of SDG&E's major IDSM efforts is a reward-program pilot called “Manage, Act, Save” or “MAS”. The MAS program is intended to engage customers with a range of DSM products and services, and to motivate them to improve their DSM knowledge and awareness, conservation practices and measure adoptions.

SDG&E reported that MAS and the Opower Home Energy Reports represented the two primary behavior program initiatives in 2014. Both of these efforts take customer data and provide reports for customers designed to enhance their understanding of their own energy usage and to offer tips on how to save. The MAS campaign differentiates itself from previous marketing efforts, and is considered a pilot because it offers incentives tied to behaviors and actions; customers can earn incentives like gift cards for making behavioral or equipment changes that save energy. In contrast, the Home Energy Reports program is strictly a reporting and usage tracking mechanism.

The MAS campaign is designed around the concept of continuous engagement—which is the intention to establish regular contact with customers around issues related to DSM. Customers may gather different/additional DSM information during each interaction, but more importantly, they build familiarity with how to use the DSM tools and resources so that when a DSM-related need arises, they know exactly where to look to find answers. The strategy actively pursues customer follow up and encourages customers to check back in with program information to see results and progress towards rewards/goals. The actions that qualify for rewards points (that can eventually be swapped for gift cards or something similar) include energy efficiency actions and energy efficiency measures, as well as enrollment in AC Cycling or Smart Rate options. However, DG-related actions or installations do not qualify for rewards.

The MAS approach is to divide all the DSM products and services into four primary categories, and then invite customers to express interest in any one, or any combination, of the four. The structure is intended to simplify the task of communicating the range of offerings to customers, and also to help customers more easily identify the DSM-related support and services in which they are most interested.

- The first category is information about where to call for assistance or to talk with an SDG&E representative about DSM options.
- The second category includes information about all the DR and energy efficiency financial incentives and rebates that are available. This category includes DG as well, but because SDG&E's CSI program is administered by an outside entity (CCSE<sup>12</sup>), the information provided is a referral to CCSE.

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<sup>12</sup> “CCSE stands for “California Center for Sustainable Energy” – This organization is the assigned implementer for the ratepayer funded California Solar Initiative program within SDG&E service territory, and is also the implementing the 2013-2015 IOU ratepayer funded statewide Marketing, Education and Outreach programs.

- The third category includes all of the online personalized tools. The online audit is included here, in addition to programmable thermostat offerings and all of the other tools offered within My Account, such as Energy Use Alerts, Home Energy Reports and Flex Alert.
- The fourth and last category relates to billing options. Customers can review and select from a number of optional rates, and they can sign up for equalized payment options.

An SDG&E staff person noted:

*“We’ve done a good job of taking everything that we offer and, by using the simple set of categories, we are better able to educate customers on the broad range of things that we offer—and to me, that is what I would call IDSM marketing.”*

SDG&E has a business call center where it fields most of the customer service calls. Calls from customers that are DSM-program related, either energy efficiency or DR, are directed to a smaller call center called an Energy Savings Center. The representatives working in this call center are trained to direct customers to the most appropriate DSM program(s), including energy audits.

*“One of the reasons we lumped audits into that bucket is for any project, whatever program it is, an integrated audit is the first step...We do have a funnelling policy here, which is that if a customer hasn’t done anything at all, we refer them to our audit services. The idea is that the first step for customers should be to understand their energy use and the best way to do that is to have an audit. We also help them determine which of our audit services is best for them.”*

SDG&E also shared with us a new IDSM initiative it launched that focuses on ways to maximize marketing effectiveness by intelligently bundling various DSM products and services together for marketing purposes. IDSM as a concept was a stepping stone for that, and SDG&E also incorporated the behavioral segmentation research discussed above into this strategy.

*“We have five customer segments that are differentiated by behavior and attitudes towards (SDG&E) and willingness to be contacted and other psychographic things. SDG&E is starting to investigate that further now, to see if we can match up program participation by group or identify geographic patterns where it might work well to bundle different offers. We have maybe 20 residential programs and could create combinations of those and consider seasonal factors as well.”*

### **3.1.9 PG&E**

PG&E’s Information Products Team manages all of the online tools including the online audit. It also manages the home energy reports, energy audits, benchmarking for larger customers, smart thermostat and Home Area Network (HAN) pilots, and a host of information and behavior-related programs and pilots.

We held discussions with PG&E marketing staff and members of the Information Products Team. We discussed current marketing strategies, pilots, online toolkit and customer tracking systems. PG&E noted its current internal technology systems allow staff to view customer records for sufficient relevant information about how long the customer has been residing in the home/facility, their energy use history, and what upgrades they have made, if any. With these information resources, PG&E has begun to implement strategies that target tailored messages to certain customers.

PG&E reported it has used its market research and information resources to create customer segments that it terms ‘personas’. More specifically, PG&E has developed 11 marketing personas, three of which are gas-only customers and eight that are gas and electricity customers. PG&E maintains a collection of information about each customer that includes 100 pieces of descriptive data; this is combined with other data resources such as third party and census data that tell PG&E even more about the house itself and the lifestyle interests of its occupants. Taken together, these data are used to create and categorize ‘personas’ that form the basis for much of PG&E’s marketing strategy. PG&E staff noted:

*“You can market, save time, save money, or make me feel good. The first two are given, but how do we make people feel good about themselves (while doing DSM).”*

That is where the personas come in; they help PG&E refine its strategy to fit the values and preferences of different personas. PG&E’s marketing strategy involves targeting messages by persona and leveraging seasonal and other timing elements to align with relevant need states, as possible. Staff offer these explanations of a few of their marketing personas:

*“We find that for most affluent customers, money isn’t a priority. We have a family persona that we term “the Gadget family”. These are families that are pretty well off; they are going to buy a Nest thermostat because it is cool, not to save money or energy, but just because it is a cool gadget and they want to show their friends. The environmental benefits of saving energy is mostly just a bonus to this group.”*

*“Another persona (is one) we term “eco active”—and they are all about that. They will spend more to be more ecocentric. We find that is a small percentage of our customer population. Many customers cannot afford to think about those types of things.”*

Like SDG&E, PG&E also recently introduced a pilot rewards program to customers. The pilot was focused on promoting energy conservation through low cost and no cost measures, and it reportedly found the pilot design very successful and popular with customers. PG&E reported that rewards programs have grown in popularity in recent years across many different business types. PG&E reported that rewards programs represent a popular and growing marketing strategy because they generally provide an ‘enhanced experience’ to customers as well as motivation for repeat business. PG&E noted that for a utility, repeat business is not a factor, of course, but it also noted that rewards programs make customers feel better about the process of purchasing energy and enhances the experience, choice notwithstanding.

Moreover, the design uses positive reinforcement, which is preferred over negative feedback; this design rewards good behavior as opposed to punishing the bad.

PG&E described the rewards program pilot as both flexible and broad. The program was based on earning a pre-determined number of ‘points’ by reducing energy use or by taking specific energy saving actions. When enough points had been earned by the customer, they could then be redeemed for gift cards or gift certificates, or could be used to make donations to a charity or school.

We discussed PG&E’s online audit tools. PG&E reported that the focus in the tool design is to encourage customers to go beyond the simple question, ‘what goes into my bill this month?’ and instead prompts them to begin comparing their current bill to bills from other months. The rewards program that PG&E recently piloted also encourages this by prompting customers to check their balance of rewards points. This way, the program discourages customers from focusing only on the occasional unusually high bill, and instead encourages them to start to develop a more meaningful and empowered understanding of what drives high energy bills, and what they can do to reduce them.

PG&E has lists of customers receiving a particular recommendation for a program or measure (e.g. AC Cycling or Refrigerator Recycling). These records are leveraged by PG&E, acting as a “lead list” and/or proactive mailing list from which to build savings. On the residential side, it is most often used for proactive mailing rather than personal phone calls. All of the outreach and recommendation data is tied together through comprehensive marketing tracking and software. For the nonresidential sector, PG&E has dedicated field representatives that use recommendations from the online audit to provide leads for the program sales teams.

At the time of the interview, PG&E planned to ramp up its use of follow up calls to nonresidential customers, leveraging all the nonresidential audit tools information. It developed a new system where the customer account and audit recommendations are now assigned to a representative who will follow up with targeted support and promotions, building on the recommendations and customer responses captured by the tools.

The online audit tools use analytics and hourly interval data to run disaggregation algorithms against the customer’s measured usage loads to isolate heating and cooling loads. These initial results are then refined using survey questions and other business-specific benchmarks.

PG&E staff report that a powerful attribute of the tools is to be able to offer a refined bill disaggregation technology that would allow customers to see exactly how much energy all their appliances use at different times—that is, a tool that would offer an accurate profile of appliance usage tied to specific customer hourly loads and narrowly defined equipment categories. Such a tool would be extremely valuable to support both customers and customer service representatives in their efforts to explain fluctuations in bills and the drivers of high bills. It could also inform what actions and investments would offer the highest return on

investment and the shortest payback, and would be able to better estimate just what those figures would be.

PG&E staff also reported that mass market customers would benefit from an Energy Alert service that includes notification of usage spikes in addition to the current alert functions of tier changes or notification of reaching specific (aggregate) usage value thresholds.

Utilities observe that there are lost opportunities due to the limitations of current software and tools, and look forward to developing new tools that provide real time and appliance-specific information that would enable customers to make more informed energy-related investment and usage decisions. In particular, a home area network device is something that can help customers understand usage at the appliance and time-specific level. It can track and compare current usage to other time periods specified by the user. The IOUs are testing this technology now, and there are efforts underway to develop algorithms to reliably disaggregate bills by appliance.

*“When people call to ask about a high bill, it’s the perfect time for our call center to become a sales program that promotes solutions. But until it’s easier for our customer service representatives and customers to interpret solutions and understand how to reference the website, nothing really happens.”*

PG&E reported that it is continually evolving and changing its online tools; some changes are minor and some are major. The partnerships with their major software vendors continue to improve, and in conjunction with this, the tools also continue to improve. Both vendors PG&E works with to develop the tools perform what is termed ‘agile development,’ a software development approach that releases software updates every three to four weeks.

In support of their goal of continuous improvements, PG&E analyzes tool usage patterns, holds focus groups and collects feedback via customer call centers and user messages. Multiple pieces go into the product development process. One major improvement PG&E made recently is that the business checkup now allows the inclusion of multi-family buildings. Another example PG&E shared with us is that in 2014, PG&E adjusted its tools so that agriculture customers could review and compare consumption year over year, which this sector had reported having a particular interest in. A third example shared by PG&E relates to its online audit tool. PG&E learned via customer feedback that solar information was positioned awkwardly within the tool, causing some customer confusion. PG&E was able to reposition the solar information in short order and improve the user experience.<sup>13</sup>

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<sup>13</sup> After the customer completes the initial energy check up, they do not get the solar banner, but after they complete the energy check-up, the solar was almost too prevalent and led to some confusion. The solution was to move the overly-prevalent solar banner to the bottom of the page.

## 4. Customer Survey Findings

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This section presents findings of the telephone survey of 302 residential customers, all of whom receive electricity service from a California investor-owned utility (IOU), reside in single family detached housing and own their homes. In this section, we use the term ‘participant’ to refer to customers who installed both distributed generation (DG) and energy efficiency measures between January 2010 and October 2014, while ‘non-participant’ refers to customers who do not have a distributed generation system and may or may not have installed energy efficiency measures. The term ‘non-participant adopter’ refers to non-participant respondents who have either installed energy efficiency measures between January 2010 and October 2014, or report participating in a demand response (DR) program.

### *Non-participant Adopters*

Note that energy efficiency measures may include either rebated IOU program measures or self-reported installations, or both. However, it is important to note that self-reported installation will only qualify a non-participant as an adopter if they also report the installation was substantial from a time and investment perspective, including having a materials cost of at least \$50. More specifically, each respondent was asked:

*“Since January 2010, have you made any upgrades to your home that improve its energy performance, such as purchasing new energy efficient appliances, efficient windows, LED or CFL lighting or insulation?”*

An answer of “yes” to the above question did not qualify the respondent as a demand side management (DSM) adopter. Respondents offering a positive response were then asked:

*“Did this upgrade involve some consideration or planning on your part? Or was it a minor change – like one or two light bulbs – that did not involve any planning?”*

Surveyors categorized responses as either a “relatively substantial upgrade” or a “minor upgrade”. If respondents asked for more specifics regarding how to categorize their energy efficiency installation, the surveyors clarified the questions by specifying that the upgrade should have required “some planning” and “cost more than \$50” to qualify as substantial.

### 4.1 Project and Household Characteristics

We begin by exploring various characteristics of respondent households, with an emphasis on identifying meaningful differences between participants and non-participants. We then present a discussion of the particular measures and features of respondents’ energy efficiency, DG and DR adoptions.

Table 13 below presents a summary of demographic characteristics collected via the telephone survey. The upper panel of the table summarizes the traits that differentiate the population of participants from non-participants; these are the traits that are statistically

significantly more likely to apply to participants than to non-participants.<sup>14</sup> The lower panel summarizes the traits that are statistically equivalent in the two populations—i.e. those that do not differentiate the two populations.

Characteristics in the upper panel are more likely to be found in the population of participants, though it is important to bear in mind that this does not necessarily imply these traits are common among participants—only that they are *more* common among participants than non-participants.

In comparison to non-participants, participants are more likely to live in larger homes with central air conditioning (AC) and a tank-style water heater. Households typically have been established for a longer period of time, have more household members, and have older household members. Participant homes are more likely to report high saturation of efficient lighting equipment and are more likely to use a smart thermostat.

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<sup>14</sup> Please see Section 2.4.2 for a full discussion of methods used for statistical hypotheses testing.

**Table 13: Demographic Characteristics: Participants versus Non-Participants**

Characteristic		All Participants (n=203)	All Non-participants (n=99)
Statistically Significant Differences	Have central air conditioning	81.8%	64.6%
	Have a hot tub, pool, or spa	61.1%	27.3%
	Home over 3,000 square feet	34.0%	24.2%
	Has a tank-style water heater, rather than tankless	84.2%	75.8%
	All or most screw-in light bulbs are energy efficient, CFLs or LEDs	70.5%	60.6%
	Have Nest or other smart thermostat	20.7%	11.1%
	Lived in residence for more than 10 years	84.7%	58.6%
	Has 5 or more household members	12.9%	5.0%
	Has one or more members over 64 years of age	51.5%	31.3%
Insignificant Differences	Has natural gas service	83.7%	82.8%
	Uses electricity as primary fuel for water heater (D5)	10.3%	8.1%
	Uses gas as primary fuel for water heater (D5)	81.8%	80.8%
	Uses electricity as primary fuel for space heating (D6)	9.9%	12.1%
	Uses gas as primary fuel for space heating (D6)	82.8%	76.8%
	Have home automation system (D16)	9.4%	8.1%
	First time homeowner (D2)	22.2%	26.3%
	Has two or more adults 18-65 (D13)	55.5%	64.6%
	Have no children under 18 (D13)	74.5%	68.8%
Has ever received a home energy assessment (A0, A1)	40.4%	32.3%	

Table 14 below summarizes characteristics of the energy upgrade projects completed by both participants and non-participants. Recall that non-participants *may* have installed an energy efficiency measure through a program since 2010, and they may report installing energy efficiency measures outside of programs. They also may report participating in DR programs. The distinguishing feature of participants is that they installed both DG and program-incented energy efficiency measures since 2010.

Table 14 includes key timing attributes such as the span of time between energy efficiency and DG upgrades (applicable only to participants). It also shows the ex-ante savings for various segments including all participants, participants by IOU (PG&E, SCE, and SDG&E), all non-participants, and non-participants who have adopted energy upgrades (substantial energy efficiency upgrades and/or enrolled in DR), as well as the percentage of respondents who did their energy efficiency work at the same time or before their DG work.



Non-participant energy efficiency projects done through IOU programs have smaller average ex-ante savings than those completed by participants, though this difference is not statistically significant. Overall, the average time elapsed between participant energy efficiency and DG installations is a little over eight months. About half of participants followed the loading order (installed energy efficiency before or concurrent with DG) and a little more than one-quarter are enrolled in a DR program. There are some notable differences in IDSM project features across IOUs.

- SCE has the shortest span between energy efficiency and DG installations, at 84 days, while for PG&E and SDG&E the span between installations is about four times that length, at 328 days.
- SDG&E and SCE have similarly-sized energy efficiency installations, with ex-ante savings of about 1,100 kWh; PG&E projects are about 20 percent smaller on average, at 872 kWh.
- Although on average participants are as likely to have followed the loading order as not, the figures are quite different by IOU. SDG&E participants are most likely to have adhered to the loading order—62 percent versus 54 percent for SCE and less than 30 percent for PG&E.
  - PG&E participants are statistically significantly less likely<sup>15</sup> to have followed the loading order than participants at the other IOUs.
- Just under one-third of SCE participants are enrolled in DR, a rate approaching twice that of PG&E participant DR enrollment—32 percent versus 18 percent, respectively. The SDG&E participant DR enrollment rate is close to that of SCE, at 28 percent.

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<sup>15</sup> See Section 2.4.2 for a full discussion of statistical testing methods. This is a result of hypothesis testing for differences in the proportions of two populations at the 95 percent confidence level and 5 percent precision, where the two populations are a) PG&E population versus b) combined SCE and SDG&E population.

**Table 14: Characteristics of Energy Upgrade Projects**

<b>Segment</b>	<b>Average Time between EE and DG (years)<sup>16</sup></b>	<b>Average EE ex- ante Savings</b>	<b>EE First or at the Same Time as DG</b>	<b>Enrolled in DR</b>
All Participants (n=203)	0.68	1,028 kWh	48.3%	26.1%
PG&E Participants (n=67)	0.88	872 kWh	28.4%	17.9%
SCE Participants (n=68)	0.23	1,061 kWh	54.4%	32.4%
SDG&E Participants (n=68)	0.92	1,148 kWh	61.8%	27.9%
All Non-participants (n=99)	n/a	67 kWh	n/a	23.2%
Non-participant Adopters (n=54)	n/a	113 kWh	n/a	42.6%

As discussed previously, the intent of including non-participants in the survey was to provide a comparison group from which we can garner the distinguishing features of IDSM adopters. We did not exclude DSM adopters from the sample, but elected to allow for a natural or general population rate of energy efficiency and DR adoptions within the non-participant sample. We did ensure that non-participants had not installed DG. We elected to allow for energy efficiency/DR but not DG installations in order to broaden the gap between participants and non-participants in terms of the comprehensiveness and size of investments made in the energy upgrade projects. DG equipment has a higher average cost and longer payback versus an average energy efficiency installation, by a wide margin.

Table 15 below summarizes the non-participant DSM adoption rates and provides a comparison to adoption rates of participants. Again, the participant sample was designed to include only IOU program participants and DG adopters; the table is shown to make the DSM uptake characteristics of the two populations very clear.

- Participant energy efficiency installation through IOU programs have a much higher average ex-ante savings—298 kWh versus 1,028 kWh.
- Participants are more likely to report energy efficiency installations outside of IOU programs than non-participants (41% versus 30%, respectively). All participants have IOU program energy efficiency installations; this is by design, as discussed above.
- DR enrollment rates are similar between participants and non-participants, though slightly higher among participants (26% versus 23%, respectively)

<sup>16</sup> If multiple energy efficiency measures were installed, we calculated this value using whichever energy efficiency measure was installed closest in time to the DG. The average energy efficiency ex-ante savings was calculated using all energy efficiency records in the IOU program tracking data. If we were to exclude non-participants who did not adopt any energy efficiency measures (those with ex-ante energy efficiency savings of 0 kWh), the average savings for all non-participants and non-participant adopters are 277 kWh and 291 kWh, respectively.

The participants distinguish themselves by having invested in both energy efficiency and DG equipment over the analysis period. Moreover, they have higher rates of uptake for all DSM options and all combinations of DSM options.

**Table 15: DSM Projects and Participation: Non-Participants versus Participants**

<b>Statistic</b>	<b>Non-Participant</b>	<b>Participant</b>
Respondents Surveyed	99	203
Installed Solar PV	0%	100%
Installed Program EE *	17%	100%
Installed EE Outside Programs *	30%	41%
Installed either IOU Program EE or Non-Program EE	40%	100%
Installed Both Program EE and Non-Program EE	7%	41%
Average Ex-ante Savings from Program EE	298 kWh	1028 kWh
Enrolled in DR	23%	26%
Enrolled in DR and Installed EE	9%	26%
Enrolled in DR, Installed EE and DG	0%	26%

\*Program energy efficiency records spanned 1/2010 to 10/2014. Non-program energy efficiency installations were collected for 1/2010 through 4/2015.

Table 16 below summarizes the percentage of various respondent segments that installed energy efficiency measures of four types:

1. IOU program-incented installations;
2. IOU program-incented installations that cover multiple end-uses;
3. All self-reported non-program installations; and
4. Self-reported non-program installations characterized as substantial by respondents.

**Table 16: Energy Efficiency Upgrades**

Segment	(a) IOU- Program EE Installs	(b) EE measures covering 2+ end-uses	Non-Program EE	
			(c) All Self- Reported EE Installs <sup>17</sup>	(d) “EE Adopter” Installs
All Participants (n=203)	100.0%	79.3%	73.9%	41.7%
PG&E Participants (n=67)	100.0%	76.1%	73.4%	37.5%
SCE Participants (n=68)	100.0%	83.8%	72.1%	45.6%
SDG&E Participants (n=68)	100.0%	77.9%	76.1%	41.8%
All Non-participants (n=99)	24.2%	41.5%	60.6%	30.3%
Non-participant Adopters (n=54)	38.9%	55.6%	72.2%	55.6%

Participants are statistically significantly more likely than non-participants to make measurable energy efficiency upgrades outside of IOU programs, and to install energy efficiency upgrades that incorporate two or more end uses.

We asked all survey respondents a number of detailed questions regarding the energy efficiency measures they installed. We did this in order to ascertain patterns and trends or differentiating features of participant adoptions as compared to non-participant adoptions. Table 17 below compares the end-use distributions of energy efficiency installations by participants to those of non-participants, both through IOU energy efficiency programs (tracking data) and outside of IOU programs (self-reported). The percentages do not add up to 100 percent because some respondents installed multiple types of measures and some did not install any.

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<sup>17</sup> For this category, we used the program tracking data and self-reported information (open response) to track the end uses (e.g. HVAC, appliances) of all the measures respondents installed and then determine whether or not each person installed energy efficiency measures with two or more end uses. The energy efficiency measures used in this tabulation include all program and non-IOU program energy efficiency; that is, it does not exclude non-IOU program energy efficiency measures that are not “substantial”.

**Table 17: Installed Energy Efficiency Upgrades, Participants versus Non-participant (Tracking Data and Self Reported Combined)**

Measure	Non-participants with EE (n=40) <sup>18</sup>			Participants (n=203)		
	Any <sup>19</sup>	Program	Substantial Non-IOU Program	Any	Program	Substantial Non-IOU Program
HVAC	15.0%	2.5%	15.0%	10.3%	9.9%	4.9%
Insulation	10.0%	0.0%	10.0%	13.3%	3.9%	11.3%
Lighting	42.5%	20.0%	27.5%	33.0%	16.3%	24.1%
Other appliances	32.5%	22.5%	22.5%	40.9%	56.7%	9.4%
Refrigerator	12.5%	2.5%	12.5%	10.8%	9.4%	3.4%
Windows	20.0%	0.0%	20.0%	16.3%	0.5%	16.3%
Clothes washer or dryer	17.5%	5.0%	15.0%	7.9%	11.8%	1.5%
Water heater	12.5%	12.5%	2.5%	1.0%	0.5%	0.5%
Pool pump	2.5%	2.5%	2.5%	1.0%	1.5%	1.0%
Building envelope	5.0%	2.5%	5.0%	3.4%	2.5%	1.5%
Whole home	0.0%	0.0%	0.0%	3.4%	4.9%	0.0%
Other	15.0%	5.0%	10.0%	23.6%	29.6%	4.4%

- Participants were statistically significantly more likely to have installed envelope measures such as insulation, windows, lighting, other appliances and “other” energy efficiency measures. Non-participants were more likely to report installing a water heater compared to participants.
- A higher percentage of non-participants than participants reported purchasing water heaters through an IOU program, and this difference is statistically significant. Water heaters are the single energy efficiency measure that non-participants are more likely to report having installed when compared to participants.

Figure 2 below shows the reported home size in square feet by respondent segment. Participants are statistically significantly more likely than non-participants to have homes greater than 3,000 square feet in size. As home size becomes larger, homes typically have higher electricity consumption. Thus, what we observe may reflect the faster payback for

<sup>18</sup> This n includes 40 non-participants who installed at least one “substantial” non-IOU program energy efficiency measure or one program energy efficiency measure. Unlike the last table, it does not include the 29 non-participants who only installed “minor” (i.e. not substantial) non-IOU program EE measures.

<sup>19</sup> It is possible for a respondent who installed a measure through an IOU program to have installed additional measures of the same type outside the program. In these cases, we have included them in the percentages of respondents who installed that measure type in the program and non-IOU program columns. Many respondents installed multiple types of measures and others did not install any measures, so these percentages will not add up to 100 percent.

solar photovoltaic (PV) investment from homes with higher usage, or those reaching higher tiers in the rate structure. Larger homes may also be more likely to have ample roof space for solar panels.

**Figure 2: Home Size**

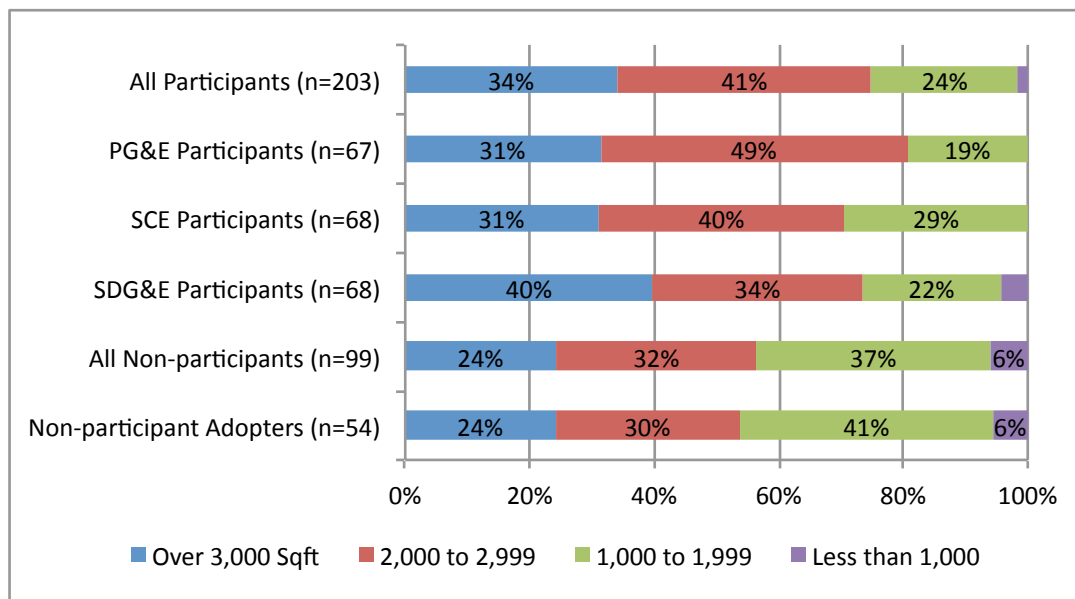


Figure 3 shows the home vintage by respondent segment. For the purposes of this evaluation, we considered any home built in 1990 and after to be less than 25 years old. Using the midpoint of each range to estimate an average home age, we found that there were no statistically significant differences between customer segments with respect to home vintage.

- More than one-third of homes in SCE's service territory are between 25 and 50 years old, while this segment is closer to 20 percent for the other service territories.
- PG&E has a larger proportion of very old homes, at just under 10 percent—versus under 5 percent for the other IOUs.
- SDG&E has a somewhat greater proportion of newer homes, with almost three-quarters (74%) of participants reporting their home is 50 years old or less. Excluding the 'don't know' category from the response distribution enhances this pattern—SDG&E has 78 percent newer homes versus 63 percent for SCE and 79 percent for PG&E.

**Figure 3: Home Vintage**

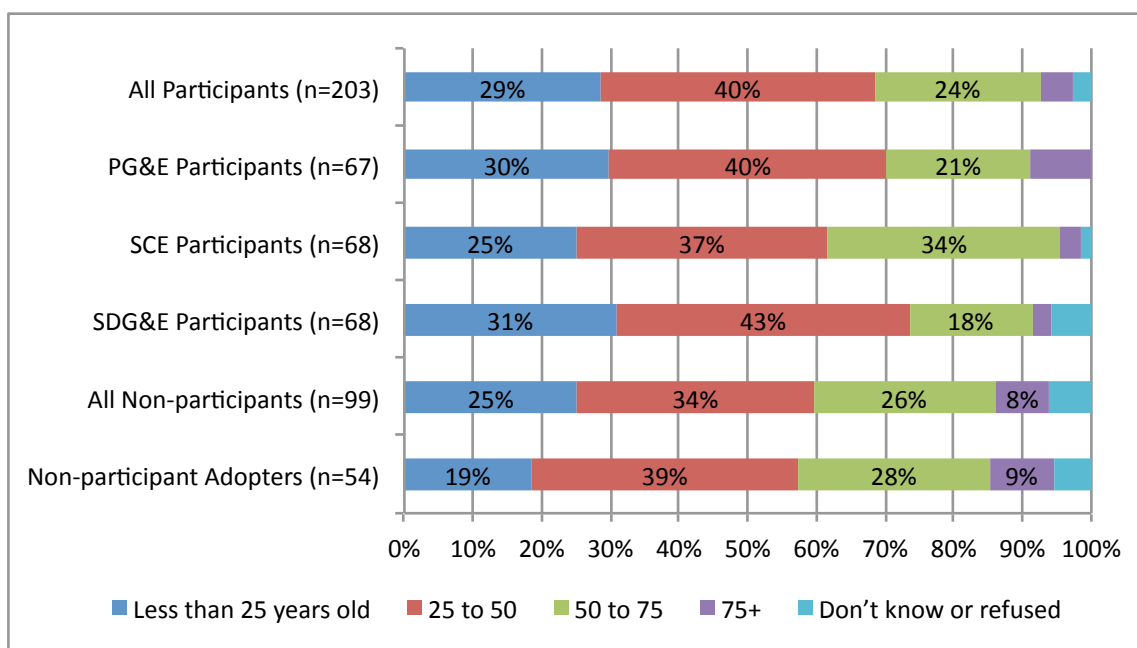


Table 18 summarizes findings from inquiries into selected equipment holdings of participant and non-participant homes.

- Participants are statistically significantly more likely than non-participants to have a hot tub, pool or spa (61% versus 22%, respectively).
  - This suggests that the higher energy bills and potentially high peak time usage that accompany this equipment may play a role in adopting IDSM solutions.
- Comparing across IOUs, SDG&E has the highest proportion of hot tub/pool/spa owners, at nearly 69 percent. The rate among PG&E participants is 52 percent, and SCE is almost 62 percent.

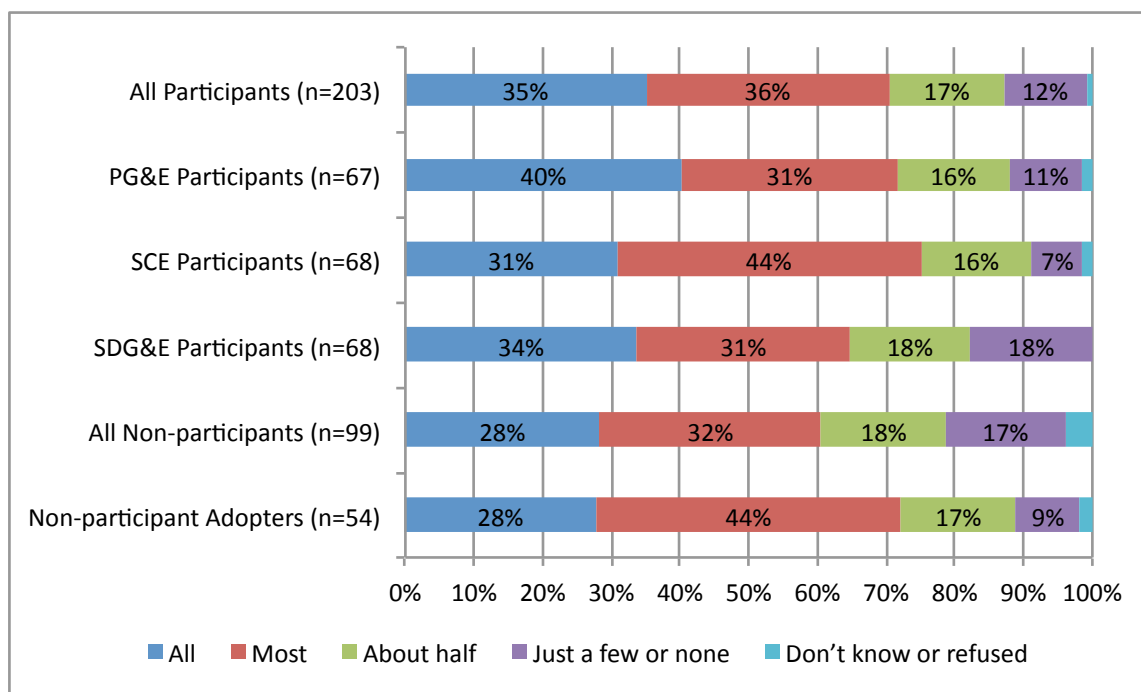
There is no meaningful difference between participants and non-participants with respect to the use of home automation systems (HAN). However, participants are statistically significantly more likely to use a smart thermostat than non-participant counterparts (21% versus 11%, respectively). A closer inspection reveals that the use of smart-thermostats is more closely associated with DSM adoption than with integrated DSM solutions, as non-participants adopting energy efficiency/DR have an equivalent likelihood of owning smart thermostats as do participants.

**Table 18: Energy Intensive Equipment and Controls**

Segment	Hot tub/pool/spa	Smart Thermostat	Home Automation Systems (HAN)
All Participants (n=203)	61.1%	20.7%	9.4%
PG&E Participants (n=67)	52.2%	17.9%	9.0%
SCE Participants (n=68)	61.8%	25.0%	13.2%
SDG&E Participants (n=68)	69.1%	19.1%	5.9%
All Non-participants (n=99)	27.3%	11.1%	8.1%
Non-participant Adopters (n=54)	22.2%	11.1%	11.1%

We also found statistically significant differences in the share of efficient lighting present in participant homes versus non-participants (Figure 4). Participants are statistically significantly more likely to report that all or most of their screw-in sockets are occupied by CFLs or LEDs when compared to non-participants. Again, this difference is related to the propensity for DSM adoption more than IDSM solutions; when comparing participants to non-participant adopters, the differences in the share of efficient lighting are no longer statistically significant.

**Figure 4: Efficient Indoor Screw-In Lighting (CFLs or LEDs)**





### 4.1.1 Demand Response Participation

In this section, we investigate customer awareness and participation in the IOUs' residential DR programs.

Table 19 and Table 20 below show rates of DR program awareness and participation by customer segment. About half of surveyed customers reported awareness of the IOUs' Smart Rate<sup>20</sup> program.

Smart Rate program awareness rates are similar among our IDSM participants<sup>21</sup> (solar and energy efficiency adopters) relative to non-participants, at 51 percent and 49 percent, respectively.

Participation rates among those that are aware of the Smart Rate program are also not different across IDSM participant and non-participant segments, at 34 percent and 36 percent, respectively. However, SDG&E participants stand out among the segments shown;

- SDG&E customers have higher rates of awareness at 58 percent, versus PG&E (48%) and SCE (47%) participants.
- Participation rates among aware participants also vary by IOU service territory. About 40 percent of program aware participants within SDG&E's and SCE's territories report participating in the program, versus fewer than 20 percent of PG&E participants.

Table 20 below summarizes rates of awareness and participation in the IOUs' AC Cycling<sup>22</sup> programs. Only those customers with central AC in their home were asked about their awareness and participation in AC Cycling. The table shows the overall percentage of participants that are aware and participate in the AC Cycling program, as well as the proportion of customers with central AC that are aware and participate in their IOU's program.

- Awareness of AC Cycling programs among IDSM participants with central AC is consistent across most respondent segments, at about 62 percent.
- IDSM participants in PG&E's and SDG&E's service territories, as well as non-participants, all have program awareness rates of 62 percent.

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<sup>20</sup> Smart Rate gives customers a discount on their Tier 1 kWh usage for the summer and fall months. In exchange, customers pay a surcharge per kWh of usage between 2-7 pm on event days only. The IOU notifies customers of event days, and there are usually between 9 and 15 event days during the program months.

<sup>21</sup> IDSM 'participants' are those that installed DG and EE after January 2010, and non-participants are customers that did not install DG but may (or may not) have installed energy efficiency—that is, energy efficiency installations occur at a 'natural' rate, and DG installations do not occur.

<sup>22</sup> AC Cycling is an optional program where a device is installed on or near the air conditioner. If a local or state energy emergency is anticipated—also referred to as an "Event Day"—this device will be remotely activated and participants' air conditioner compressor will cycle on and off in short increments totaling no more than 15 minutes of every half hour.

- SCE is the exception, with a statistically significantly higher rate of AC Cycling awareness, at 74 percent. Also, SCE recruits a higher proportion of aware participants (40%), versus SDG&E (23%) and PG&E (29%), and in comparison to non-participants (29%). Overall, SCE has the highest AC Cycling participation rate, at 27 percent.

Overall, among those aware of the DR options, the rate of uptake is slightly higher for Smart Rate versus Smart AC. Among aware participants, 34 percent participate in Smart Rate versus 32 percent in Smart AC. Among aware non-participants, the difference in uptake across the DR programs is more pronounced, at 36 percent for Smart Rate and 28 percent for Smart AC.

**Table 19: Awareness and Participation in IOU Smart Rate Program**

Survey Segment	Percentage of Customers Aware of Smart Rate	Percentage of Customers Participating in Smart Rate	Percentage of Aware Customers Participating in Smart Rate
All Participants (n=203)	51.2%	17.2%	33.6%
PG&E Participants (n=67)	47.8%	9.0%	18.8%
SCE Participants (n=68)	47.1%	19.1%	40.6%
SDG&E Participants (n=68)	58.8%	23.5%	40.0%
All Non-participants (n=99)	48.5%	17.2%	35.5%

**Table 20: Awareness and Participation in IOU AC Cycling Program**

Survey Segment	Percentage of Customers with Central AC	Percentage of Customers Aware of AC Cycling*	Percentage of Customers with Central AC Aware of AC Cycling	Percentage of Customers Participating in AC Cycling*	Percentage of Aware Customers Participating in AC Cycling
All Participants (n=203)	81.8%	54.2%	66.3%	17.2%	31.8%
PG&E Participants (n=67)	82.1%	50.7%	61.8%	14.9%	29.4%
SCE Participants (n=68)	89.7%	66.2%	73.8%	26.5%	40.0%
SDG&E Participants (n=68)	73.5%	45.6%	62.0%	10.3%	22.6%
All Non-participants (n=99)	64.6%	39.4%	61.0%	11.1%	28.2%

\*Note: Customers were only queried for their AC Cycling program awareness and participation if they reported having central AC.

#### 4.1.2 Participant Experience with IDSM Projects

This section begins by exploring the integration aspects of IDSM projects undertaken by participants. After this, we examine qualitative feedback from participant experience with their IDSM projects, with respect to satisfaction with DSM measures and perceived benefits and drawbacks of an integrated approach.

#### *4.1.2.1 Integration Characteristics of Participant DSM Adoptions*

The survey prompted participants to report a number of details regarding their decision making and the corresponding degree of integration in decision making across the energy efficiency, DG and DR options they selected. We first asked whether their decisions were simultaneous, and if they were not simultaneous, we asked them to report whether their experience with one DSM investment had been influential in their subsequent DSM investment decisions. We found that a relatively small proportion of participants had made their energy efficiency and DG investment decisions simultaneously—17 percent, or 35 of the 203 participants. Another 11 percent reported that despite being separate decisions, their first DSM investment had been influential in their subsequent adoptions, yielding a total of 28 percent that had an integrated element to their DSM investment decision making.

Participants who enrolled in a DR program were asked to report on the timing and influence of their DR enrollment decision in relation to other DSM investments they had made. More specifically, we asked whether their decision to enroll in DR and make energy upgrades (energy efficiency and/or DG) were simultaneous (i.e. made together) or, if made separately, whether their experience with the first investment influenced their decision to implement others. Of the participants we spoke with, 26 percent were enrolled in a DR program. Of this 26 percent, 23 percent made their decisions either simultaneously, or they were influenced to enroll in DR by their previous DSM investments.

Table 21 below shows the proportion of each participant segment reporting an integrated approach to their energy efficiency/DG investments, and for those enrolled in a DR program, the table shows the proportion that reported that their DR enrollment decision was integrated with other DSM investment decisions. As shown in Table 21, it is somewhat less common for a DR decision to be integrated with DG and/or energy efficiency than it is for DG and energy efficiency decisions to be integrated (23% versus 28%, respectively); this difference is not statistically significant. However, there are important differences among the IOUs. Both PG&E and SDG&E have higher rates of integrated decision making with DR, while SCE is decidedly the opposite. SCE has a statistically significantly higher rate of DG/energy efficiency integrated decision making versus the other IOUs, and a lower rate among DR enrollees. As discussed above, SCE has high rates of AC Cycling awareness and the highest rate of participation among those that are aware. It is possible SCE deployed a strong marketing effort that might have been the primary motivating force for these enrollments.

**Table 21: Integration of Participant DSM Decision Making**

<b>Segment</b>	<b>DG &amp; EE Decisions Integrated<sup>23</sup></b>	<b>Enrolled in DR Program</b>	<b>DR with EE/DG Decisions Integrated (for those enrolled in DR)</b>
All Participants (n=203)	28.1%	26.1%	22.6%
PG&E Participants (n=67)	28.4%	17.9%	33.3%
SCE Participants (n=68)	36.8%	32.4%	9.1%
SDG&E Participants (n=68)	19.1%	27.9%	31.6%

Table 22 below summarizes responses to the survey question prompting participants to report whether or not they would recommend an integrated approach to a friend that was considering investing in an energy upgrade project. We asked this question of *all* participant respondents, even those that did not report an integrated element to their decision making. Although only 28 percent implemented an integrated approach, 37 percent would recommend an integrated approach to their friends. These figures suggest that a measurable proportion of participant not using an integrated approach would recommend this approach to a friend.

**Table 22: Recommendation of Integrated Approach**

<b>Segment</b>	<b>Would Recommend Integrated Approach</b>
All Participants (n=203)	36.9%
PG&E Participants (n=67)	38.8%
SCE Participants (n=68)	38.2%
SDG&E Participants (n=68)	33.8%
Integrated DG/EE Decision (n=57)	57.9%
Integrated DR/EE/DG Decision (n=12) <sup>24</sup>	33.3%
No Integrated Decisions (n=139)	27.3%

About 60 percent of those that made their energy efficiency and DG investment decisions simultaneously reported that their approach offered tangible benefits; another 20 percent

<sup>23</sup> A “DG & EE integrated decision” is when a respondent made the decision to implement their energy efficiency and DG at the same time (DM1), or the decision was not made at the same time but their experience with the first (either energy efficiency or DG) influenced their decision to implement the second (DM4).

<sup>24</sup> A “DR with EE/DG integrated decision” is when a respondent made the decision to enroll in the DR program at the same time as they decided to implement their energy efficiency or DG (DM11), or the decision was not made at the same time but their experience with one or more of the energy upgrades (the energy efficiency, DG, or both) influenced their decision to enroll in the DR program (DM13). Some people who did not make an integrated energy efficiency/DG decision did make an integrated DR/energy efficiency or DR/DG decision.

were neutral, and 20 percent found the approach had drawbacks. Looking more closely at the reasons all participants would recommend or not recommend an integrated approach (Table 23) we see that respondents view the benefits of an integrated approach to be general ease (37%), project costs (20%) and bill savings (16%). Project cost is also given as the top reason that people would *not* recommend an integrated approach (32%). Other reasons that respondents would not recommend an integrated approach included that they were inherently separate decisions (30%), the hassle/timing/slowness of the process (11%), and that energy efficiency impacts the size of DG required (10%). The latter is an interesting finding, indicating that customers have absorbed the message underlying the loading order—but that their interpretation is that energy efficiency should be done separately and first. The solar sizing issue was also cited as a reason that respondents would recommend doing both at the same time (5%).

**Table 23: Reason for Recommendation of Integrated Approach<sup>25</sup>**

Reason	Would Recommend (n=75)	Would Not Recommend (n=94)
Because it is easier/makes sense to do both at once	37.3%	
Because of bill savings	16.0%	
Because of energy savings	14.7%	
Happy with the results	2.7%	
Because of project cost	20.0%	31.9%
EE impacts the size of DG you need to get	5.3%	9.6%
Doesn't matter/other option didn't occur to me	2.7%	4.3%
Because they are separate decisions		29.8%
Hassle/need time to plan/slows process		10.6%
Because of project complexity		6.4%
EE and DG not useful for everyone		2.1%
Other		3.2%
Don't know/not sure/refused	1.3%	2.1%

#### 4.1.2.2 Satisfaction with DSM Measures

In this section we review findings related to customer satisfaction with energy efficiency and DG equipment.

##### *Satisfaction with Energy Efficiency Measures*

In order to assess satisfaction with energy efficiency installations, we asked respondents who had taken on any energy efficiency improvements the following:

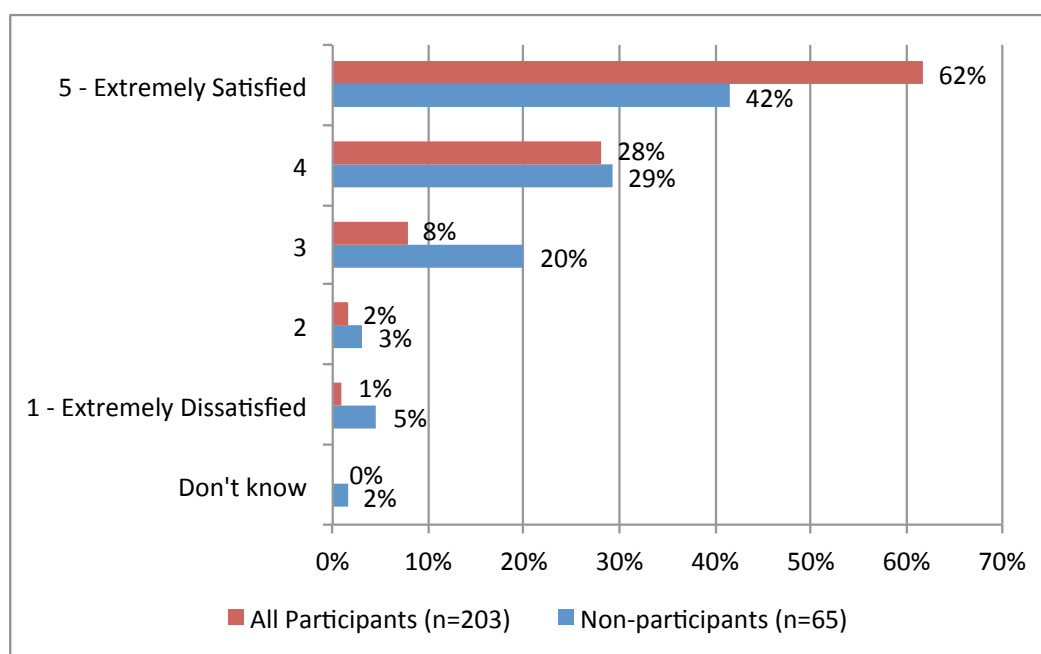
<sup>25</sup> This question was not asked of the 34 participants who refused or said they were not sure whether or not what they would recommend an integrated approach to a friend.

*“On a scale of one to five where one is extremely dissatisfied and five is extremely satisfied, how satisfied are you with the performance of your energy efficiency improvements overall?”*

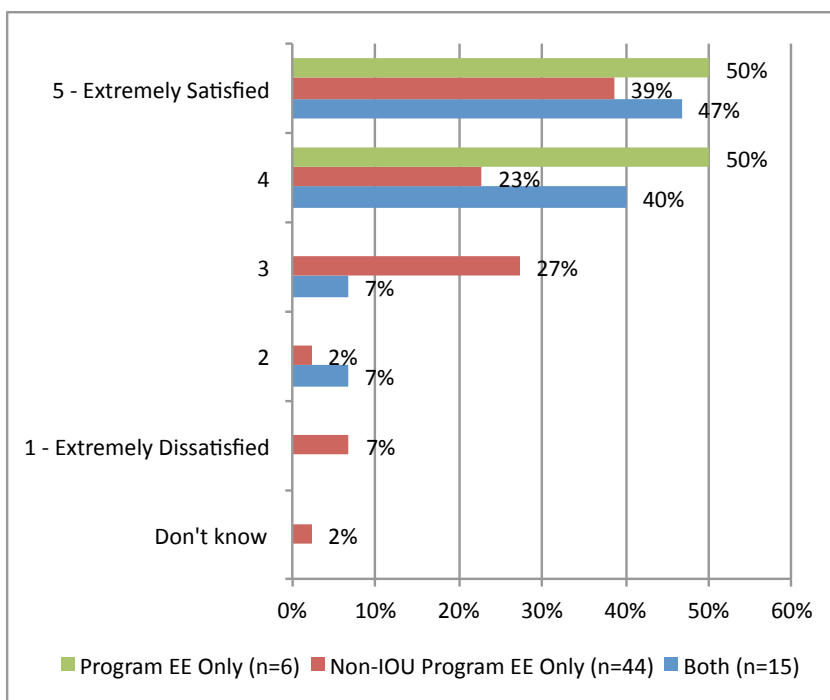
Participants reported greater levels of satisfaction with their energy efficiency improvements than did non-participants. Even when comparing participant energy efficiency installations to non-participant program installations, participants had greater levels of satisfaction.

Overall, participants were statistically significantly more likely to report a higher level of satisfaction (a rating of 4 or 5) with their improvements when compared to non-participants.

**Figure 5: Satisfaction with Energy Efficiency Improvements**



**Figure 6: Non-participant Satisfaction with Energy Efficiency Improvements**



We asked respondents to explain the main reason for their satisfaction rating if they gave an extremely high or low rating; results are shown in Table 24. Extremely satisfied respondents (who gave a satisfaction rating of 5) cite decreased energy consumption, decreased noise, improved comfort, lack of problems encountered, saving money, saving the environment and the equipment working as expected. Two respondents gave reasons for being extremely dissatisfied (i.e. reported a satisfaction rating of 1); these reasons were a lack of financial savings and equipment that is not working.

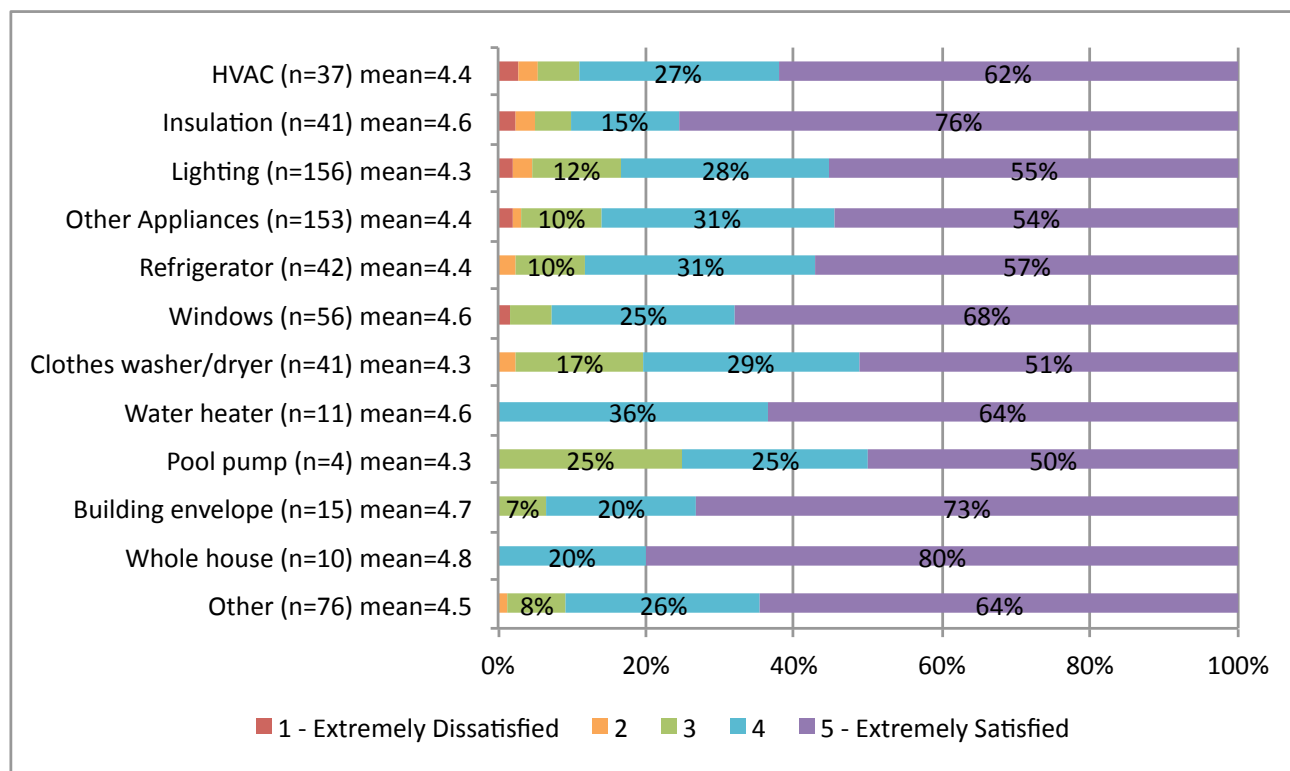
**Table 24: Main Reason for *Extreme* Satisfaction Rating**

Satisfaction Rating	Main Reason for Rating	Participants	Non-participants
5 – Extremely Satisfied	<b>n</b>	<b>125</b>	<b>27</b>
	Saving money (bill savings and/or rebate)	48.8%	40.7%
	Working as expected	26.4%	33.3%
	Decreased energy consumption	8.8%	11.1%
	Improved comfort	5.6%	
	Saving the environment	2.4%	
	Decreased noise	1.6%	3.7%
	No problems	0.8%	3.7%
	Other	2.4%	7.4%
	Don't know/Refused	3.2%	
1 – Extremely Dissatisfied	<b>n</b>	<b>2</b>	<b>3</b>
	Not saving money	50.0%	66.7%
	Equipment not working	50.0%	33.3%

We investigated satisfaction levels by technology to see if particular measures were leaving customers more or less satisfied than others. Figure 7 below summarizes satisfaction ratings by energy efficiency measure for all respondents, including both IOU program and self-reported measures. The mean satisfaction score is shown in the measure labels at the left of the figure. Mean satisfaction scores are fairly consistent across technologies, ranging from 4.3 (clothes washer/dryer, lighting, pool pump) to a high of 4.8 (whole house). Clothes washers/dryers and pool pumps also have the highest proportion of customers rating their satisfaction on the lower end of the scale—1, 2 or 3—but HVAC and insulation have the highest proportion of extremely dissatisfied ratings—at 2.7 percent and 2.4 percent, respectively.



**Figure 7: Participant Satisfaction with Energy Efficiency Measures<sup>26</sup>**



We also looked at satisfaction with energy efficiency measures installed by participants and non-participants and found that participants were statistically significantly more likely to report being extremely satisfied with insulation, lighting, other appliances and windows. Results are shown in Table 25. Similarly, participants reported a statistically significantly higher mean satisfaction rating for HVAC, lighting and other appliances. This is unsurprising given the large difference between participants that reported being extremely satisfied with their energy efficiency measures overall (62%) and non-participants that reported being extremely satisfied overall (42%).

<sup>26</sup> Excludes responses that were “don’t know”, includes non-IOU program energy efficiency measures whether or not they were “substantial”. Many respondents installed multiple types of measures, so these percentages will not add up to the total n. Respondents who installed the same measure type through a program and non-IOU program are only counted once for that measure in the figure.

**Table 25: Satisfaction with Energy Efficiency Measures, IDSM Participants and Non-participants, IOU Program Installations versus Non-IOU Program Installations<sup>27</sup>**

Measure	IDSM Participant EE Installations				IDSM Non-Participant EE Installations			
	IOU-Program		Non-IOU Program		IOU-Program		Non-IOU Program	
	n	Mean	n	Mean	n	Mean	n	Mean
HVAC	20	4.7	11	4.6	1	5.0	7	3.3
Insulation	8	4.8	28	4.8	0		7	3.7
Lighting	33	4.5	100	4.5	8	4.0	29	3.8
Other Appliances	115	4.4	25	4.5	9	4.3	23	4.0
Refrigerator	19	4.5	14	4.4	1	5.0	9	4.2
Windows	1	4.0	45	4.7	0		11	4.1
Clothes washer or dryer	24	4.3	4	4.5	2	4.5	11	4.1
Water heater	1	5.0	3	4.7	5	4.8	3	4.3
Pool pump	3	4.7	3	4.7	1	3.0	1	3.0
Building envelope	5	4.8	6	4.5	1	5.0	3	4.7
Whole house	10	4.8	0		0		0	
Other	60	4.6	11	4.5	2	4.5	8	4.4

### *Satisfaction with Distributed Generation Equipment*

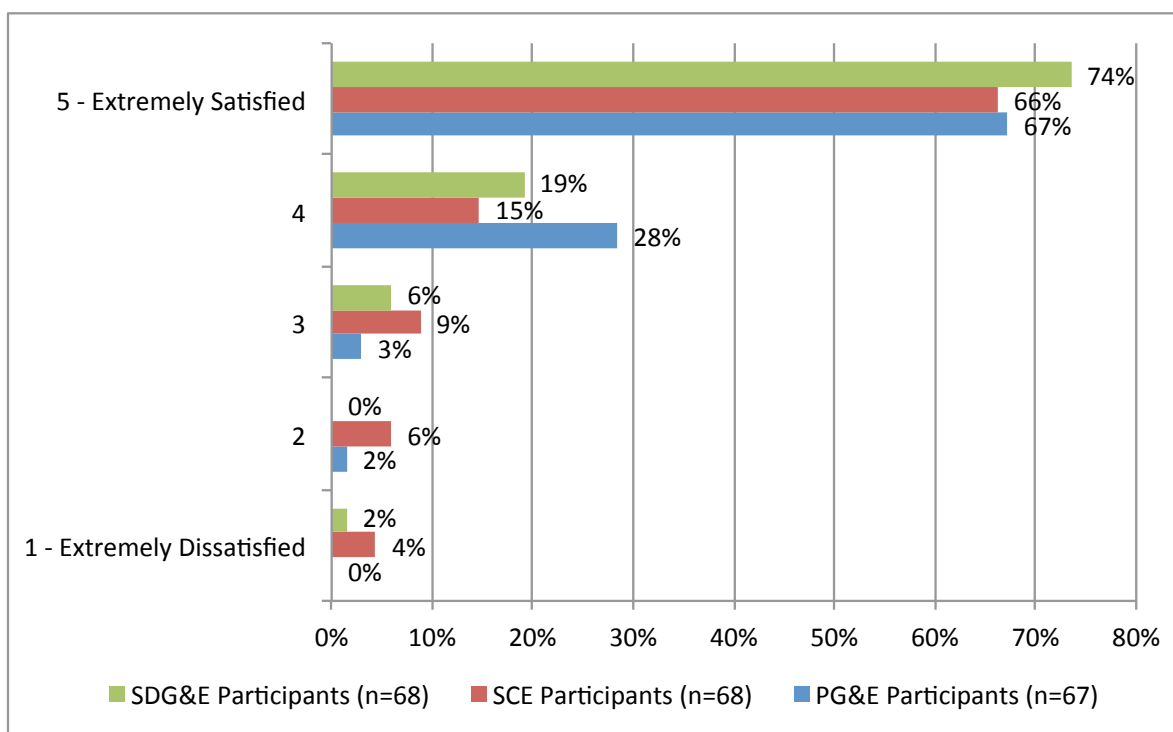
Participants gave feedback on their overall satisfaction with their DG system by answering the following question:

*“How satisfied are you with the performance of your [DG\_MEASURE]? On a scale of one to five where one is extremely dissatisfied and five is extremely satisfied.”*

As shown in Figure 8 below, the majority of participants reported being extremely satisfied with their DG system, with close to 70 percent reporting this level of satisfaction. Across the three utility territories, SDG&E has the most highly satisfied participants, and SCE participants were most likely to report a 1 or 2 rating, indicating some level of dissatisfaction. The lower level of satisfaction among SCE participants is statistically significant, suggesting there may have been some quality of installation issues in SCE's service territory at one time, or perhaps savings expectations were not met.

<sup>27</sup> Excludes responses that were “don't know”, includes non-IOU program energy efficiency measures whether or not they were “substantial”. It is possible for a respondent who installed a measure through an IOU program to have installed additional measures of the same type outside the program. In these cases, we have included them in both the program and non-IOU program columns. Many respondents installed multiple types of measures, so these percentages will not add up to the total n.

**Figure 8: Satisfaction with Performance of Distributed Generation System**



## 4.2 Resources and Pathways

In this section, we explore the results of survey inquiries related to how participants and non-participants came to make the decision to do energy efficiency, DG and/or DR. We start by looking at what type of planning is done before taking action (Section 4.2.3) and then present information on how respondents report using the utility website (either in general or to make their decision). The last subsection (Section 4.2.4) reviews the role of audits in respondent decision making.

### 4.2.1 Primary Project Considerations

Figure 9 below examines the primary overall drivers reported by respondents for DSM upgrades.<sup>28</sup> In the figures and text that follow, we explore in greater detail how customers go from interest in DSM to making a decision and then to implementation.

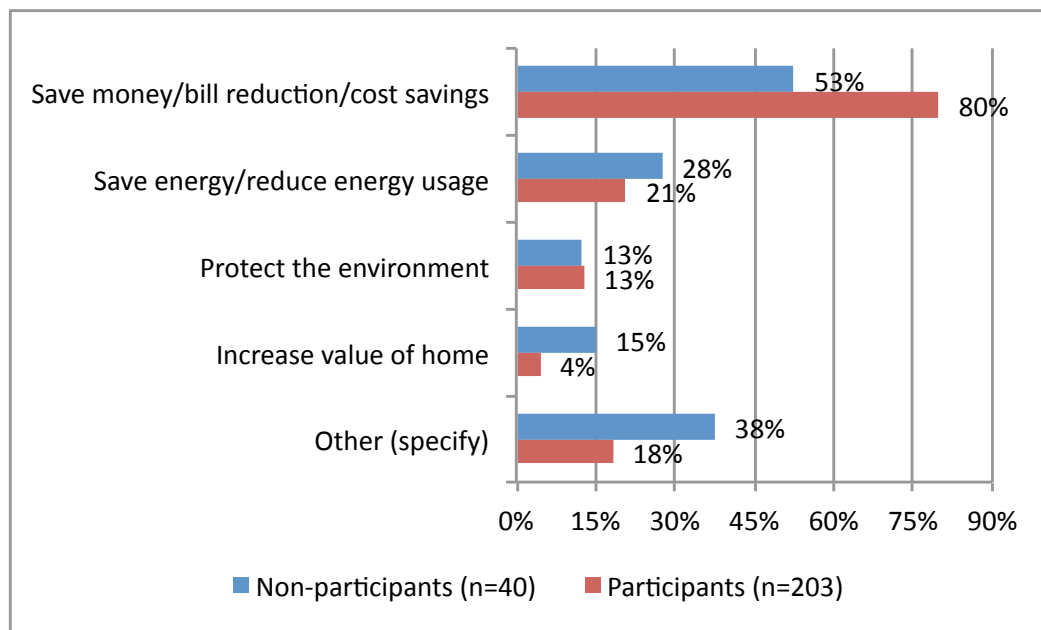
<sup>28</sup> Non-participants do not have DG, but many have received energy efficiency measures through an IOU program and/or self-reported adopting a substantial energy efficiency measure since January 2010, where “substantial” measures cost more than \$50 and/or involve some consideration or planning to implement.

There are a couple of notable statistically significant differences between participants and non-participants in terms of the primary drivers for their DSM projects. Of course, participants, having installed both energy efficiency and DG, were motivated to invest more time and money relative to non-participants that invested in energy efficiency only.

- Participants’ larger DSM investments are associated with greater concern over saving money long term and in bill reduction when compared to non-participant adopters.
- Non-participants’ energy efficiency-only adoptions were more likely to be motivated by a desire to increase home value.

“Other” common reasons for completing the energy upgrades included appliance replacement, home repair/remodel, influence of family members or neighbor’s DSM adoptions, comfort and the investment opportunity/payback features.

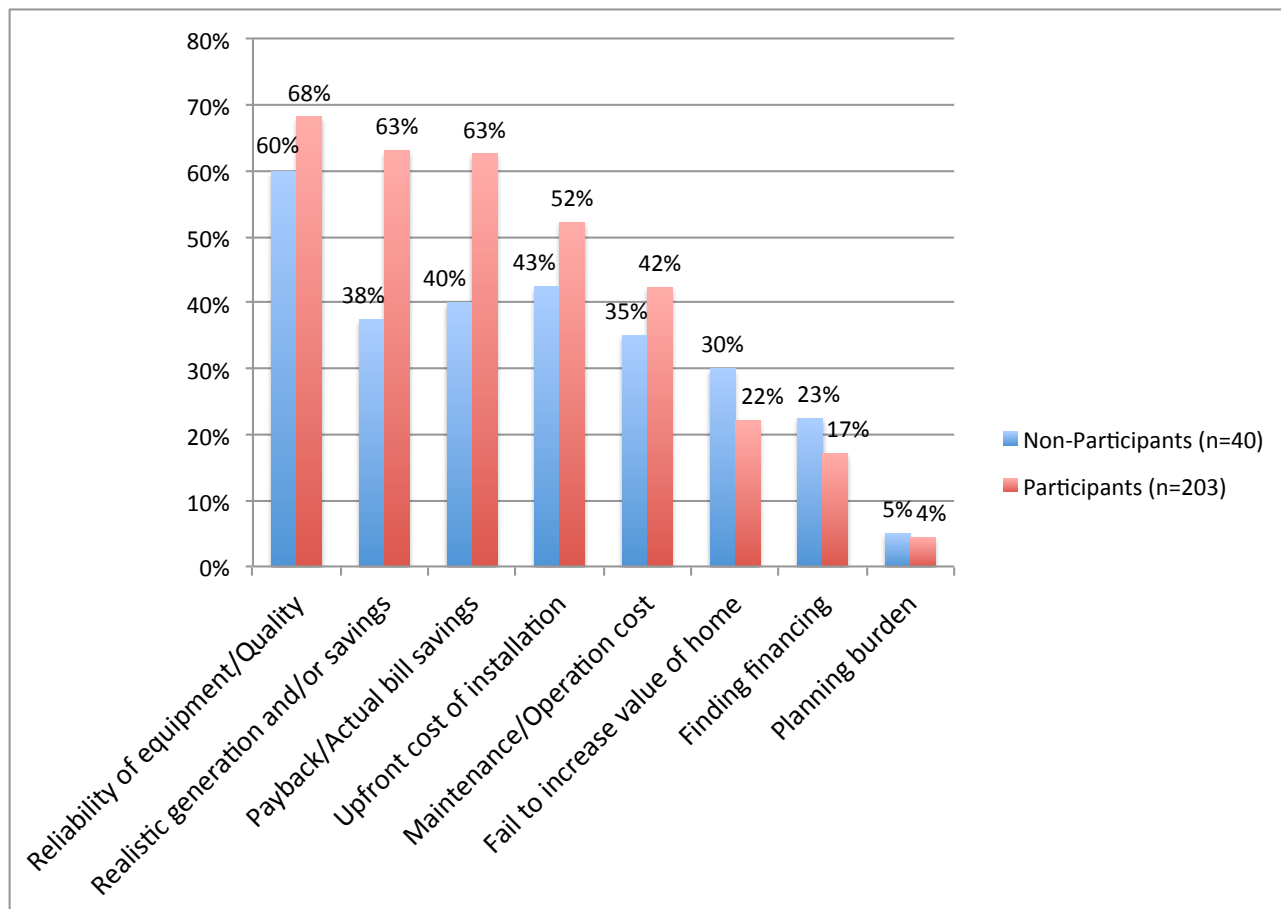
**Figure 9: Primary Reasons Completed Energy Upgrades**



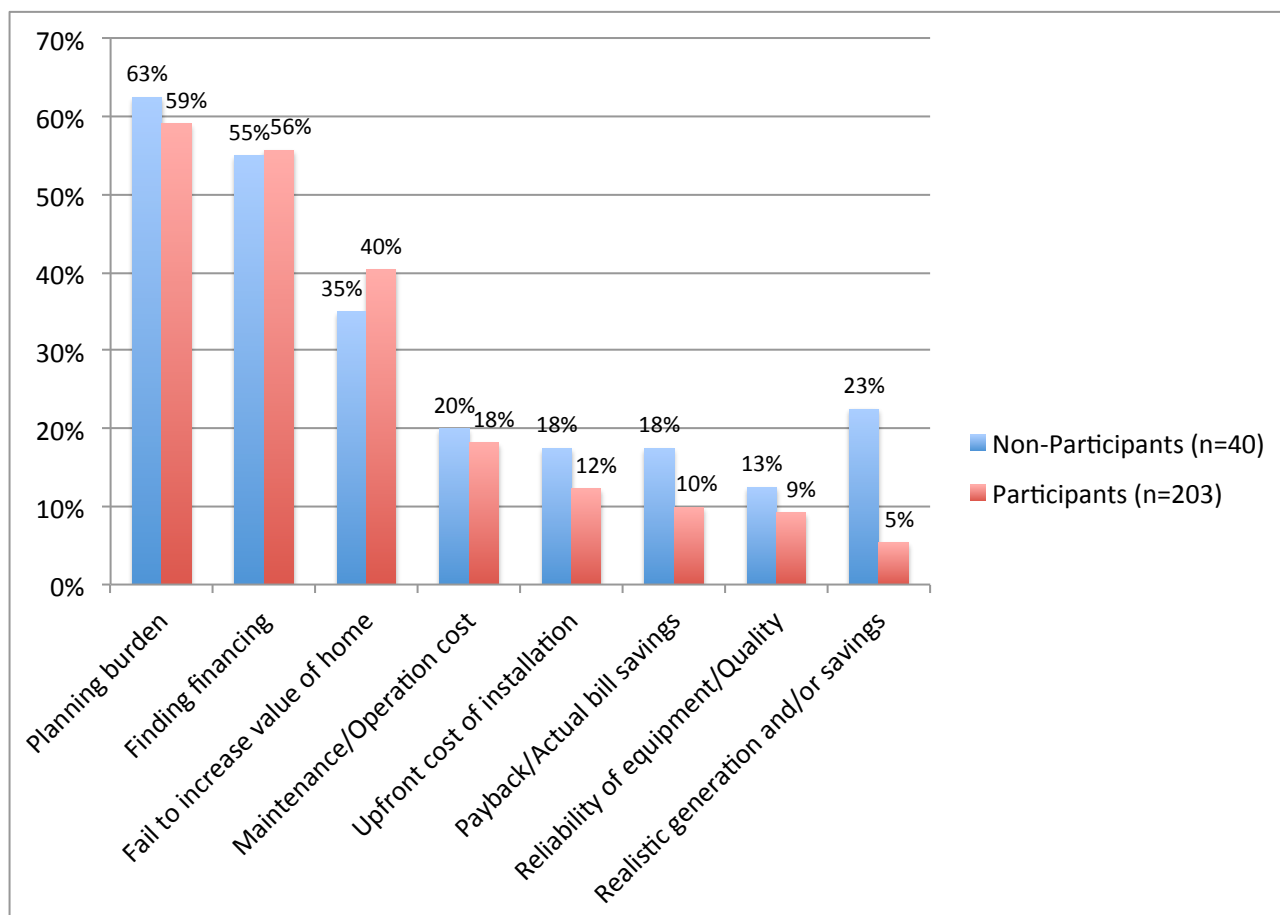
We asked both participants and non-participant adopters about any concerns that they might have had as they considered their DSM upgrade opportunities before making their final decisions. Responses are summarized in Figure 10 below. Frequencies with which various concerns were reported as “serious” are summarized in panel a, for both participants and non-participant adopters. Similarly, frequency with which issues were reported as “not at all a concern” are summarized in panel b.

**Figure 10: DSM Project Concerns, Participants versus Non-Participant Adopters**

**a. "Serious" Concerns When Considering DSM Adoptions**



**b. “Not at all a Concern” When Considering DSM Adoptions**



Overall, participants and non-participants have the same top three concerns, though they are consistently reported as concerns by a greater proportion of participants than non-participants:

- Reliability of equipment/quality (68% versus 60%)
- Upfront cost of installation (63% versus 43%)
- Payback/actual bill savings (63% versus 40%)

Overall, participants were more likely to characterize their concerns as serious than non-participants. The mean frequency with which participants characterize their concern as serious across all categories is 47 percent, versus 38 percent for non-participant adopters. Furthermore, participants' top three concerns were ranked as serious by an average of 65 percent of respondents, versus 48 percent for the top three concerns of non-participant adopters.

Participants and non-participants are also quite similar across issues reported as being not at all a concern. However, unlike the serious concerns, those issues reported to be relatively un concerning are reported as such by about the same proportion of participants and non-participants. Both groups generally report little concern for the same top three issues. The planning burden is ranked lowest on the list of concerns by both participants and non-participant adopters—59 percent and 63 percent, respectively.

#### 4.2.2 Barriers to IDSM Adoption

In addition to looking at the concerns reported by participants and non-participant adopters, we also looked at the concerns of non-participants who considered energy upgrades but elected not to proceed, or have not yet implemented upgrades. In other words, we looked at concerns that are preventing non-participants from investing in DSM energy upgrades. Results of this inquiry are shown in Table 26 below. The table presents the responses of non-participants segmented by the self-reported degree of interest in DSM options. Among the 99 non-participants surveyed, 40 had adopted energy efficiency measures and so are excluded from the table. Of the remaining 59, 27 percent reported continuing to be interested in these options but had not taken action; another 27 percent reported that although they had considered DSM options, they are no longer interested. The largest proportion (46%) reported never having considered DSM investments.

**Table 26: Factors Preventing Non-participants from Investing in Energy Upgrades (Non-Adopters)**

Specific Concern or Constraint	Considered and Interested (n=16)	Considered, No Longer Interested (n=16)	Never Considered (n=27)	Total (n=59)
Cost	37.5%	37.5%	29.7%	33.9%
Already have measures installed (energy efficiency)		18.8%	7.4%	8.5%
Energy bill is not large enough / payback	18.8%	12.6%	11.1%	13.6%
No need / No reason	6.3%	12.6%	25.9%	17.0%
Not planning on staying at location in long term	6.3%	6.3%	11.1%	8.5%
Financing	6.3%		3.7%	3.4%
Don't believe solar panels are efficient	6.3%			1.7%
Future sale of the home			3.7%	1.7%
Home aesthetics		6.3%		1.7%
Other		6.3%	3.7%	3.4%
Don't know	18.8%		3.7%	6.8%

Regardless of their current interest or past consideration of DSM, the primary concern of all non-adopters is the upfront cost. Almost 40 percent of non-adopters that considered DSM investments, and 30 percent of those that never seriously considered DSM, cite cost as a primary concern. Respondents who considered DSM investments were most prohibited by cost—both those still currently interested and those no longer interested.

Among non-adopters that are still interested in DSM, in addition to upfront cost, this group expressed concern about whether they had a big enough energy bill to substantiate a DSM investment; another concern was time of payback (19%). An additional common response among this group was “don’t know” (19%)—indicating simple inertia may be a barrier for a measurable number of customers, which indicates there remains some IDSM uptake potential in this market.

Almost one-third of the non-adopters that considered but did not adopt DSM measures told us they did not see a need for them. About 19 percent said that they had ‘already installed measures’, implying that they had perhaps upgraded appliances prior to 2010 and did not see a need to upgrade at the time of the survey or they believe their minor energy efficiency upgrades are sufficient. Others simply said they saw no need for it (13%), indicating they are not aware of any benefits or investment payback that would motivate them to take action. While it may in fact be the case that these homes do not have DSM potential, it may also be the case that these homeowners lack awareness and knowledge of DSM potential, and might take a different approach if they were provided with this information.

We asked non-participants that reported adopting energy efficiency measures about barriers preventing them from investing in DG. Table 27 is similar to the preceding table, but this table summarizes the responses of non-participants that adopted energy efficiency measure(s), and their consideration and concerns related to DG investment. Overall, the top concern is related to the upfront cost and/or whether their energy use is high enough for the investment to pay for itself in a reasonable period of time. Another common barrier to adoption cited by this group is that DG is something they do not think they need, or that it is a low priority.

We highlight which barriers are more likely to end interest in DG altogether by looking at the barriers mentioned by non-participants who considered DG and now report that they are no longer interested. Within this group the two primary barriers are:

- Upfront cost and the length or likelihood of investment payback; and
- External restrictions, such as homeowner association regulations or physical properties of the roof.

Among non-participants still interested in DG, primary concerns are more focused on upfront cost than they are on payback, indicating this group is more likely to believe that the investment will pay back its cost over a reasonable period, but are still concerned over their ability to manage the upfront cost. Within this group, about 20 percent reported that they plan to move forward with DG, and another 13 percent were neutral—i.e. not providing a solid



reason one way or the other, suggesting that inertia may be a factor for a portion of this group as well.

**Table 27: Factors Preventing Non-participants from Investing in DG, Non-Participant Energy Efficiency Adopters**

Specific Concern or Constraint	Considered and Interested (n=15)	Considered, No Longer Interested (n=11)	Never Considered (n=14)	Total (n=40)
Cost	53.3%	27.3%	28.6%	37.5%
Energy bill not large enough/ payback	6.6%	27.3%	14.3%	15.0%
Don't need or low priority		9.1%	21.4%	10.0%
Home Owner Association restricted		18.2%	7.1%	7.5%
None, plan to move forward with DG	20.0%			7.5%
Concerns regarding roof		9.1%	7.1%	5.0%
Personal employment/financial issues	6.6%			2.5%
Other			21.4%	7.5%
Neutral/Don't know	13.3%			7.5%

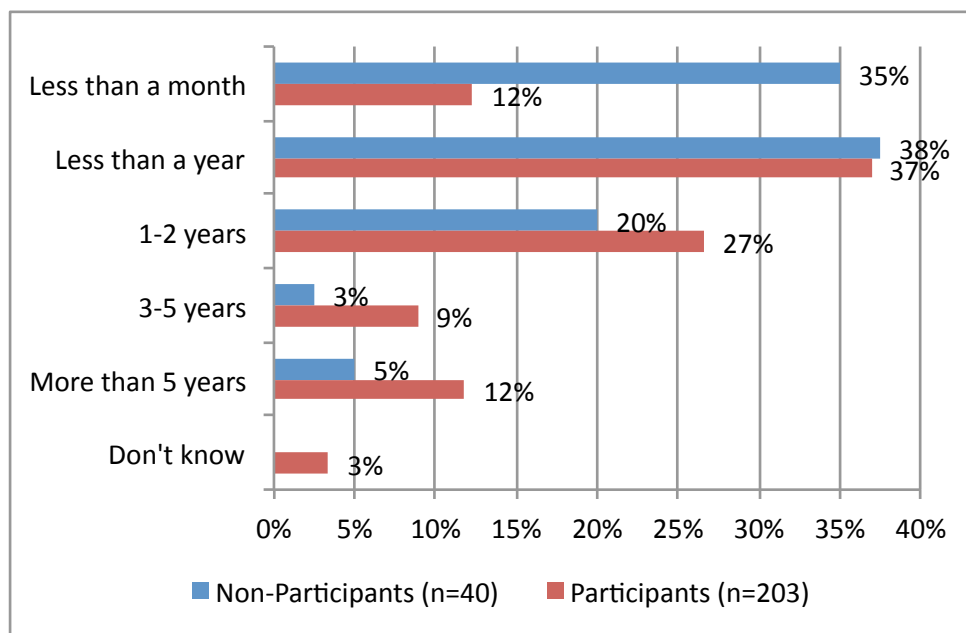
### 4.2.3 IDSM Project Planning

Program and IDSM marketing strategies seek to support and promote DSM uptake that takes place through a web of exchange across consumers, suppliers, utilities and other organizations. A better understanding of the process a residential IOU customer goes through as they move from awareness to adoption is key to selecting the direction and the content of promotional efforts. One of the basic attributes of the customer adoption process is the timing—how long does it typically take for a customer to move from having a serious interest in DSM projects to implementing them? We asked this question of our participant respondents and non-participant energy efficiency adopters; results are summarized in Figure 11 below.

The majority of participants planned their DSM projects for a period somewhere between two months and two years (64%), and almost half planned their projects for a period longer than one year. Non-participant adopters reported a shorter planning horizon on average, with more than one-third reporting a planning period of less than one month, and nearly three-quarters reporting a planning time of less than one year. Participants made more substantial DSM investments versus energy efficiency-only adopters, and based on this evidence, we surmise that planning horizons are typically longer for larger/higher-cost DSM investments.

This evidence suggests that one unique attribute of IDSM projects is the need for a relatively longer planning horizon.

**Figure 11: Length of Time Before Installation Process that Respondent Began to Seriously Consider Energy Upgrades to Home, IDSM Participants and Non-Participants**



A good understanding of the project planning process can inform the development of a useful market support strategy, designed to enable, facilitate and effectively encourage the market processes that ultimately lead to project uptake. In light of the longer planning horizon, it is particularly valuable to understand how project planning unfolds. The telephone survey explored the frequency and types of information sources consulted by participants as they moved through their DSM project planning process. Figure 12 below summarizes survey responses to questions posed to both participants and non-participant adopters regarding the information sources they used to investigate and plan their DSM projects.

The figure illustrates clearly that participants consulted a greater variety of information sources than did non-participant adopters. On average, participants used about 5 of the 12 sources and non-participants used about 3 of the sources. In addition, participants used 10 of the 12 information sources more frequently than non-participants. .

At a high level, there are three primary information sources reported by nearly all DSM adopters:

1. Online research (85% of participants, 80% of non-participant adopters), including utility (57% of participants, 45% of non-participant adopters) and/or non-utility websites (81% of participants, 70% of non-participant adopters);
2. Interaction with contractors (86% of participants, 58% of non-participant adopters); and

3. Call centers or other direct contact with utility (67% of participants, 50% of non-participant adopters).

Online research was the top information source among participants and non-participants alike and is explored further in Section 4.2.3.2. Well over half of participants (57%) and nearly half of non-participant adopters visited their IOU website to collect information in their DSM planning process. The great majority (over 80%) of all adopters use internet research tools to collect DSM-related information.

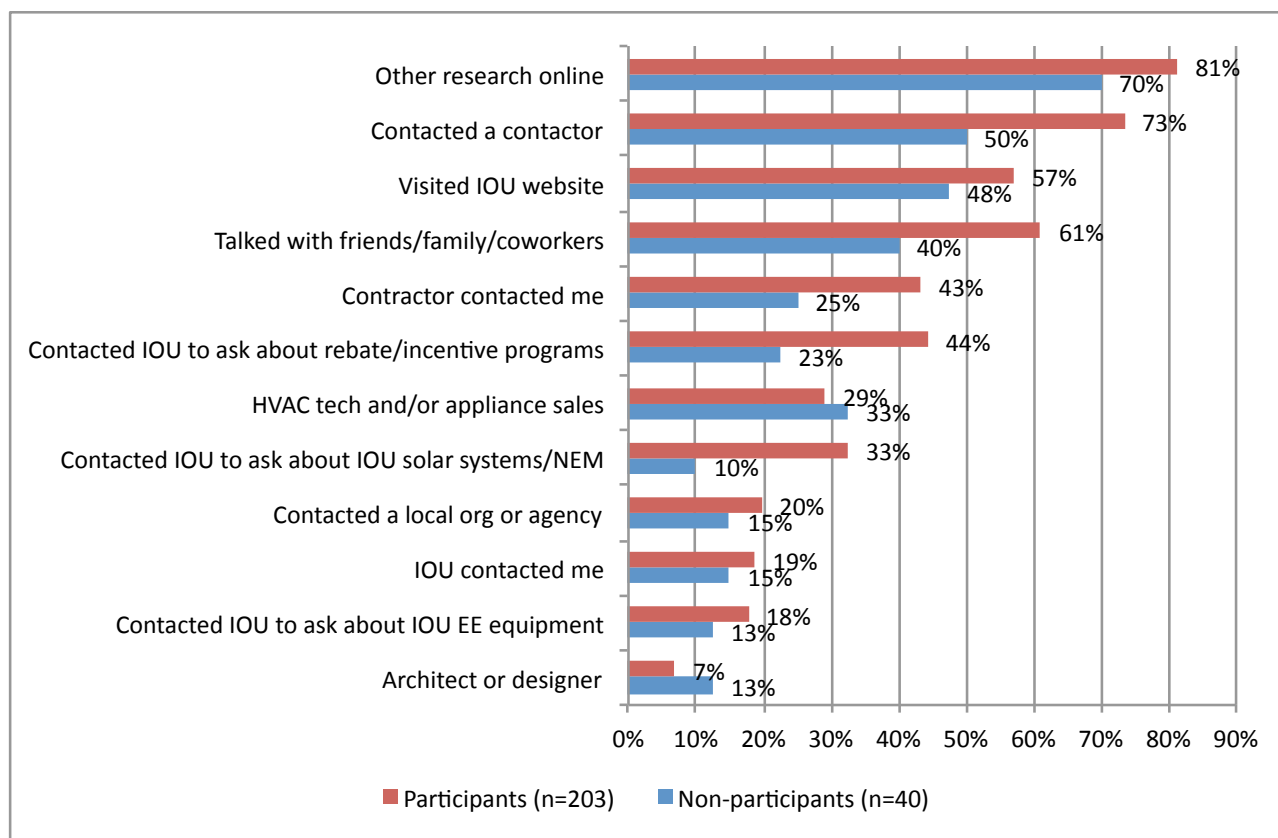
Another notable feature of the findings summarized in Figure 12 is the role of contractor direct sales. About 43 percent of participants were contacted directly by a contractor, versus only 25 percent of energy efficiency-only adopters.<sup>29</sup> These data suggest that being a recipient of direct, personalized sales efforts is a feature that distinguishes energy efficiency/DG adoptions from energy efficiency-only adoptions, and thus it appears likely that direct sales efforts are a driver of IDSM adoptions. The specific details surrounding participant and non-participant interactions with contractors is explored in Section 4.2.3.1 below.

Another meaningful difference between participants and non-participant adopters is in their propensity to contact utility representatives for information about DSM programs and rebates. Participants were nearly twice as likely to report engaging in this information collecting activity (43% versus 22%). This result suggests the IOUs are well positioned to provide key information about integrated solutions to IDSM adopters during their planning process.

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<sup>29</sup> This difference is statistically significant at 95 percent confidence, 5 percent precision.

**Figure 12: Information Sources Used in Planning DSM Upgrade**



#### 4.2.3.1 Interaction with Contractors

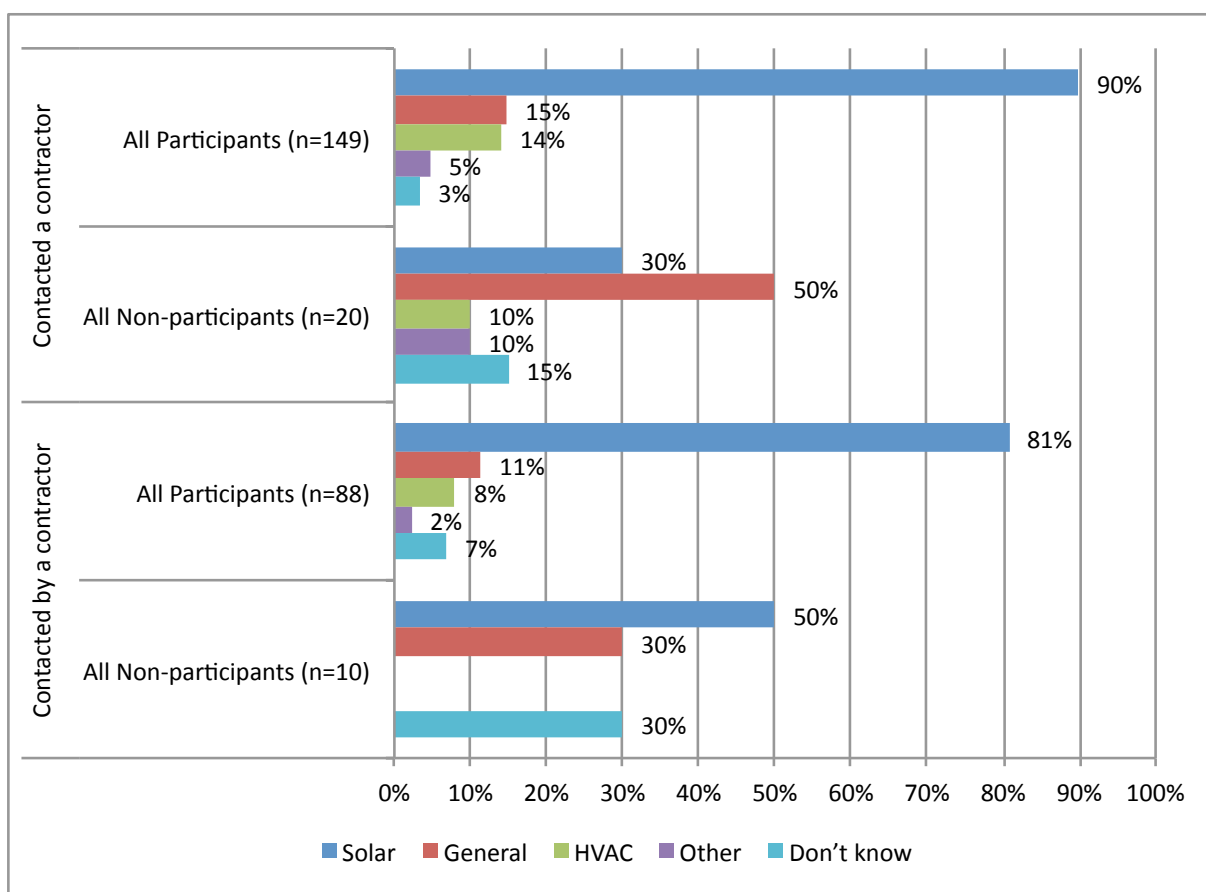
We asked respondents to provide some details about interactions with contractors that took place as part of their DSM project planning. Figure 13 below summarizes contractor interactions for participants and non-participant adopters, broken down by contractor specialty, and by those that were contacted by a contractor versus those that reached out to a contractor.

First, it is notable that of the 73 percent of the participants we surveyed that reached out to a contractor, 90 percent contacted a solar contractor during their information gathering process. Taken together, these data suggest that about two-thirds of participants (66%) reached out to solar contractors in their information gathering process. This finding indicates solar contractors have an important and substantial opportunity to provide IDSM support to residential customers. A smaller proportion of participants (27%) reached out to other types of contractors, and these were more typically HVAC and general contractors.

As discussed above, 43 percent of participants reported being contacted by a contractor, and as shown below, most of these were solar contractors (83%). This is an important finding as it underscores the power of direct sales efforts. The cost of one-on-one outreach efforts is substantial, and yet this is clearly a primary customer recruitment avenue for integrated

adoptions, and a measurable factor for energy efficiency-only adoptions (25%). The other important feature of these results is that they demonstrate the relative dominance of solar contractors versus all other types of contractors in engaging with customers prior to DSM uptake. This is true both for interactions resulting from direct sales efforts (when a contractor reaches out to a potential customer) and as a resource (where customers reach out to a contractor). Overall, more than three-quarters (78%) of all DSM adopters that were contacted by a contractor were contacted by a solar contractor. Even the energy efficiency-only adopters that reached out to a contractor were highly likely to contact a solar contractor (30%). It appears the current market structure supports greater personalized marketing and outreach within the solar industry than energy efficiency or other types of energy-retrofit service specialists.

**Figure 13: Contractor Interactions by Type and Point of Initiation**



#### 4.2.3.2 Internet Resources: IOU and Non-IOU Websites

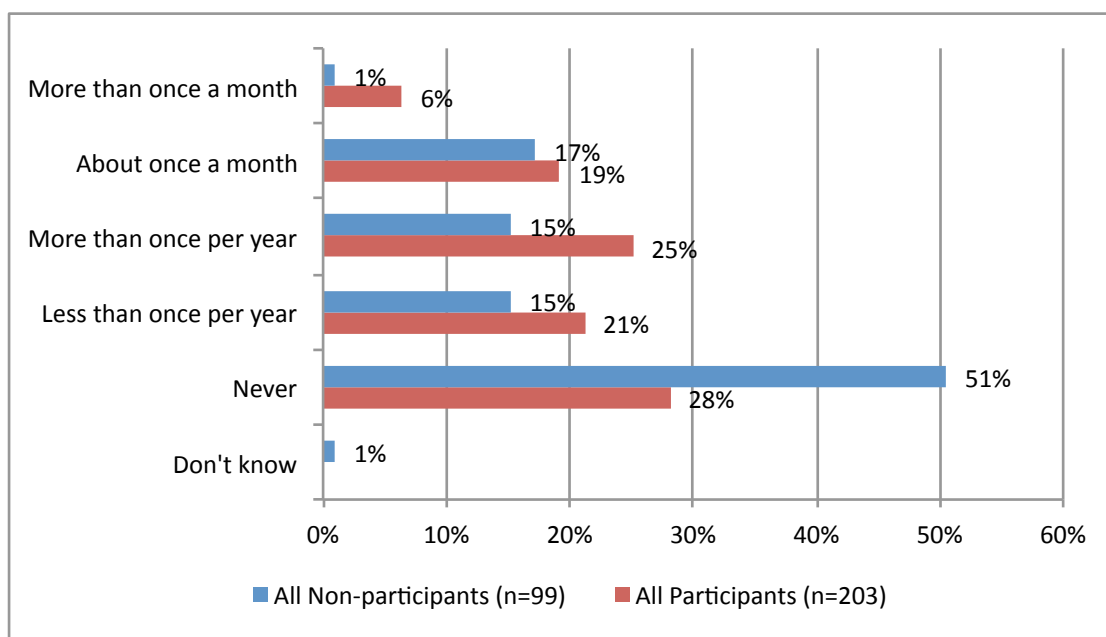
In this section, we explore the use of utility websites as well as non-utility websites in the DSM project planning process. For utility websites, we explore details related to how the sites are used, and with what frequency they are visited.

### Utility Website Use

Figure 14 shows the frequency with which participants and non-participants report visiting IOU websites. About two-thirds of non-participants visit their IOU website less than once per year—and over half (51%) report never having visited the site. However, the reverse is true of participants; about two-thirds have visited their IOU website at least once, and half (50%) visit more than once per year. Non-participants are statistically significantly more likely to report never having visited their IOU’s website (51% versus 28%). One quarter (25%) are regular users of their IOU’s website, reporting that they visit it once per month or more.

These data suggest that customers interested in DSM options often look to IOU websites for information, while those customers not yet aware or interested in DSM options are unlikely to receive messages via this channel. In-depth interviews with IOU staff indicate that this is a well-understood phenomenon, and IOUs typically look to alternate channels for opportunities to draw customers into the DSM market.

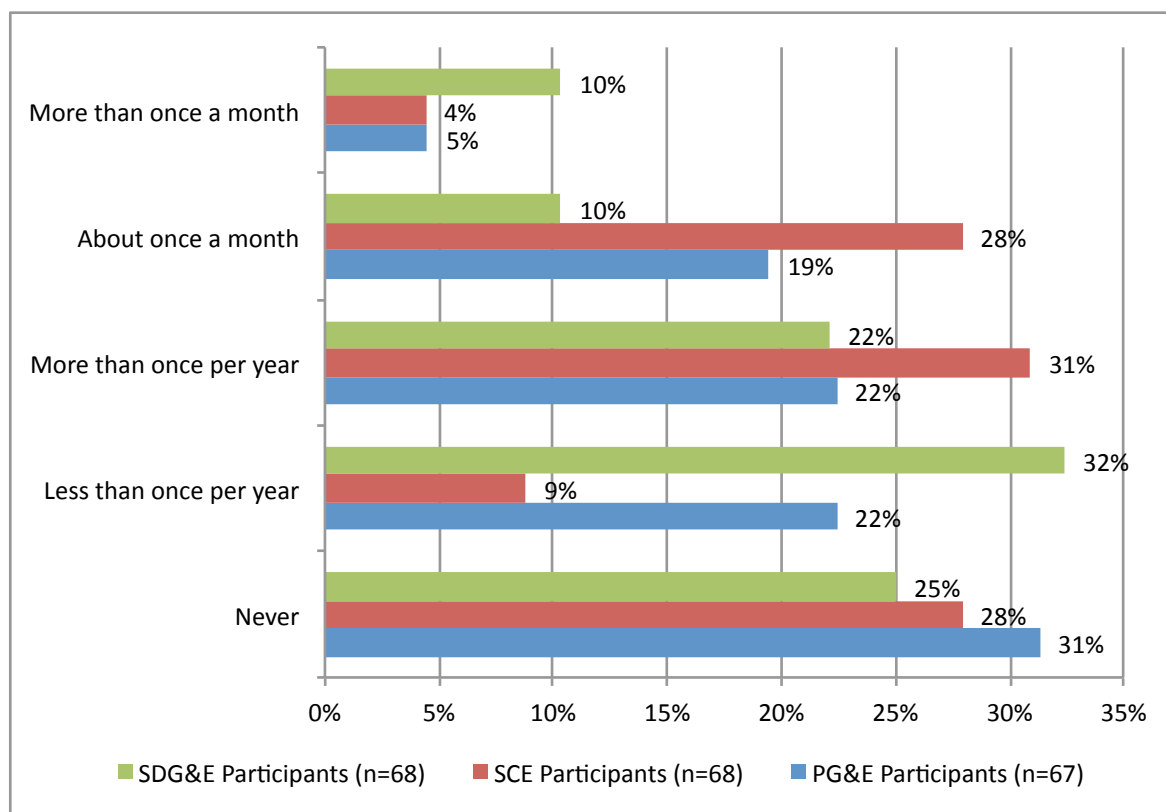
**Figure 14: Frequency of IOU Website Visit (Participants vs. Non-Participants)**



IOU website visitation patterns also differ within the participant group by IOU. Figure 15 below summarizes the frequency of IOU website use among participants, broken down by IOU service territory. Overall, the proportion of participants that reported having ever visited their IOU’s website is about the same across the IOUs—ranging from 25 percent for SDG&E to 31 percent for PG&E. However, among those that do use their IOU’s website, SCE participants stand out with a greater proportion of more frequent users. Almost one-third of SCE participants report visiting their IOU website once per month or more, and almost two-thirds (63%) visit more than once per year. Between 20 percent and 25 percent of

PG&E and SDG&E participants reported visiting more than once per month, and 42 percent to 46 percent visit more than once per year.<sup>30</sup>

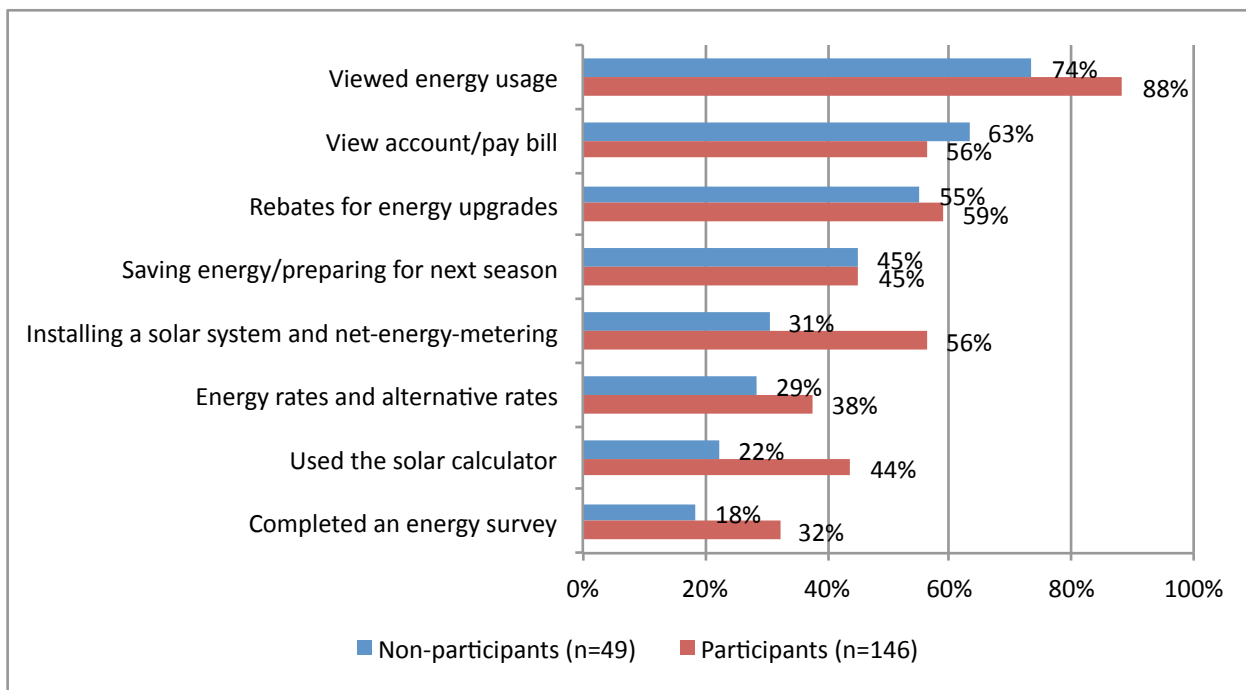
**Figure 15: Frequency of IOU Website Visit (Participants by IOU)**



Our survey inquired about the kinds of information respondents viewed and the specific online tools they used from the IOU websites. We asked all respondents who had ever visited their IOU’s website (n=195) to report which specific tools or areas of the site they had visited. The results of this inquiry are shown in Figure 16 below.

<sup>30</sup> There are no statistically significant differences across the IOUs in the number of respondents who say they “never visit” their IOU website and those who say they visit “more than once per month”. However, SCE participants are statistically significantly more likely to report visiting their IOU’s website once per month and statistically significantly less likely to report visiting less than once per year.

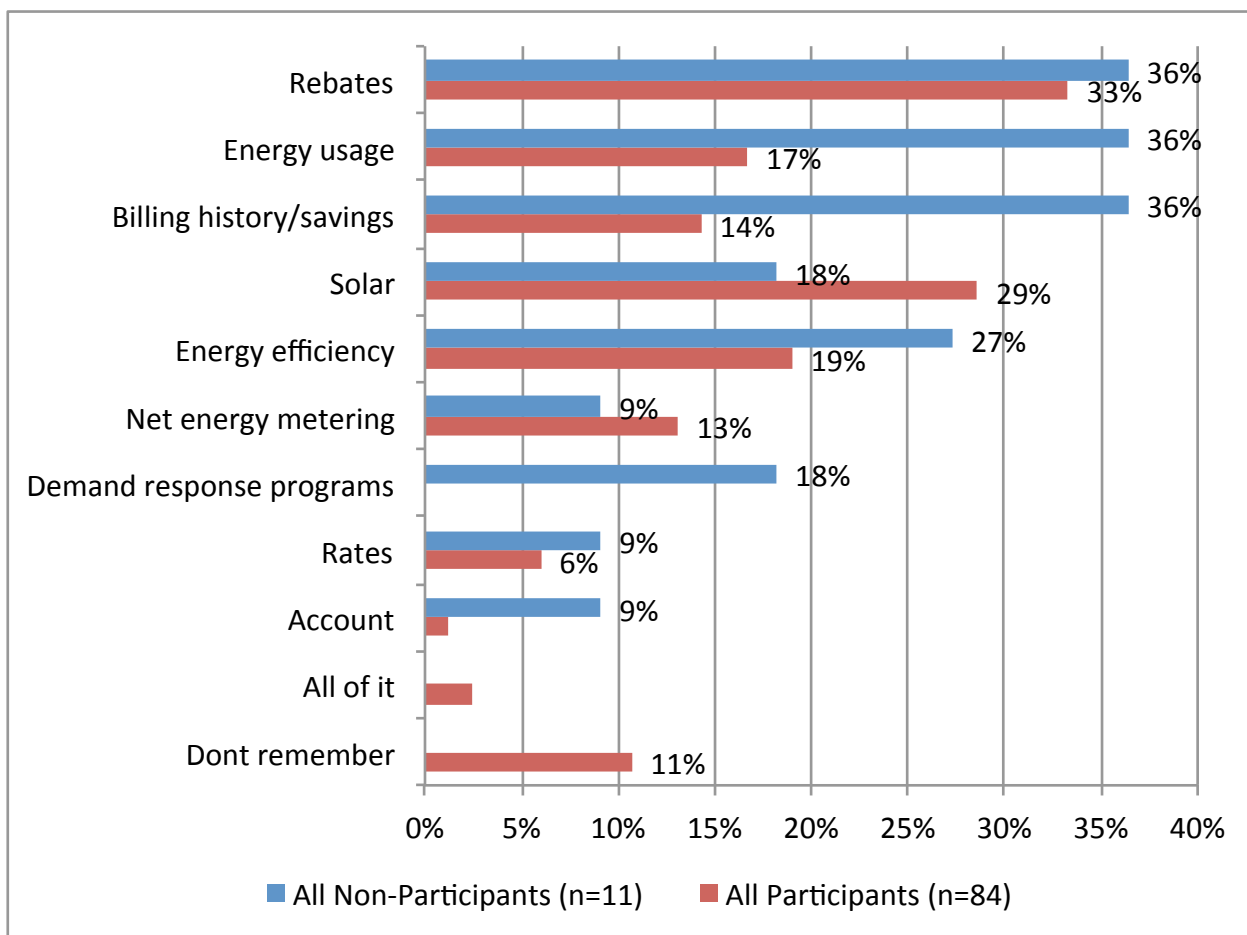
**Figure 16: Information Viewed and Tools Used on IOU Website (of Respondents who Visited IOU Site)**



We also asked all DSM adopters that reported using their IOU website to report specifically what kinds of information related to energy upgrades they reviewed (n=95). This was collected via an open-ended survey question, the results of which are shown in Figure 17 below. Although highly likely to report viewing energy usage information when making general energy-related inquiries, participant adopters were more likely to seek information on rebates, energy efficiency and solar options when visiting the IOU website specifically to support considering an upgrade. In contrast, non-participant adopters were more likely to focus on energy use and billing history, indicating, perhaps, that there were still basic research objectives to be met before a final decision could be reached, and/or these customers had less resolution with respect to their decision to move forward with retrofit investments.



**Figure 17: Areas of Utility Website Visited (for Information About Energy Upgrades, of Those Who Visited IOU Site)**



When visiting the IOU site for general purposes, the most common activity reported was viewing personal energy usage—almost 90 percent of participants and about three-quarters of non-participants reported utilizing this feature of the website. This is the most common activity among both participants and non-participants that use their IOU website. However, participants were statistically significantly more likely to report viewing their energy use via their IOU website compared to non-participants. This is indicative of a generally higher interest in monitoring energy use among participants, which is likely reflective of participants’ interest in their DSM investment payback—i.e. the inherent relationship between DG investment payback and net energy consumption.

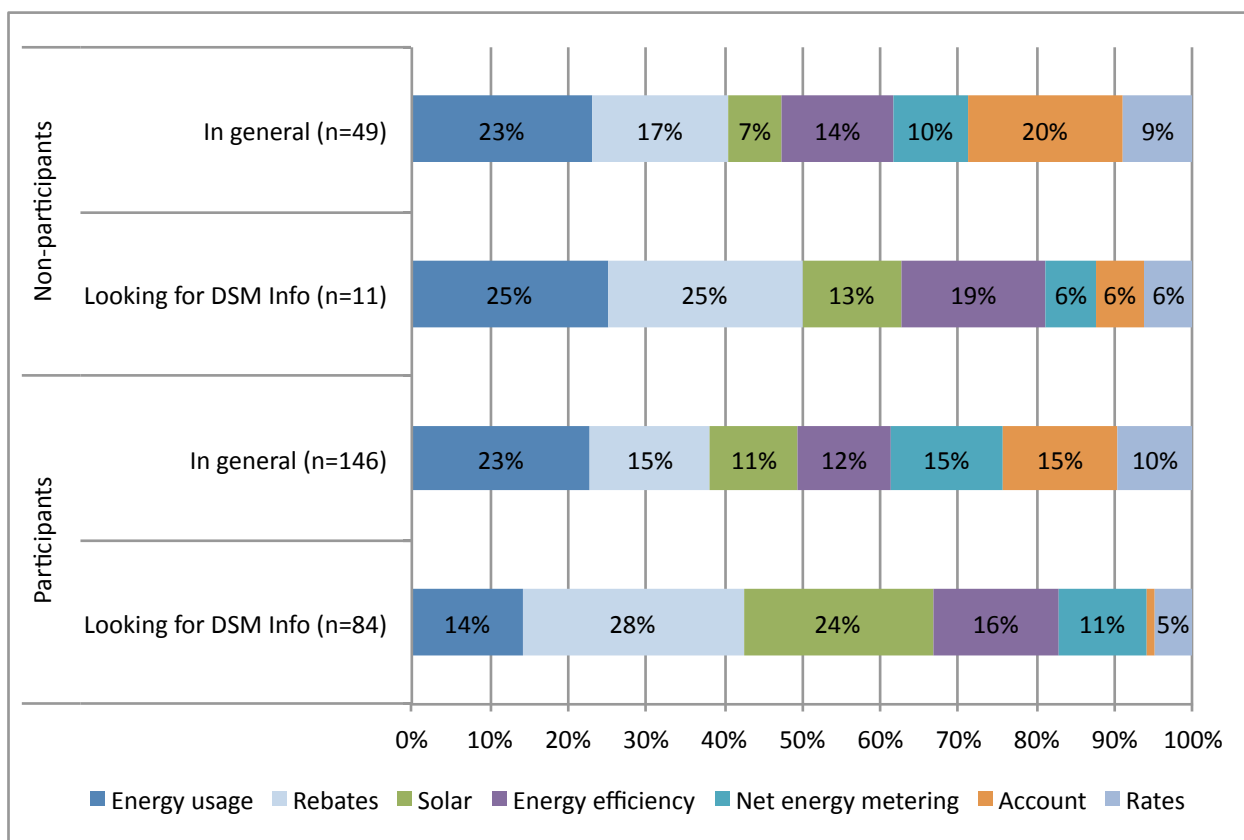
About one-third of participants reported having used their IOU’s online audit tool. Although this is not a majority of participants, the rate is statistically significantly higher than among non-participants (32% versus 18%). Over half of participants report looking to the IOU website for information about Net Energy Metering (NEM) (56%) and surprisingly a good portion of non-participants also sought information about NEM (31%). Somewhat under half

of participants used their IOU’s solar calculator (44%), which is twice the rate at which non-participants used the tool (22%).

When respondents were looking specifically for information about energy upgrades, participants were statistically significantly less likely than nonparticipants to look at their billing history/savings, research demand response programs or view their account (Figure 17).

Figure 18 compares the top three activities of participants and non-participants when visiting their IOU website for either general purposes or specifically to look at DSM information. The data suggest that regardless of whether the purpose of the visit was directly related to DSM considerations, viewing energy use is a popular use of the site. IDSM participants were more focused on rebates and solar information as they planned their projects, but still spent about 20 percent of their visits looking at account and rate information.

**Figure 18: IOU Website Use: General Purpose versus DSM Project Planning**



### *Non-Utility Website Use*

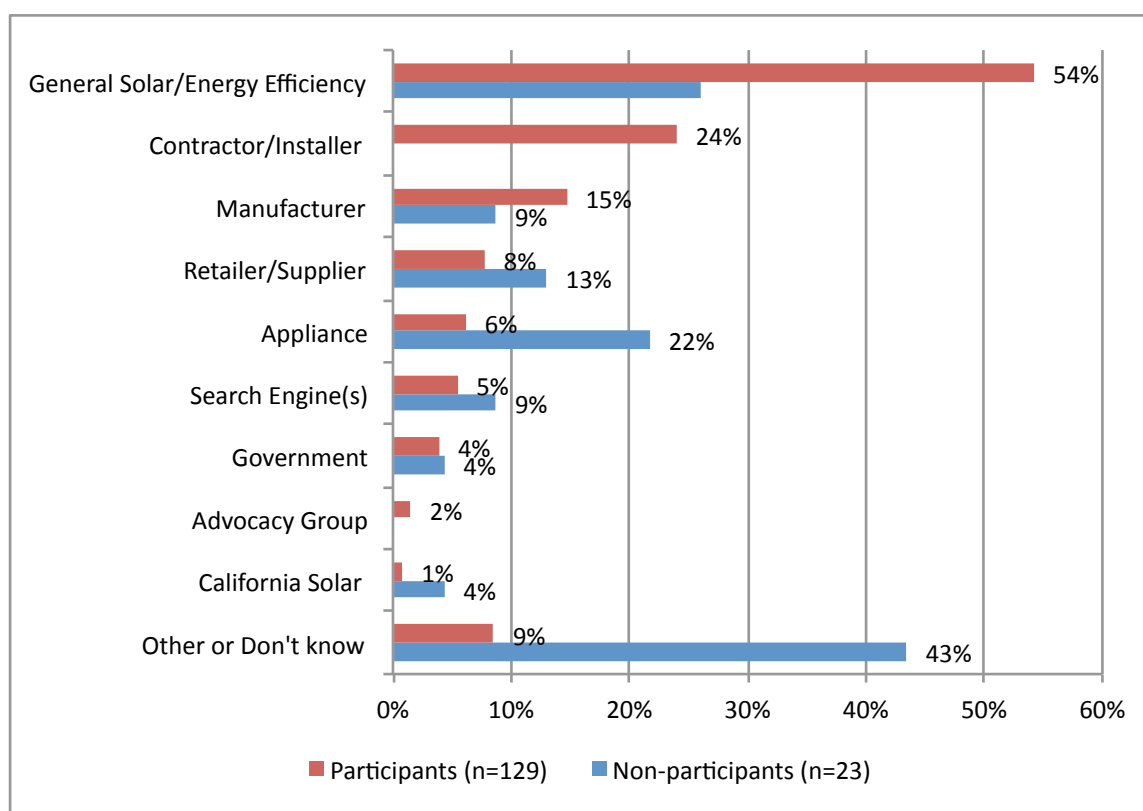
Figure 19 below shows the types of non-IOU websites that respondents visited to learn more about energy upgrades by participant and non-participant categories. These data are in response to an open-ended question, “What types of websites did you visit?”, to which

customers might have provided multiple categories of response, so the totals across all the categories add up to more than 100 percent.

Participants were likely to report using general solar/energy efficiency websites and contractor websites. In contrast, non-participants were more likely to visit appliance and retailer websites.

Another distinct finding as shown in the figure below is that participants were more likely to provide more narrowly-defined responses to this inquiry, while a high proportion of non-participants provided vague or general responses, categorized as “other” websites. We surmise that the more serious interest in DSM led to more focused research and greater recall of the types of websites utilized.

**Figure 19: Non-IOU Websites Use for Planning DSM Projects**

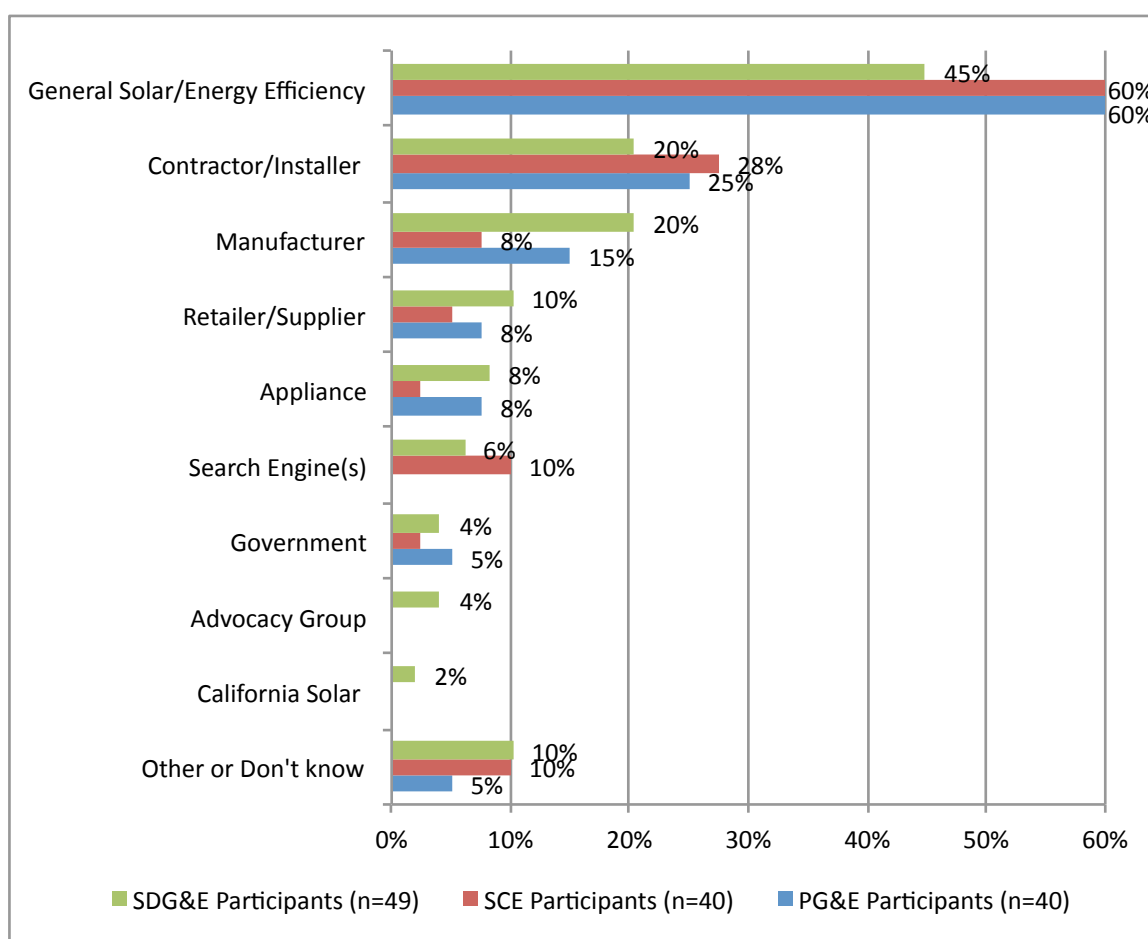


The type of website visited by participants varies by IOU. Figure 20 repeats the participant data shown in Figure 19 above, but is broken out by IOU.

- SDG&E participants are statistically significantly less likely to report visiting general solar/energy efficiency websites and statistically significantly more likely to visit the website of an advocacy group;

- PG&E participants are statistically significantly less likely to use a search engine than participants in other IOU service territories, but instead report visiting specific DSM-related websites (i.e. general solar/energy efficiency/contractor/manufacturer),
- SCE participants are more likely to use a search engine than other IOU customers (10% versus 6% for SDG&E and none for PG&E)
  - SCE participants are on par with PG&E in their propensity to visit general solar/energy efficiency (60%) and contractor websites (28% versus 25% for PG&E), but less likely to visit manufacturer websites than the other IOUs (8% versus 20% for SDG&E and 15% for PG&E)

**Figure 20: Non-IOU Websites Used by Participants for DSM Planning**



#### 4.2.4 Role of Audits

A total of 82 participants (40%) and 22 non-participant adopters (41%) received some type of home energy audit. Ten of the non-participant non-adopters (n=44), or 23 percent, also reported receiving energy audits. Respondents reporting that they had an energy audit were queried for details regarding the delivery mechanism of the audit (in-home, online, other) as well as the IDSM content of the audit.

Table 28 below summarizes the frequency with which respondents reported receiving energy audits, as well as the types of audit they received. Note that some audit recipients reported more than one type of audit, so the “Total” percent will not reflect the sum of the percents for each audit type.

Somewhat under half (45%) of customers adopting all DSM strategies, i.e. DG, EE and DR<sup>31</sup> had an energy audit, and the majority of these (69%) were in-person. This underscores findings more broadly suggestive that in-person contact –with contractors, IOUs, auditors—is a major driver for IDSM adoption. All segments shown in the table below indicate greater frequency of in-person audits than any other type, perhaps reflecting a greater level of recall for these audit types, as tracking data indicate that in-person audits are less often provided to residential customers, at least among those provided via IOU programs.

**Table 28: Energy Audit by Delivery Mechanism and IDSM Participation Segment**

Type of Audit	All Participants (n=203)	Participants with EE/DG/DR (n=53)	All Non-participants (n=99)	Non-participant Adopters (n=54)
In-person	24.1%	28.3%	22.2%	25.9%
Online	9.9%	13.2%	6.1%	5.6%
Mail	8.4%	3.8%	8.1%	11.1%
Phone	2.0%	0.0%	2.0%	1.9%
Don't know	1.0%	0.0%	0.0%	0.0%
<b>Total</b>	<b>39.9%</b>	<b>45.3%</b>	<b>32.3%</b>	<b>40.7%</b>

We assessed the integrated content of the energy audits by asking each audit recipient to report whether the audit included a DG assessment and if it provided information about DR programs or alternative rate plans. Table 29 below summarizes the IDSM content of the audits received by audit type and segment.

<sup>31</sup> Customers currently enrolled in DR and installing EE and DG measures since January 2010.

**Table 29: Topics Discussed by Audit Type and Segments**

Audit Type	Topic(s) Discussed	All Participants	Participants	All Non- participants	Non- participant Adopters	Total
			with Energy Efficiency/DG/ DR			
In-Person Audit	n	49	15	22	14	71
	DG Info	59.2%	80.0%	59.1%	57.1%	59.2%
	DR Info	40.8%	53.3%	36.4%	42.9%	39.4%
	Both	36.7%	53.3%	27.3%	28.6%	33.8%
	EE only	34.7%	13.3%	31.8%	28.6%	33.8%
Online Audit	n	15	7	3	2	18
	DG Info	46.7%	57.1%	33.3%	50.0%	44.5%
	DR Info	33.3%	42.9%	33.3%	50.0%	33.3%
	Both	13.3%	14.3%	0.0%	0.0%	11.1%
	EE only	20.0%	14.3%	33.3%	0.0%	22.2%
Other Type of Audit	n	30	4	15	14	45
	DG Info	41.2%	50.0%	71.4%	66.7%	51.3%
	DR Info	88.2%	100.0%	71.4%	83.3%	82.6%
	Both	41.2%	50.0%	57.1%	66.7%	46.5%
	EE only	5.9%	0.0%	14.3%	16.7%	8.7%

Results show that about two-thirds of in-person audits included some integrated content, and one-third were energy efficiency-only. The integrated content of in-person audits was more likely to be DG than DR (59% versus 39%). Online audits were relatively uncommon, and so the sample sizes are small; still, among these, it appears the majority offered some integrated content consisting more typically of either DG or DR (66%) but not both (11%). “Other” types of audits (mail, phone, and “don’t know” responses) appear to have the greatest integrated content, with less than 9 percent reported as “energy efficiency only”.

Overall, the IDSM content of the energy audits received by participants and non-participant adopters is similar, with close to 60 percent including DG information, suggesting that receipt of information via audits may not be a driver for IDSM adoption in the current marketplace.

We asked audit respondents to describe the influence of the audit they received on their DSM decision(s) in two stages. First, we asked whether or not the audit was helpful or had any influence on their decision to go through with their DSM investment. If they said yes, we then asked them to characterize the audit as very, somewhat, not very or not at all helpful.

Table 30 shows the respondent self-reports related to the helpfulness of the audits by the integrated content of the audit. Overall, participants receiving an audit with only energy efficiency information were much more likely to report that it had no influence than audits with any integrated content (67% versus 26%, respectively). In contrast, 72 percent of audits

with some integrated content were reported as being very or somewhat helpful, versus 27 percent of energy efficiency-only audits. This pattern generally holds for non-participant adopters as well, though they were less likely overall to report the audit had an influence on their decision making than participants (59% versus 63%).

**Table 30: Role of Audit in DSM Decisions, by IDSM Content of Audit**

Segment	Response	All Audits	With Any Integrated Content	With DG Info	With DR Info	With both DG/DR	With Energy Efficiency Only
All Participants	<b>n</b>	<b>82</b>	<b>61</b>	<b>43</b>	<b>41</b>	<b>27</b>	<b>21</b>
	Very or Somewhat Helpful	61.0%	72.2%	76.7%	75.6%	77.8%	28.6%
	Not Very or Not At All Helpful	2.4%	1.6%	2.3%	2.4%	3.7%	4.8%
	No Influence	36.6%	26.2%	20.9%	22.0%	18.5%	66.7%
Non-participant Adopters	<b>n</b>	<b>22</b>	<b>17</b>	<b>13</b>	<b>12</b>	<b>8</b>	<b>5</b>
	Very or Somewhat Helpful	50.0%	58.8%	46.2%	75.0%	62.5%	20.0%
	Not Very or Not At All Helpful	9.1%	11.8%	15.4%	8.3%	12.5%	0.0%
	No Influence	40.9%	29.4%	38.5%	16.7%	25.0%	80.0%

### 4.3 Need States

One of the intentions of the telephone survey was to investigate the relevance and relative power of various circumstances or life events in prompting customers to pursue DSM upgrades. Customers do not have a consistent degree of interest and/or receptivity to IDSM-related information and marketing. An event such as moving to a new home or the change of season can prompt greater interest and likelihood of implementing a DSM project. We refer to these circumstances as “need states”—and in the survey, prompt customers to report the applicability and relevance of those circumstances to their decisions to make DSM investments. As a control (i.e. for comparison purposes), we asked non-participant, non-adopters to also report whether the needs states had applied to them during the analysis timeframe.

Respondents who made DSM investments (i.e. participants and non-participant adopters) were asked to report if a certain need state applied to their household during the analysis period and whether the need state was relevant to their DSM investment decision. Non-

participant non-adopters were asked only if the need state had applied to them during the analysis period.

Table 31 below shows the frequency of various need states among participants and non-participants that were relevant during the analysis period. Note that the section under the heading "Applied (Not Necessarily Relevant)" reflects the rates at which each circumstance was applicable to the respondent over the analysis period, regardless of whether any DSM adoption was made or whether the respondent felt it was relevant to any DSM adoptions that they might have made. The section under the heading "Applied and Was Relevant" shows the frequency of needs states that were reported to have applied *and* been relevant to DSM adoption decisions; thus, that section does not include responses from non-participant, non-adopters.



**Table 31: Circumstances that Inspired Respondents to Seriously Consider Home Energy Upgrades**

Need States	Applied (Not Necessarily Relevant)			Applied and Was Relevant	
	All Participants (n=203)	Non-participant Adopters (n=54)	Non-participant Non-Adopters (n=44)	All Participants (n=203)	Non-participant Adopters (n=54)
Change in home occupancy	23.1%	18.5%	34.1%	10.3%	11.1%
Change in employment	9.8%	16.7%	25.0%	3.9%	1.9%
Experienced unusually high energy bill	68.5%	27.8%	20.5%	61.6%	24.1%
Preparing for change in season	29.1%	24.1%	36.4%	19.7%	14.8%
Installed new energy intensive equipment <sup>32</sup>	12.8%	5.6%	4.5%	10.3%	3.7%
Time to replace a major appliance	40.9%	55.5%	36.4%	28.6%	29.6%
Learned about rebates/incentives/financing	70.5%	59.2%	36.4%	60.6%	29.6%
Increased concern about impact on environment	66.0%	38.9%	0.0%	51.2%	27.8%
Home renovation/remodel	31.5%	25.9%	13.6%	13.3%	22.2%
Moved/purchased home	8.9% <sup>33</sup>	22.3%	9.1% <sup>34</sup>		

Several of the need states as shown in the table have high rates of applicability among participants, with the top three ranging from 66 percent to 71 percent. These same top three need states were also highly likely to be characterized as relevant to DSM investments, ranging from 51 percent to 62 percent. These need states, and their self-reported relevance to DSM adoption decisions are as follows:

- Experienced an unusually high bill (69% applied, 62% relevant);
- Learned about rebates/incentives/financing (71% applied, 61% relevant); and/or

<sup>32</sup> All of the non-participants who installed energy intensive equipment reported that the equipment was a pool, hot tub or spa. Participants who installed energy intensive equipment reported that they installed a pool/hot tub/sauna (65%), air conditioning equipment (23%), an electric car charger (12%), pool pump/motor (8%), other appliances (8%), and/or something else (16%).

<sup>33</sup> Moving/purchasing home is counted as applicable for participants and non-participants installing DSM projects after January 2010 if they report planning their DSM project within two years of moving. Non-participant non-adopters that moved into their homes during the analysis period are counted as applicable.

<sup>34</sup> Moving/purchasing home is counted as applicable for non-participant non-adopters if they reported moving/purchasing their homes during the analysis period.

- Experienced increased concern about issues related to energy use and the environment (66% applied, 51% relevant).

The installation of new energy intensive equipment had a lower rate of participant-reported applicability (13%) but was highly likely to be relevant if present, as 77% of those to whom it was applicable reported it was also relevant to their DSM adoption decision. Furthermore, this circumstance was almost three times more frequent among participants as non-participant adopters (13% versus 4.5%) indicating it is a strong driver of IDSM, even if not high in frequency.

Some of the need states stand out as differentiating IDSM participants from non-participants. The first is the receipt of an unusually high bill. This was reported as applicable by nearly 70 percent of participants but by only about 25 percent of non-participants. The second is 'increased concern about their impact on the environment' which was reported as applicable by 66 percent of participants but by only 39 percent of non-participants. Furthermore, this was reported as relevant at a greater frequency, with 77 percent of participants to whom it applied reporting it as relevant, versus 72 percent of non-participant adopters. These data suggest that experiencing increased concern for ones' impact on the environment is a stronger driver for IDSM adoptions than it is for DSM adoptions.

Another marked difference between participants and non-participant adopters is in the apparent relevance of home purchase and home renovation projects. Although almost one-third of participants had completed a home renovation project over the analysis period, only 42 percent of that subset reported their DSM projects were part of the larger renovation.<sup>35</sup> Among non-participant adopters, 26 percent reported having completed a home renovation over the analysis period, but 86 percent of that subset reported their DSM upgrades were part of the renovation. Overall, home renovation was found to be applicable and relevant for 13 percent of participant projects and 22 percent of non-participant projects.

Just fewer than 9 percent of participants planned their DSM upgrades within two years of moving into their homes, and a similar percentage of non-participant non-adopters moved into their homes at some point over the analysis period. Thus, the rate at which participants reported planning their recent DSM upgrades shortly after moving is not different from the non-adopter frequency of simply moving—suggesting no relationship between the two events among participants. In contrast, 22 percent of non-participant adopters planned their DSM projects shortly after moving into their homes, a rate over twice that of non-adopters. The data suggest that moving/purchasing a home is an important driver of energy efficiency upgrades, but not of IDSM upgrades.

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<sup>35</sup> For home renovation, we considered projects to be applicable to DSM upgrades if they occurred over the analysis period, and both relevant and applicable to DSM upgrades if the DSM upgrades were completed as part of the larger renovation project.

## 5. Residential Online Toolkit Tracking Data Analysis

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In this section, we review tracking data from customers that visited the online audit tool across three investor-owned utilities (IOUs) (PG&E, SCE and SDG&E).<sup>36</sup> The set of possible recommendations offered to customers varied across IOU. For each IOU, we present demand side management (DSM) participation, household characteristics and recommendations received from the online audit tool by various customer segments. We define the segments below, as they will be used throughout each IOU-specific section. In some cases, we describe the differences in these data across utilities.

- **Complete population.** This represents all customers who used the IOU’s online audit tool between a certain set of dates. For PG&E, those dates are March 2012 to July 2014. For SCE, those dates are February 2012 through May 2014 (with most activity starting in 2013) and for SDG&E, those dates are May 2012 through August 2014. For SDG&E, we present this in two ways; the first includes all tool users and the second includes just the tool users for whom we have evidence the audit survey had been completed--- which we determined via tracking records showing at least one audit recommendation marked as either “complete” or “incomplete.”
- **IDSMS recommendation recipients.** This group is a subset of the complete population and is defined as any customer who received two recommendations or more that spanned the categories of energy efficiency, DR and DG. If a customer received two energy efficiency recommendations, and no other recommendations, they would not be included in this category.
- **IDSMS willing vs. unwilling customers.** Of the group of customers who received IDSMS recommendations, we further categorized them into IDSMS willing or IDSMS unwilling groups. These are mutually exclusive groups. Customers who are IDSMS willing have indicated that they have done or would do at least one recommendation from two or more DSM categories such as installing an efficient water heater (energy efficiency) and getting solar PV (DG). Table 32 shows which suggestions fell into the DR or DG categories for each IOU.
- **Single vs. multiple visits.** This stratification divides customers who visited the site once from those who visited more than once.

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<sup>36</sup> We produced a data request as well as a follow up data request to each IOU. We were unable to use the data received from SoCalGas.

**Table 32: Demand Response and Distributed Generation Online Audit Recommendations**

<b>Recommendation Category</b>	<b>PG&amp;E</b>	<b>SCE</b>	<b>SDG&amp;E</b>
Demand Response	<ul style="list-style-type: none"> <li>• AC Cycling</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Distributed Generation	<ul style="list-style-type: none"> <li>• Solar PV</li> <li>• Solar hot water</li> <li>• Solar lighting</li> </ul>	<ul style="list-style-type: none"> <li>• Solar hot water</li> </ul>	<ul style="list-style-type: none"> <li>• Solar hot water</li> </ul>

\*Solar PV was noted “flag remove” in the data we received and is not included in this analysis.

Table 33 shows how often users at each IOU received a DR or DG recommendation. In the third column for each IOU, we show the percentage of users who reported having “done” the recommendation out of those that received the recommendation.

**Table 33: Demand Response and Distributed Generation Audit Recommendations**

	PG&E (n=27,641)			SCE (n=4,973)			SDG&E (n=1,635)		
	Offered by IOU	% Of Audits that Received Rec	% That Report Having "Done" Rec	Offered by IOU	% Of Audits that Received Rec	% That Report Having "Done" Rec	Offered by IOU	% Of Audits that Received Rec	% That Report Having "Done" Rec
Summer AC Cycling (DR)	yes	27%	29%	no	n/a	n/a	no	n/a	n/a
Solar PV (DG)	yes	5%	23%	no	n/a	n/a	no	n/a	n/a
Solar Water Heater (DG)	yes	4%	7%	yes	100% <sup>37</sup>	1%	yes	1.5%	0.06%
Solar Outdoor Lighting (DG)	yes	6%	59%	no	n/a	n/a	no	n/a	n/a

<sup>37</sup> This is based on our assumption with the SCE data that all recipients received all recommendations. More detail on this decision can be found in the SCE section.

We also categorized customers based on their participation in various IDSM strategies:

- **Net Energy Metering (NEM):** This is the group of customers whose accounts are marked as NEM, which can reasonably be interpreted to mean they have rooftop solar.
- **Demand Response (DR):** These are customers that are enrolled in a demand response program through the IOU. This represents PG&E customers who are enrolled in Smart Rate and/or Smart AC and SDG&E customers that are Summer Savers and/or are enrolled in Reduce your use Rewards. We did not receive data on DR enrollment from SCE.
- **Both NEM and DR:** This group is customers who are both NEM and DR as defined above.
- **Neither NEM nor DR:** This group contains the majority of customers and is all audit tool users who are not enrolled in either NEM or DR.
- **Energy Alert:** This group contains PG&E customers who used the audit tool and receive energy alerts. Energy Alert is a program that notifies customers when they are moving into a higher-priced electric tier. These data were not available for SCE and SDG&E customers.
- **Home Energy Report Recipient:** This group contains PG&E customers who received a Home Energy Report. This data was not available for SCE and SDG&E customers.

## 5.1 PG&E Residential Online Toolkit Tracking Data

This section examines PG&E residential online toolkit usage data and recommendation uptake rates.

### 5.1.1 DSM Participation by Toolkit Use Frequency and IDSM Willingness

Table 34 shows the rates of participation in DR and NEM programs by toolkit use frequency and IDSM willingness (defined in the beginning of Section 5).

Customers who visit the online toolkit site multiple times are already engaged with their energy usage in various ways. One-time visitors are statistically significantly less likely to be enrolled in NEM or DR whereas multi-visit users are significantly more likely to be enrolled in DR, enrolled in NEM and receiving Energy Alerts.

Customers who we consider to be IDSM willing express their willingness not only in their responses to online audit tool recommendations (which is how the category is defined), but also in their enrollment in DR, NEM and Energy Alerts. IDSM-willing customers are statistically significantly more likely to receive Energy Alerts, be enrolled in DR, and to be enrolled in both NEM and DR versus IDSM-unwilling customers.

**Table 34: IDSM Participation Segment by Usage and Willingness**

<b>DSM Participation Segment</b>	<b>Complete Population (n=27,641)</b>	<b>Single Visit (n=25,467)</b>	<b>Multiple Visits (n=2,174)</b>	<b>IDSM Willing (n=3,066)</b>	<b>IDSM Unwilling (n=2,083)</b>
NEM	3%	3%	4%	8%	7%
DR	5%	5%	9%	15%	3%
NEM and DR	0%	0%	1%	1%	0%
Neither NEM Nor DR	92%	93%	88%	79%	91%
Energy Alert	4%	4%	9%	6%	4%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

### 5.1.2 Demographic Data

In this section, we present demographic data by tool usage and IDSM willingness (Table 35) and by IDSM participation segment (Table 36).

Overall, the homes of single-visit and multiple-visit customers are similar<sup>38</sup> across most of the demographic characteristics shown below, save two. One difference between these segments that is statistically significant is that one-time users are more likely to live in multi-family homes versus multiple-visit users. Note that despite an underlying correlation between home type and the likelihood of renting (i.e. a greater portion of multi-family dwellings are rented) one-time visitors are not more likely to be renters than multi-visit customers. The second statistically significant difference is that single-visit customers are more likely to have central air conditioning (AC), though the magnitude of the difference is not large, 69 percent versus 67 percent, respectively.

A comparison of IDSM willing to IDSM unwilling customers yields a number of statistically significant differences. In particular, IDSM willing customers are statistically significantly more likely than IDSM unwilling customers to:

- Live in single family homes;
- Own their place of residence;
- Live in a home that is less than 50 years old;
- Use electricity as their main heating source; and
- Have central AC.

<sup>38</sup> That is, single-visit and multiple visit customers are not statistically significantly different from one another.

**Table 35: PG&E Toolkit User Demographic Data, by Use Frequency and IDSM Willingness**

Home Characteristic		Complete	Single Visit	Multiple	IDSM	IDSM
Category	Type	Population (n=27,641)	(n=25,466)	Visits (n=2,174)	Willing (n=3,066)	Unwilling (n=2,083)
House Type	Multi-Family	15.4%	15.6%	13.9%	6.6%	14.3%
	Single Family	84.6%	84.4%	86.1%	93.4%	85.7%
Ownership	Own	70.0%	69.9%	71.2%	83.8%	72.6%
	Rent	30.0%	30.1%	28.8%	16.2%	27.4%
Home Age	<= 10	8.6%	8.6%	8.3%	9.3%	8.8%
	11-20	16.3%	16.4%	15.7%	20.8%	18.8%
	21-30	15.7%	15.6%	16.5%	16.5%	16.0%
	31-40	15.4%	15.3%	16.2%	16.9%	16.5%
	41-50	12.1%	12.1%	12.1%	12.3%	12.1%
	51 +	31.9%	32.0%	31.3%	24.1%	27.7%
Heating Fuel	Electricity	11.5%	11.5%	11.4%	9.5%	7.7%
	Natural Gas	83.7%	83.7%	84.4%	85.8%	88.1%
	None	0.2%	0.2%	0.1%	0.2%	0.0%
	Not Sure	4.0%	4.0%	3.9%	3.7%	3.3%
	Other	0.6%	0.7%	0.3%	0.8%	0.9%
Has AC	No	68.9%	69.0%	67.2%	59.2%	66.5%
	Yes	31.1%	31.0%	32.8%	40.8%	33.5%
Home Size	Mean sq. ft.	1,809	1,813	1,761	2,003	1,917
Number of Occupants	Mean persons/home	3.70	3.71	3.61	3.68	3.60
Number of Adults	Mean adults/home	2.44	2.45	2.39	2.48	2.39
Number of Children	Mean children/home	1.26	1.26	1.22	1.20	1.21
<b>Total</b>		<b>27,641</b>	<b>25,446</b>	<b>2,174</b>	<b>3,066</b>	<b>2,083</b>



We next examine differences between customers enrolled in NEM or DR to those not involved in either program. When compared to customers not involved in either NEM or DR, customers enrolled in NEM are statistically significantly more likely to:

- Live in a single family home;
- Own their residence;
- Heat their home with natural gas;
- Have AC;
- Have a larger average home size (in square feet);
- Have more adults on average in the household; and
- Have fewer children on average in the household.

Similar statistically significant differences are found when comparing customers not involved in either NEM or DR to customers enrolled in an IOU DR program, with a couple of exceptions. It is not surprising that DR participation is associated with having an AC, since this is a requirement of the AC Cycling program (one of two residential DR programs available). More specifically, the list shown above holds true except the last two. No differences are found between DR participants and the no-DSM group (not NEM or DR) in terms of household size or composition.

**Table 36: Demographic Data by IDSM Participation Segment**

Home Characteristic		NEM	DR	NEM and DR	Neither NEM Nor DR	Energy Alert
Category	Type	(n=922)	(n=1,351)	(n=96)	(n=25,463)	(n=1,209)
House Type	Multi-Family	0.5%	9.8%	0.0%	16.2%	11.7%
	Single Family	99.5%	90.2%	100.0%	83.8%	88.3%
Ownership	Own	99.2%	83.1%	99.0%	68.4%	77.2%
	Rent	0.8%	16.9%	1.0%	31.6%	22.8%
Home Age	<= 10	7.7%	7.7%	8.5%	8.7%	8.9%
	11-20	19.4%	19.1%	19.5%	16.0%	14.3%
	21-30	12.6%	15.0%	11.0%	15.8%	15.8%
	31-40	14.0%	15.9%	19.5%	15.4%	15.9%
	41-50	13.7%	13.6%	15.9%	12.0%	12.5%
	51 +	32.7%	28.6%	25.6%	32.1%	32.6%
Heating Fuel	Electricity	5.6%	9.9%	8.3%	12.2%	9.9%
	Natural Gas	91.8%	86.5%	90.6%	82.8%	86.2%
	None	0.0%	0.1%	0.0%	0.2%	0.2%
	Not Sure	1.6%	3.0%	0.0%	4.2%	3.2%
	Other	1.0%	0.5%	1.0%	0.6%	0.5%
Has AC	No	26.8%	23.2%	11.5%	72.6%	30.0%
	Yes	73.2%	76.8%	88.5%	27.4%	70.0%
Home Size	Mean	2,363	1,921	2,459	1,756	1,775
Number of Occupants	Mean	3.66	3.68	3.80	3.71	3.68
Number of Adults	Mean	2.54	2.43	2.65	2.44	2.41
Number of Children	Mean	1.12	1.25	1.16	1.27	1.26
<b>Total</b>		<b>922</b>	<b>1,351</b>	<b>96</b>	<b>25,463</b>	<b>1,209</b>

### 5.1.3 Recommendation Responses

This section presents a list of recommendation types that were given to customers; each row in the tables presented in this section represents a single measure or a group of measures. The number of recommendations included in a table row is contained in parentheses next to the recommendation group name.

Tables in this section either include only the customers who are IDSM recommendation recipients (when presenting IDSM willing compared to the IDSM unwilling customers) or all

customers (when we present details on NEM, DR and Home Energy Reports). The IDSM recipient group is a subset of the complete set of customers who used the online tool and is defined as any customer who received two recommendations or more that spanned the categories of energy efficiency, DR, and distributed generation (DG). If a customer received two energy efficiency recommendations (and no DG or DR recommendations), they would not be included in this category.

During the online energy audit, customers were given the option to respond to each recommendation as either “done,” “not interested,” or “will do.” The first subsection below presents an analysis of recommendation uptake rates—that is, the percentage of customers that indicated they have done the recommendation. The second subsection examines the rates of recommendation refusal—that is, the rates with which various customer segments responded that they are not interested in a recommendation.

### *5.1.3.1 Online Audit Recommendation Uptake Rates*

The subsection below presents an analysis of recommendation uptake rates—the percentage of customers that received a specific recommendation type that indicated they have implemented the recommendation. This is shown first for IDSM recommendation recipients, (i.e. those that received recommendations from two or more DSM areas) by IDSM willingness, and then for all online audit participants segmented by various DSM participation segments.

#### *Recommendation Uptake Rates by IDSM Willingness*

First, we present a high level summary of recommendation uptake among IDSM recommendation recipients, by IDSM willingness. Table 37 shows the five recommendations with the highest level of uptake among IDSM recommendation recipients. Appliances, behavior and efficient lighting were in the top five across each segment shown in the table.

**Table 37: Top Five Recommendation Uptake Rates for IDSM Recommendation Recipients<sup>39</sup>, by IDSM Willingness**

<b>All (Who Received Two IDSM Recs)</b>	<b>IDSM Willing</b>	<b>IDSM Unwilling</b>
Appliances (79.4%)	Solar Lights (85.6%)	Appliances (73.4%)
Efficient Lighting (76.7%)	Appliances (83%)	Efficient Lighting (67.2%)
Behavior (68.2%)	Efficient Lighting (81.8%)	Behavior (62.1%)
Plug Load (66.4%)	Demand Response (80.9%)	HVAC Maintenance/Other (58.0%)
Efficient Water Heater (65.8%)	Behavior (72.8%)	Plug Load (57.6%)

<sup>39</sup> A customer is considered to receive an IDSM recommendation if they receive one or more recommendations from two or more DSM strategy areas, e.g. a customer that receives one EE recommendation and one DR recommendation.

Table 38 below shows all recommendation uptake rates among those customers receiving IDSM recommendations. Though it is arguably a result of how we define IDSM willing and IDSM unwilling, the table confirms that customers responding positively to two recommendations that span two DSM areas are statistically significantly more likely to implement every single recommendation category when compared to IDSM unwilling customers<sup>40</sup>.

**Table 38: Recommendation Uptake Rates, for IDSM Recommendation Recipients**

	All (Who Received IDSM Recs <sup>41</sup> )		IDSM Willing		IDSM Unwilling	
	%	n	%	n	%	n
Demand Response (1)	46.4%	4,283	80.9%	2,459	0.0%	1,824
Appliances (4)	79.4%	7,279	83.0%	4,599	73.4%	2,680
Behavior (29)	68.2%	59,369	72.8%	34,161	62.1%	25,208
Envelope (11)	49.3%	13,765	54.5%	8,639	40.6%	5,126
HVAC Equipment (9)	31.5%	6,736	36.2%	4,103	24.1%	2,633
HVAC Maintenance/Other (19)	65.2%	25,238	69.6%	15,794	58.0%	9,444
Efficient Lighting (3)	76.7%	5,529	81.8%	3,591	67.2%	1,938
Solar PV (1)	24.9%	1,273	38.5%	823	0.0%	450
Solar Water Heat (1)	7.0%	1,094	12.1%	637	0.0%	457
Solar Lights (1)	63.6%	1,646	85.6%	1,223	0.0%	423
Monitoring /Controls (6)	54.3%	8,999	60.7%	5,658	43.5%	3,341
NC/remodel (1)	40.4%	877	45.2%	538	32.7%	339
Plug Load (4)	66.4%	7,555	72.0%	4,636	57.6%	2,919
Pool (2)	30.6%	654	36.3%	435	19.2%	219
Refrigeration Equip (2)	57.5%	2,332	64.2%	1,497	45.6%	835
Refrigeration Maintenance/Other (3)	53.2%	6,606	60.2%	3,783	43.9%	2,823
Efficient Water Heater (7)	65.8%	1,170	70.6%	755	57.1%	415

<sup>40</sup> IDSM unwilling customers are those that received one or more recommendation from two or more DSM strategies, but responded positively – i.e. ‘will do’ or ‘done’ to recommendations from no more than one DSM strategy area.

<sup>41</sup> An IDSM recommendation occurs when a customer receives one or more recommendations from two or more DSM strategy areas – e.g. one DR and one EE recommendation.

### *Recommendation Uptake by DSM Program Participation*

Next, we examine recommendation uptake across segments related to DR and DG program participation as well as receipt of a Home Energy Report.<sup>42</sup> Table 39 below shows the five recommendation categories with the highest rates of uptake. For each segment, the categories are ranked from highest to lowest by implementation rate. Appliances, behavior, HVAC maintenance and efficient lighting were in the top five across each segment shown in the table. Across all five segments, appliances have the highest implementation rate. Efficient lighting comes in second for all segments except DR participants, where water heaters are second. DR participants exhibit greater receptivity to water heater recommendations than any other segment (70%). In contrast, NEM participants are the only group where efficient water heater does not appear in the top five categories. NEM customers also show greater receptivity to both behavior (69%) and plug load (66%) recommendations than any other segment.

**Table 39: Top Five Measure Recommendation Uptake Rates, by IDSM Participation Segment**

<b>NEM</b>	<b>DR</b>	<b>Neither NEM nor DR</b>	<b>Home Energy Report (HER) Recipient</b>	<b>Not a HER Recipient</b>
Appliances (83.0%)	Appliances (79.2%)	Appliances (81.8%)	Appliances (83.3%)	Appliances (81.6%)
Efficient Lighting (78.2%)	Efficient Water Heater (69.9%)	Efficient Lighting (71.1%)	Efficient Lighting (74.2%)	Efficient Lighting (71.0%)
Behavior (69.2%)	Efficient Lighting (69.2%)	Efficient Water Heater (68%)	HVAC Maintenance/ Other (68.9%)	Efficient Water Heater (67.8%)
HVAC Maintenance/ Other (66.4%)	HVAC Maintenance/ Other (67.6%)	HVAC Maintenance/ Other (67.5%)	Behavior (66.2%)	HVAC Maintenance/ Other (67.2%)
Plug Load (65.6%)	Behavior (65.5%)	Behavior (65.3%)	Efficient Water Heater (65.6%)	Behavior (65.3%)

Table 40 below shows rates of recommendation uptake across all measure categories and DSM participation segments. There is very little difference in the general propensity to implement recommendations across these segments, with the overall recommendation implementation rate ranging from 61 percent to 63 percent. However, there are differences across the segments in implementation rate by recommendation category, as discussed in detail below.

<sup>42</sup> Note that receipt of a Home Energy Report is likely to be initiated by PG&E and not the customer, though that is not the case 100 percent of the time.

**Table 40: IDSM Recommendation Uptake, by DSM Participation Segments**

	NEM		DR		Neither NEM nor DR		Home Energy Report (HER) Recipient		Not a HER Recipient	
	%	n	%	n	%	n	%	n	%	n
Demand Response (1)	29.9%	418	64.1%	700	25.3%	6,457	34.1%	929	28.0%	6,585
Appliances (4)	83.0%	1,030	79.2%	1,035	81.8%	15,279	83.3%	2,030	81.6%	15,203
Behavior (29)	69.2%	5,538	65.5%	8,730	65.3%	144,990	66.2%	17,331	65.3%	141,225
Envelope (11)	55.3%	1,920	52.7%	1,860	51.2%	22,534	54.4%	3,601	51.2%	22,469
HVAC Equipment (9)	36.0%	783	38.6%	705	35.2%	7,459	35.9%	1,243	35.4%	7,594
HVAC Maintenance/Other (19)	66.4%	2,638	67.6%	3,198	67.5%	42,246	68.9%	6,106	67.2%	41,618
Efficient Lighting (3)	78.2%	569	69.2%	640	71.1%	9,738	74.2%	1,289	71.0%	9,590
Solar PV (1)	49.7%	197	10.1%	89	19.4%	1,201	11.3%	186	24.3%	1,278
Solar Water Heat (1)	6.6%	121	4.5%	89	6.9%	984	3.1%	159	7.2%	1,020
Solar Lights (1)	54.5%	145	59.0%	117	58.7%	1,547	65.1%	218	57.6%	1,575
Monitoring /Controls (6)	61.8%	1,101	60.2%	1,197	55.1%	16,642	59.7%	2,368	55.2%	16,440
NC/remodel (1)	43.4%	122	48.3%	87	42.8%	856	47.2%	163	42.3%	886
Plug Load (4)	65.6%	936	60.6%	1,086	55.8%	18,233	55.7%	2,233	56.6%	17,922
Pool (2)	31.1%	106	47.2%	72	37.1%	873	53.1%	113	35.3%	923
Refrigeration Equip (2)	57.3%	260	59.1%	235	64.1%	3,114	63.3%	420	63.4%	3,157
Refrigeration Maintenance/Other (3)	45.6%	744	49.5%	861	48.6%	13,491	50.0%	1,719	48.3%	13,291
Efficient Water Heater (7)	63.7%	135	69.9%	103	68.0%	1,336	65.6%	192	67.8%	1,364

Table 40 above shows that NEM participants exhibit greater interest in recommendations that offer low cost energy savings, and/or those that relate to having greater control over time-of-use, (when compared to those not enrolled in DR or NEM); these types of recommendations include:

- DR
- Behavior
- Envelope
- Efficient lighting
- Monitoring/controls
- Plug load

A comparison of customers with DR to those without NEM or DR show that those enrolled in DR are more amenable to recommendations related to control over time-of-use and reduction in peak time usage in particular. The data show statistically significantly greater likelihood that those enrolled in DR (compared with those not enrolled in either NEM or DR) will implement recommendations in the following categories:

- HVAC equipment
- Monitoring/controls
- Plug load
- Pool

Customers who received Home Energy Reports were likely already getting many recommendations regarding actions they could take in their home to save energy, as the reports include tips and recommendations for saving energy. A comparison of customers receiving Home Energy Reports to those who did not shows that report recipients gravitate toward low cost/no cost solutions that reduce their bill. Home Energy Report recipients are statistically significantly more likely (when compared to those not receiving a report) to implement recommendations in the following categories:

- DR
- Appliances
- Behavior
- Envelope
- HVAC maintenance
- Efficient lighting
- Solar lights
- Monitoring/controls
- Pool

Interestingly, Home Energy Report recipients were actually *less likely* to implement solar water heat or solar PV when compared to those who had not received reports. This is consistent with our hypothesis that report recipients are more likely to be seeking low cost

/no-cost solutions than other online audit participants, as they were exposed to materials that raise awareness of the benefits of these smaller changes.

### 5.1.3.2 Online Audit Recommendation Refusal Rates

In this section, we examine the rates at which customers refused recommendations. We first look at those customers receiving IDSM recommendations (i.e. recommendations from two or more DSM categories) by IDSM willingness, and we then examine all online audit participants' refusal rates segmented by DSM participation categories.

#### *Refusal Rates Among IDSM Recommendation Recipients*

Table 41 below shows rates of refusal among IDSM recommendation recipients by recommendation category. Among all IDSM recommendation recipients, refusal rates are highest for solar water heat (77%) and HVAC equipment (59%), a pattern that also holds true for IDSM willing customers. Among those categorized as IDSM unwilling, solar water heat and DR have the highest refusal rates. However, the definition of IDSM unwilling corresponds to their response to DR and DG recommendations, so this is not a very compelling result. However, we do take notice of the fact that IDSM unwilling customers are more likely to reject every single recommendation category across the board, not only the DR and DG-related recommendations.

**Table 41: Recommendation Refusal Rates, for IDSM Recommendation Recipients**

Recommendation	All (Who Received Two IDSM Recs)		IDSM Willing		IDSM Unwilling	
	%	n	%	n	%	n
Demand Response (1)	45.9%	4,283	10.2%	2,459	94.0%	1,824
Appliances (4)	9.8%	7,279	7.2%	4,599	14.2%	2,680
Behavior (29)	13.4%	59,369	10.3%	34,161	17.5%	25,208
Envelope (11)	28.5%	13,765	23.5%	8,639	36.8%	5,126
HVAC Equipment (9)	58.8%	6,736	53.5%	4,103	67.0%	2,633
HVAC Maintenance/Other (19)	19.4%	25,238	15.9%	15,794	25.2%	9,444
Efficient Lighting (3)	7.1%	5,529	4.4%	3,591	12.2%	1,938
Solar PV (1)	41.6%	1,273	29.9%	823	63.1%	450
Solar Water Heat (1)	77.3%	1,094	67.2%	637	91.5%	457
Solar Lights (1)	24.5%	1,646	8.1%	1,223	72.1%	423
Monitoring /Controls (6)	23.4%	8,999	18.0%	5,658	32.6%	3,341
NC/remodel (1)	52.1%	877	48.1%	538	58.4%	339
Plug Load (4)	15.7%	7,555	11.9%	4,636	21.7%	2,919
Pool (2)	52.6%	654	48.0%	435	61.6%	219
Refrigeration Equip (2)	29.8%	2,332	24.2%	1,497	39.8%	835
Refrigeration	24.3%	6,606	19.4%	3,783	30.9%	2,823



Recommendation	All (Who Received Two IDSM Recs)		IDSM Willing		IDSM Unwilling	
	%	n	%	n	%	n
Maintenance/Other (3)						
Efficient Water Heater (7)	17.3%	1,170	12.1%	755	26.7%	415

### *Refusal Rates by DSM Program Participation*

In this section, we examine recommendation refusal rates among all online audit participants segmented by DR and DG participation, as well as by receipt of a Home Energy Report.

Table 42 below presents refusal rates for those enrolled in NEM, those enrolled in DR and those not enrolled in either. We also present recommendation refusal rates for those who received a Home Energy Report versus those who did not. The patterns in these data are similar to those shown above for IDSM recommendation recipients, with respect to the most often rejected recommendations. Similar to IDSM recommendation recipients, when we consider all online audit participants, the recommendations most likely to be rejected are solar water heat and HVAC equipment. Solar water heat has the highest refusal rate across the board, ranging from 68 percent to 76 percent. Solar water heat refusal rates are highest among Home Energy Report recipients, at 76 percent, which is consistent with our previous observations that HER recipients are most amenable to lower cost solutions. We also note that NEM participants are least likely to reject solar water heat recommendations (68% versus a range of 72% to 76% for other segments). This finding suggests that having experience with solar PV provides a somewhat greater level of confidence in the performance of solar technology versus those customers who do not have that experience.

**Table 42: Recommendation Refusal Rates by DSM Participation Segments**

	NEM		DR		Neither NEM nor DR		Home Energy Report (HER) Recipient		Not a HER Recipient	
	%	n	%	n	%	n	%	n	%	n
Demand Response (1)	46.2%	418	6.1%	700	35.4%	6,457	32.2%	929	33.6%	6,585
Appliances (4)	7.5%	1,030	7.5%	1,035	5.9%	15,279	5.6%	2,030	6.1%	15,203
Behavior (29)	15.3%	5,538	9.2%	8,730	9.6%	144,990	9.7%	17,331	9.8%	141,225
Envelope (11)	25.6%	1,920	20.5%	1,860	19.7%	22,534	19.4%	3,601	20.3%	22,469
HVAC Equipment (9)	53.5%	783	49.4%	705	52.9%	7,459	52.5%	1,243	52.6%	7,594
HVAC Maintenance/Other (19)	18.8%	2,638	12.0%	3,198	12.7%	42,246	13.2%	6,106	12.9%	41,618
Efficient Lighting (3)	7.4%	569	6.7%	640	6.4%	9,738	5.9%	1,289	6.5%	9,590
Solar PV (1)	2.0%	197	57.3%	89	40.0%	1,201	52.2%	186	34.3%	1,278
Solar Water Heat (1)	67.8%	121	71.9%	89	72.9%	984	76.1%	159	71.7%	1,020
Solar Lights (1)	31.0%	145	20.5%	117	22.2%	1,547	23.4%	218	22.7%	1,575
Monitoring/Controls (6)	19.4%	1,101	14.6%	1,197	18.4%	16,642	16.3%	2,368	18.5%	16,440
NC/remodel (1)	50.0%	122	48.3%	87	48.0%	856	46.0%	163	48.8%	886
Plug Load (4)	17.1%	936	12.0%	1,086	12.7%	18,233	14.8%	2,233	12.6%	17,922
Pool (2)	43.4%	106	31.9%	72	45.4%	873	27.4%	113	46.5%	923
Refrigeration Equip (2)	31.5%	260	26.4%	235	22.6%	3,114	26.4%	420	23.1%	3,157
Refrigeration Maintenance/Other (3)	38.4%	744	25.4%	861	25.2%	13,491	25.7%	1,719	25.9%	13,291
Efficient Water Heater (7)	17.8%	135	11.7%	103	14.3%	1,336	14.1%	192	14.7%	1,364

Although the overall recommendation uptake rate among NEM customers is on par with other segments, as discussed in the previous section, the NEM participant segment is more likely to reject recommendations—i.e. reject any recommendation—than any other segment. Overall recommendation rejection rates range from a low of 14 percent for DR participants to a high of 21 percent for NEM participants. Other segments are close to the DR refusal rate; they range within a narrow band of 14 percent to 15 percent. This trend is also illustrated in the pattern surrounding behavior recommendations in particular. Behavior recommendations are the most common type of recommendation offered by the tool, and we find NEM participants are more likely to both implement those recommendations as well as reject those recommendations, when compared to customers not currently enrolled in DR or NEM.

The NEM segment's high overall recommendation refusal rate combined with a rate of implementation that is similar to other segments is a curious finding. It suggests this segment may be more engaged with the online tool, even though they are not more likely to implement recommendations. We note that NEM participants may have already invested substantially in energy upgrades and so may be more discerning in their selection of recommendations to implement, but at the same time have a higher level of commitment to energy savings reflected in implementation rates on par with those that have likely invested less in energy upgrades to date.

There are other characteristics that differentiate NEM participants from other segments. Refusal rates for DR recommendations across the segments generally range from 25 percent to 32 percent (excluding the DR participant segment) but are much higher among NEM participants, at 46 percent. NEM participants may find the prospect of participating in AC Cycling or Smart Rate programs to be more daunting given the complexity of managing a combination of generation and consumption, or they may find the incentives available to NEM participants insufficient. These data do not offer conclusive evidence either way, but suggest that NEM participants may need additional support or encouragement to pursue DR opportunities. Moreover, the data suggest it may be worthwhile to offer customized online solutions oriented to the needs of NEM participants due to the distinct characteristics of their response to audit recommendations.

Patterns in the data also suggest that DR participants may have distinct needs and wants with respect to the online tools. Data show that recommendations for solar PV are rejected more often (57%) by DR participants than by any other segment (other segments range from 34 percent to 52 percent). DR participants are the only segment for which solar PV appears in the top four most-often-rejected recommendations; the difference in the solar PV rejection rate compared with the segment not participating in NEM or DR is statistically significant. We note that the pattern of higher rejection rates among DR participants is not repeated for solar water heat or solar lights, indicating the pattern does not reflect an overall aversion to solar technology, but perhaps to solar PV in particular. We are moved to consider whether this pattern is due to a reluctance to take on the complexity of managing DG and DR in combination, as we surmised may be the case among NEM participants. These data are not

conclusive on this point but suggest that both DR and NEM participants may need additional support or reassurance to approach implementation of both DSM solutions at once.

Also similar to previous observations, we observe that DR participants are less likely than their counterparts (those not enrolled in DR or NEM) to reject recommendations related to pools, monitoring/controls and HVAC equipment. Again, as discussed previously, it appears that DR participants seek recommendations that will support their ability to control time-of-use and reduce peak time loads.

## 5.2 SCE Residential Online Toolkit Tracking Data

In this section, we examine online audit tracking data from SCE. We note that the tool from which these data were pulled is no longer active. The tool development was transferred to a new vendor, and a new tool was developed that replaces the one from which these data were selected. The objective of this analysis is to gain insight into customer needs and wants from observed patterns of tool use, not to evaluate the efficacy of the tool itself. Thus, the fact that the tool is no longer active does not change our analysis approach.

SCE provided data reflecting which online tool users were also enrolled in NEM. However, they were not able to provide data reflecting which users were enrolled in DR or in AMI-enabled behavior programs such as Energy Alerts.

The SCE online audit recommendations included only one that would qualify as either DR or DG—a recommendation for solar water heat. Thus, analysis of IDSM recommendation recipients, as well as the distinction between IDSM willing and unwilling would be only a reflection of solar water heat. Further, and as discussed in greater detail later on in this section, the SCE data did not provide an indication that customers received a specific recommendation, only that a customer indicated the recommendation had been implemented. For this reason we could not identify the subset customers that received IDSM recommendations, limiting the analysis further.

### 5.2.1 Demographic Data

In this section we examine demographic data for SCE's online toolkit users. We examine these data for the total population of users, and also that population segmented by frequency of toolkit use and participation in the NEM program (i.e. owners of solar PV).

Table 43 below shows the distribution of demographic characteristics for the complete population of online toolkit participants, and for segments reflecting frequency of tool usage and NEM participation. We find that demographic characteristics are similar across most segments. Most online toolkit users live in single family home (90%) and more than three-quarters have a home built after 1960. Most have gas-fueled heating systems (87%)—and central AC (98%). However, single-visit users are statistically significantly more likely to have AC than those that have visited the tool multiple times (98% versus 95%). This could reflect income differences or be correlated with other factors related to climate (and corresponding need for AC).

The data show that NEM participants have similar traits to the overall population of users, but have these same traits in a more pronounced way. NEM participants using the online audit tool typically:

- Live in single family homes (nearly 100% of the sample versus 90% of the overall participant population);
- Live in homes built after 1960 (85% versus 78% of overall participant population);
- Have central AC equipment (99% versus 98% of overall participant population);
- Heat their homes with natural gas (92% versus 87% of overall participant population),

NEM participants have a somewhat larger average home size than the general population of online audit participants, at approximately 2,500 square feet versus 2,200 square feet for the general population of users. They also tend to have somewhat larger households, with an average of 3.6 occupants per home versus 3.4 in the general population.

**Table 43: SCE Toolkit User Demographic Data, by Use Frequency and NEM Participation**

Home Characteristic		Complete Population	Single Visit	Multiple Visits	NEM
Category	Type	(n=4,973)	(n=4,367)	(n=606)	(n=550)
House Type	Multi-Family	10.7%	10.9%	9.2%	0%
	Single Family	89.3%	89.1%	90.8%	100%
Home Age	<= 10	0.0%	0.0%	0.0%	0%
	11-20	31.8%	30.8%	39.6%	50%
	21-30	13.8%	13.6%	14.7%	13%
	31-40	32.1%	33.2%	23.8%	22%
	41-50	9.1%	9.1%	9.7%	5%
	51 +	13.2%	13.4%	12.2%	10%
Heating Fuel	Electricity	10.4%	10.3%	11.0%	6%
	Natural Gas	86.6%	86.7%	85.2%	92%
	Other	3.0%	2.9%	3.8%	2%
Has AC	No	2.4%	2.1%	4.8%	1%
	Yes	97.6%	97.9%	95.2%	99%
Home Size	Mean	2,225	2,205	2,366	2,496
Number of Occupants	Mean	3.42	3.41	3.48	3.55
<b>Total</b>		<b>4,973</b>	<b>4,367</b>	<b>606</b>	<b>550</b>

## 5.2.2 Recommendation Responses

This section presents an analysis of recommendation implementation rates by segment. Note that limitation in the data prevented us from knowing which customers received which recommendations, but we were able to glean which customers indicated they had implemented a recommendation.<sup>43</sup>

Table 44 below presents recommendation categories with the highest implementation rates across various segments of the participant population. In particular, the table shows implementation rates for the total population of users, IDSM willing, single-visit and multi-visit users, and users enrolled in the NEM program (i.e. owners of solar PV).

Overall, the highest implementation rate is in the refrigeration equipment category, which has an uptake rate of nearly one in four. Refrigeration equipment is also the most often implemented recommendation across all other segments, except IDSM willing. (Note that the definition of IDSM willing and the absence of any DR-related recommendations biases the results of this segment toward solar implementation.) Efficient lighting, behavior and monitoring/controls all tie for second, at 21 percent implementation.

IDSM willing have the highest implementation rate, with an average of nearly 60 percent across all measure categories, suggesting that customers willing to implement recommendations over more than one DSM strategy are generally more willing to implement all recommendation versus other segments of participants.

Multi-visit users have the second highest overall implementation rate at 14 percent. This group is a relatively small percentage of all users (14%) but reflects the same overall preferences in measure uptake, with the same top five measures as those of the total population (see Table 44 below). However, this group tends to favor efficient lighting a bit more than the overall population, ranking it a close second to refrigeration equipment (30% versus 27%).

In comparison to single-visit users, multi-visit customers have higher measure uptake rates across the board. Multi-visit customers exceed single-visit customer uptake rates by a span of between 4 and 7 percentage points.

NEM customers are only slightly behind multi-visit users in their overall recommendation implementation rate, at 13 percent. NEM customers are also similar to multi-visit customers in their individual measure uptake rates, differing in uptake rates by no more than 2 percentage points for any of the five top measures. In comparison to other segments, this group has a greater preference for monitoring and controls equipment than do other

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<sup>43</sup> For SCE, the data were structured so that all “viewed” recommendations and all “done” recommendations were listed for each participant, however, not all “done” recommendations had a corresponding “viewed” recommendation. Therefore, we assumed that all respondents received all recommendations and that those recommendations that were “done” were indeed completed.

segments, perhaps related to a desire to monitor generation performance in addition to consumption. NEM participants are the only segment where the monitoring/controls category of recommendation is ranked number two as most commonly implemented; in other segments, it is ranked third or lower.

**Table 44: Top Five Measure Implementation Recommendation Rates, by Segment**

<b>All (Total Population) (n=4,973)</b>	<b>IDSM Willing (n=61)</b>	<b>NEM (n=550)</b>	<b>Single Visit (n=4,367)</b>	<b>Multiple Visits (n=606)</b>
Refrigeration Equip (24%)	Solar Water Heat (100%)	Refrigeration Equip (30%)	Refrigeration Equip (23%)	Refrigeration Equip (30%)
Behavior (21%)	HVAC Maintenance/ Other (84%)	Monitoring/ Controls (26%)	Efficient Lighting (21%)	Efficient Lighting (27%)
Efficient Lighting (21%)	Monitoring/ Controls (80%)	Efficient Lighting (25%)	Monitoring/ Controls (21%)	Monitoring/ Controls (25%)
Monitoring/ Controls (21%)	Efficient Lighting (75%)	Plug Load (25%)	Plug Load (20%)	Behavior (24%)
Plug Load (20%)	Plug Load (75%)	Behavior (22%)	Behavior (20%)	Plug Load (24%)

Table 45 presents all recommendation uptake rates for SCE online audit tool users. The patterns discussed above are repeated here, with the addition of uptake rates for less popular measures. Solar water heat has very low implementation rates, similar to the pattern observed within the PG&E data. However, it is important to note that we do not know which customers received which recommendations, so the data below represent overall implementation rates among all users, not among those that received the recommendation, and therefore has limited analytical use. It is a snapshot of user 'actions' related to audit recommendations, and can be interpreted only to reflect preferences at a very general level.

**Table 45: Recommendation Uptake Rates by Measure and Segment**

	All (Total Population) (n=4,973)	IDS M Willing (n=61)	NEM (n=550)	Single Visit (n=4,367)	Multiple Visits (n=606)
Appliances (16)	12.0%	55.0%	14.0%	12.0%	15.0%
Behavior (39)	21.0%	64.0%	22.0%	20.0%	24.0%
Envelope (4)	6.0%	56.0%	8.0%	5.0%	8.0%
HVAC Equipment (7)	13.0%	54.0%	14.0%	12.0%	15.0%
HVAC Maintenance/Other (1)	7.0%	84.0%	9.0%	6.0%	10.0%
Efficient Lighting (3)	21.0%	75.0%	25.0%	21.0%	27.0%
Solar Water Heat (1)	1.0%	100.0%	1.0%	1.0%	2.0%
Monitoring /Controls (1)	21.0%	80.0%	26.0%	21.0%	25.0%
NC/remodel (1)	2.0%	70.0%	1.0%	2.0%	4.0%
Plug Load (3)	20.0%	75.0%	25.0%	20.0%	24.0%
Pool (1)	0.0%	0.0%	0.0%	0.0%	0.0%
Refrigeration Equip (1)	24.0%	57.0%	30.0%	23.0%	30.0%
Refrigeration Maintenance/Other (1)	1.0%	3.0%	1.0%	1.0%	2.0%
Efficient Water Heater (8)	8.0%	61.0%	10.0%	8.0%	10.0%



## 5.3 SDG&E Residential Online Toolkit Tracking Data

SDG&E online tool tracking data had some limitations that led us to take a somewhat different approach to usage pattern analysis. We received records for 5,000 customers that used some part of SDG&E’s online tool offering; this may include some combination of viewing personal energy use information, using the solar calculator, viewing rate information or engaging with the online audit tool. Out of the 5,000 records we received, 1,635 had engaged with the online tool and had gotten far enough along with it to have had viewed at least one recommendation (or more specifically, 1,635 responded either “complete” or “incomplete” to one or more recommendations). No recommendations were listed for the remaining 3,365 users. Thus, we examine the overall population of 5,000 records for correlations in usage frequency with participation in NEM and DR programs, to assess whether the tool appears to either lead customers into these programs or support them through their participation experience. We then examine the sub-population of those that viewed recommendations to assess the preferences and use-patterns of online audit users.

We do not present results by IDSM willing and unwilling categories, due to the low number of people that fell into either of these categories. Only 19 total users received recommendations from two or more DSM categories; this is due to there being only one non-energy efficiency recommendation—solar hot water—provided by the tool.

### 5.3.1 Online Toolkit Use Frequency and DSM Participation

Table 46 shows the rates of participation in DR and NEM programs by customer visit frequency. The data show that about 20 percent of the online toolkit users are multi-visit users, and that they are statistically significantly more likely to be enrolled in DR or be enrolled in both NEM and DR versus single-visit customers. Conversely, single-visit customers are statistically significantly more likely to fall into the “Not NEM or DR” group than multi-visit customers. While we cannot say whether multi-use of the tool leads to DR and/or the combination of NEM and DR participation, it is apparent that a good portion of multi-use customers are engaged in these programs, and therefore, the online toolkit is a valuable avenue of support for IDSM-engaged customers.

**Table 46: Online Toolkit Users, DSM Participation by Usage Frequency**

DSM Participation Segment	Complete Population (n=5,000)	Single Visit (n=4,044)	Multiple Visits (n=956)
NEM	21.7%	22.1%	20.2%
DR	36.8%	32.7%	54.3%
NEM and DR	5.2%	4.6%	7.6%
Neither NEM Nor DR	46.6%	49.8%	33.2%

Table 47 below is similar to Table 46, but the data in Table 47 reflect the subset of online toolkit users that are also online audit participants. The data are similar to those shown for the whole population of toolkit users. Here again we observe that multi-visit users have greater likelihood of DR participation than the population of online audit users (59% versus 39%, respectively) and are also more likely to participate in both NEM and DR (11% versus 7%, respectively). Also similar to the patterns in the whole population of users, multi-use is not correlated with higher rates of NEM participation.

**Table 47: Online Audit Users, DSM Participation by Usage Frequency**

DSM Participation Segment	Complete Population	Single Visit	Multiple Visits
	(n=1,635)	(n=1,315)	(n=320)
NEM	30.7%	31.5%	27.5%
DR	39.4%	34.7%	58.8%
NEM and DR	7.0%	6.1%	10.6%
Neither NEM Nor DR	36.9%	39.9%	24.4%

### 5.3.2 Online Toolkit Users' Demographic Data

In this section, we examine demographic data by frequency of tool usage and DSM participation status.

#### *Demographic Data by Toolkit Use Frequency*

As shown in Table 48 below, SDG&E online toolkit users typically live in single-family homes (83%); own their homes (87%); and have gas heat (75%) and central AC (77%). Homes are 2,200 square feet on average, and mean occupancy is 2.3 persons per home.

Unlike other IOU service territories, for SDG&E we observe a correlation between multi-visit users and residency in multi-family homes. Multiple-time visitors are statistically significantly more likely to live in a multi-family home versus single-use customers (20% versus 16%, respectively). Multi-visit users are also more likely to have electric heat than single users (23% versus 15%) and slightly more likely to have central AC (78% versus 76%).

A comparison of demographic characteristics of all toolkit users to those of online audit participants yields little notable difference, so we elect not to present demographic data for this subpopulation.

**Table 48: SDG&E Online Toolkit User Demographic Data, by Use Frequency**

Home Characteristic		Complete Population	Single Visit	Multiple Visits
Category	Type	(n=5,000)	(n=4,044)	(n=956)
House Type	Multi-Family	17.1%	16.3%	19.9%
	Single Family	82.9%	83.7%	80.1%
Ownership	Own	87.3%	87.5%	86.4%
	Rent	12.7%	12.5%	13.6%
Home Age	<= 10	0.0%	0.0%	0.0%
	11-20	27.2%	27.7%	25.4%
	21-30	8.2%	8.2%	8.0%
	31-40	19.7%	19.9%	19.3%
	41-50	23.3%	23.6%	22.2%
	51 +	21.6%	20.7%	25.1%
Heating Fuel	Electricity	18.4%	15.3%	23.0%
	Natural Gas	74.7%	76.9%	71.4%
	Other	6.9%	7.8%	5.6%
Has AC	No	23.5%	24.2%	22.4%
	Yes	76.5%	75.8%	77.6%
Home Size	Mean	2,243	2,246	2,235
Number of Occupants	Mean	3.27	3.26	3.29

While the majority of online toolkit users live in single family dwellings (83%), SDG&E tool users are more likely to live in multi-family homes relative to online tool users in other IOU service territories (17% versus 15% for PG&E and 11% for SCE).

Forty-five percent of toolkit users' homes were built before 1970 (i.e. are more than 40 years old), and 22 percent were built before 1960. This is a somewhat older housing stock than found among SCE tool users, where only 22 percent of homes were built before 1970, but slightly younger than in PG&E's service territory, where almost one-third were built before 1960.

SDG&E customers also show higher rates of electric heat than other service territories (18% versus 12% for PG&E and 10% for SCE). SDG&E has lower AC saturation than SCE (77% versus 98%) but higher than PG&E (31%). Home size (approximately 2,200 square feet on average) is the same as in SCE's service territory, but larger than the average home of a PG&E

online tool user, which is 20 percent smaller at 1,800 square feet. Household size among SDG&E tool users is 3.3 persons per home, on par with SCE (3.4) but smaller than PG&E (3.7).

### *Demographic Data by DSM Participation*

Table 49 below presents demographic data by DSM participation segment. The data yield statistically significant differences between customers who participate in NEM compared versus those that do not participant in either NEM or DR.

However, we find little demographic difference between those that participate in DR when compared with those that participate in NEM.

Similar to what was observed in PG&E and SCE territories, we find NEM customers are more likely than those not enrolled in NEM to have the following characteristics:<sup>44</sup>

- Live in a single family home
- Own their residence
- Have AC
- Live in a larger home
- Have a larger household

Online toolkit users enrolled in NEM are more likely to live in a single family home than those not enrolled is DSM (97% versus 81%). DR participants are similar to those not enrolled in DSM in their propensity to live in single family homes, at 80%, and those enrolled in both NEM and DR mimic those of NEM, at 99 percent.

NEM participants are also more likely to own their own residence (100% versus 84%). Home ownership is equally high among those enrolled in DR and NEM, but DR participants are similar to DSM non-participants (i.e. not enrolled in either) in rates of home ownership (85% versus 84%).

The data also show that those not participating in NEM are more likely to heat their home with electricity (18% versus 14%), and this is particularly true for those enrolled in DR (20%) and least common among those enrolled in DR and NEM (11%). Differences in heating fuel type could be linked to geographic regions or home types, possibly reflecting climate, income levels or trends during the particular decade a region was developed.

NEM customers were more likely to have AC (81% versus 74%). Again, this is even more true for those enrolled in DR and NEM (85% have AC) but only less so for those enrolled in DR (77%). Note that one of the two DR programs offered to residential customers requires central AC for eligibility (AC Cycling), so the higher rate among DR participants is not surprising.

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<sup>44</sup> The differences in these traits between those with NEM and those not enrolled in NEM or DR are statistically significant at the 95 percent confidence level, 5 percent precision.

Home size is largest among those with NEM and DR with average square footage near 2,600 square feet—almost 20 percent larger than homes not enrolled in DSM (~2,200 sq. ft.).

Average household size does not vary substantially across the segments. NEM participants have the largest average household size, at over 3.4 persons per home, while DR participants have the smallest, at 3.2.

**Table 49: SDG&E Online Toolkit Users, Demographic data by IDSM Participation Segment**

Home Characteristic		NEM	DR	NEM and DR	Neither NEM Nor DR
Category	Type	(n=1,085)	(n=1,842)	(n=259)	(n=2,332)
House Type	Multi-Family	3.4%	20.2%	1.3%	19.5%
	Single Family	96.6%	79.8%	98.7%	80.5%
Ownership	Own	99.7%	85.4%	99.6%	84.0%
	Rent	0.3%	14.6%	0.4%	16.0%
Home Age	<= 10	0.0%	0.1%	0.0%	0.0%
	11-20	29.3%	27.0%	35.1%	27.3%
	21-30	8.0%	9.0%	6.1%	7.3%
	31-40	17.2%	21.1%	16.9%	19.6%
	41-50	25.1%	22.1%	20.8%	23.0%
	51 +	20.5%	20.8%	21.2%	22.8%
Heating Fuel	Electricity	14.0%	20.3%	10.9%	18.0%
	Natural Gas	76.4%	73.3%	77.3%	75.5%
	Other	9.6%	6.4%	11.7%	6.4%
Has AC	No	18.6%	22.8%	14.8%	26.2%
	Yes	81.4%	77.2%	85.2%	73.8%
Home Size	Mean	2,549	2,194	2,607	2,174
Number of Occupants	Mean	3.43	3.18	3.42	3.28
<b>Total</b>		<b>1,085</b>	<b>1,842</b>	<b>259</b>	<b>2,332</b>

### 5.3.3 Recommendation Responses

#### *Recommendation Uptake Rates by Toolkit Usage Frequency and DSM Participation*

This section examines rates of audit recommendation implementation among online audit participants. As discussed earlier, a subset on online toolkit users completed the audit portion and received a list of recommendations. Table 51 presents the percentage of certain customer segments that said that they had “done” a certain recommendation, out of the total number of people that received that recommendation.

The recommendations are rolled into groups, and the number of recommendations in each group is presented next to the name of the group in the table. Overall, 1,635 of the 5,000 users received tips. The remaining respondents were able to fill out some or all of the demographic questions as shown in the preceding sections.

Table 50 shows the five recommendations with the highest uptake rates for the whole population of participants, subpopulations related to DSM participation, and frequency of tool-use.

Refrigeration and HVAC equipment are the top two overall recommendations in rates of uptake, at 43 percent each, and are highest among the NEM/DR participant segments, where nearly two-thirds of these recommendations were implemented. Single-visit customers and those not participating in NEM/DR are more likely to have implemented a pool-related recommendation than other segments—approximately 40 percent of pool recommendations were implemented in these segments versus an average of 25 percent in other segments.

**Table 50: Top Five Recommendation Uptake Rates by IDSM Participation Segments**

All (Total Population)	NEM	DR	NEM and DR	Neither NEM nor DR	Single Visit	Multiple Visits
Refrigeration Equip (43%)	Refrigeration Equip (67%)	HVAC Equipment (51%)	Refrigeration Equip (67%)	Pool (43%)	HVAC Equipment (39%)	Refrigeration Equip (67%)
HVAC Equipment (43%)	HVAC Equipment (43%)	Refrigeration Equip (50%)	HVAC Maintenance /Other (63%)	HVAC Equipment (34%)	Pool (38%)	HVAC (57%)
Pool (35%)	Efficient Water Heater (41%)	Behavior (41%)	Refrigeration Maintenance /Other (54%)	Refrigeration Equip (33%)	Appliances (37%)	Refrigeration Maintenance /Other (51%)
Refrigeration Maintenance /Other (34%)	Appliances (38%)	Efficient Lighting (41%)	HVAC Equipment (50%)	Refrigeration Maintenance /Other (30%)	Behavior (30%)	Behavior (51%)
Behavior (34%)	HVAC Maintenance /Other (37%)	Refrigeration Maintenance /Other (40%)	Efficient Water Heater (46%)	Behavior (30%)	Efficient Lighting (30%)	Efficient Water Heater (47%)

Table 51 and Table 52 below present recommendation uptake rates for the population of online toolkit users, as well as segments related to DSM participation and tool-use frequency. Overall, the data reflects 7,059 recommendations, of which 2,355—or 33 percent—were implemented. The highest rates of implementation across the segments shown are within the multi-visit segment, where nearly half (48%) of recommendations were implemented.

Segments that include DR participants are close runners-up; the NEM/DR segment implementing 43 percent of recommendations and DR participants implementing 40 percent. NEM participants mimic the population at large, with a 33 percent overall implementation rate. Those not enrolled in DR or NEM have the lowest overall rate, at 28 percent, though it is not substantially lower.

Behavior recommendations are by far the most prevalent type of recommendation, representing 57 percent of all recommendations, and they are implemented at a rate of 34 percent overall. The highest rate of behavior recommendation implementation is within the multi-visit segment, at 51 percent. DR participants also have high implementation rates for behavior recommendations; the DR/NEM segment has a 44 uptake rate, and DR overall is 40 percent. NEM participant behavior recommendation uptake rate (33%) are similar to single-visit customers (30%) and the overall population (34%) in their rates of behavior recommendation implementation.

The second most common recommendation type is efficient lighting, representing 18 percent of all recommendations and implemented by one-third of recommendation recipients. The highest rate of efficient lighting implementation is among multi-use customers (46%) and DR participants (41%).

Although the data available here are inconclusive, they do suggest that participants returning to the tool multiple times are more likely to implement recommendations. Multi-use customers make up 320 of the total sample of audit participants (1,635)—or 20 percent. Continuing to encourage and support multi-visit use of the tool may correspond to higher rates of recommendation uptake. Multi-visit users were expansive in their recommendation preferences, showing statistically significantly higher rates of implementation across a range of measure types, when compared to single-visit customers:

- Behavior
- HVAC equipment
- Efficient lighting
- Solar water heat
- Refrigeration maintenance/other
- Efficient water heater

DR participants also have a notably higher rate of recommendation implementation and show a penchant for peak-load reducing efficiency upgrades, including HVAC, refrigeration and lighting.

**Table 51: Recommendation Uptake Rates by Tool Use Frequency**

	All (Total Population)		Single Visit		Multiple Visits	
	%	n	%	n	%	n
Appliances (4)	32.4%	37	36.7%	30	14.3%	7
Behavior (32)	34.2%	4,042	29.9%	3,187	50.5%	855
Envelope (5)	20.4%	216	18.5%	173	27.9%	43
HVAC Equipment (10)	42.6%	235	38.7%	186	57.1%	49
HVAC Maintenance/Other (6)	27.6%	417	26.0%	335	34.1%	82
Efficient Lighting (3)	33.5%	1,297	30.4%	1,050	46.6%	247
Solar Water Heat (1)	4.2%	24	0.0%	21	33.3%	3
Pool (3)	35.3%	17	38.5%	13	25.0%	4
Refrigeration Equip (2)	42.9%	7	25.0%	4	66.7%	3
Refrigeration Maintenance/Other (2)	33.8%	340	29.3%	270	51.4%	70
Efficient Water Heater (9)	33.3%	427	29.2%	329	46.9%	98

**Table 52: Recommendation Uptake Rates by DSM Participation Segment**

	All (Total Population)		NEM		DR		NEM and DR		Neither NEM nor DR	
	%	n	%	n	%	n	%	n	%	n
Appliances (4)	32.4%	37	38.5%	13	37.5%	16	33.3%	3	18.2%	11
Behavior (32)	34.2%	4,042	32.8%	1,212	40.9%	1,635	43.6%	328	30.3%	1,523
Envelope (5)	20.4%	216	18.5%	65	24.4%	78	27.3%	11	19.0%	84
HVAC Equipment (10)	42.6%	235	43.3%	67	51.1%	92	50.0%	14	34.4%	90
HVAC Maintenance/Other (6)	27.6%	417	37.2%	121	34.8%	181	63.3%	30	17.9%	145
Efficient Lighting (3)	33.5%	1,297	30.7%	365	40.6%	502	26.3%	76	27.3%	506
Solar Water Heat (1)	4.2%	24	0.0%	9	0.0%	8	0.0%	2	11.1%	9
Pool (3)	35.3%	17	20.0%	5	33.3%	6	0.0%	1	42.9%	7
Refrigeration Equip (2)	42.9%	7	66.7%	3	50.0%	4	66.7%	3	33.3%	3
Refrigeration Maintenance/Other (2)	33.8%	340	33.7%	101	40.4%	151	53.6%	28	30.2%	116
Efficient Water Heater (9)	33.3%	427	40.8%	103	38.8%	188	46.4%	28	24.4%	164



## 6. Patterns of IDSM Uptake in the Small Commercial Sector: An Analysis of Existing Data

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In this section, we examine patterns of integrated demand side management (IDSM) uptake in the small commercial sector, using data collected as part of the 2010-2012 Commercial Saturation Survey (CSS) and the Commercial Market Share Tracking Study (CMST). As part of this study, participation in demand response (DR), distributed generation (DG) and energy efficiency programs was merged with the full non-residential IOU customer frame and related billing histories. This exercise provided for the identification of sites that had participated in programs covering multiple demand side management (DSM) strategies. Furthermore, a telephone survey was done as part of the study, and a number of questions were posed to respondents related to attitudes, awareness and knowledge of IDSM-related issues. Although results from these data assembly and data collection exercises were reported via the CSS and CMST studies, we take another look at these data here with an eye towards highlighting distinctive features of small commercial IDSM uptake. The intent is to provide the audience with a profile of the basic characteristics of IDSM adoptions from which we can build an informed—and more detailed study—of small commercial customers in the future.

For the purposes of reporting and analysis, the CSS/CMST study team divided the sample frame into size categories based primarily on annual 2010 kWh consumption. The non-residential frame initially was assembled with 2010 billing and customer information system (CIS) data submitted by the IOUs. These data were updated in 2011 using refreshed investor-owned utility (IOU) submissions. Due to natural turnover, some establishments present in the 2010 data were not present in 2011, and some new sites were added in 2011 that were not present in 2010. The annual consumption data used to categorize establishments by kWh-consumption is based on 2010 bills wherever possible. If 2010 bills were unavailable, 2011 bills were used. Consumption-based size categories are defined as follows:

- Large Sites: Yearly kWh > 1,750,000
- Medium Sites: 300,000 < yearly kWh ≤ 1,750,000
- Small Sites: 40,000 < yearly kWh ≤ 300,000
- Very Small Sites: Yearly kWh ≤ 40,000
- Unknown: Sites where billing data were unavailable

### 6.1 Energy Characteristics of Commercial/Industrial Establishments by Size

It is generally well-understood that small commercial customers face higher barriers to DSM measure adoption than larger commercial customers. These are born out in the CSS/CMST survey data. Smaller customers tend to:

- Be more likely to lease facilities;
- Have shorter termed leases (among those leasing);
- Have longer average duration between facility renovation projects;
- Have shorter average tenure at a location (i.e. are more likely to have moved recently);
- Have a less secure business outlook, both retrospectively and prospectively;
- Be more likely to rate energy efficiency as only 'somewhat' or 'not at all important';
- Be less likely to reference environmental responsibility in their marketing materials;
- Be less likely to have
  - a long term energy plan;
  - an energy policy governing procurement of energy-consuming equipment; and/or
  - an energy manager responsible for containing energy costs.
- Be less likely to:
  - have installed energy efficiency equipment through an IOU program;
  - participate in a DR program; and/or
  - have DG equipment on-site.
- Be less likely to have had an integrated audit;
- Be less likely to be aware of building benchmarking; and
- Be less likely to be aware or have installed both CFLs and LED lighting.

The supporting data for each of these statements is shown in Table 53 below. The table shows the percentage of respondents within each size category that fit the Survey Response Distribution shown in the left-most column.

**Table 53: Commercial Establishment Energy Characteristics by Establishment Size, Based on CSS/CMST Telephone Survey**

<b>Survey Response Distribution</b>	<b>Very Small</b>	<b>Small</b>	<b>Medium</b>	<b>Large</b>
Percent Lease	54% (n=2605)	48% (n=2170)	36% (n=1708)	31% (n=399)
Percent of leasers with less than 3 year lease	36% (n=1466)	18% (n=988)	11% (n=535)	10% (n=108)
Percent remodeled within 5 years	23% (n=2605)	29% (n=2222)	33% (n=2117)	39% (n=594)
Moved within past 3 years	19% (n=2605)	13% (n=2222)	8% (n=2117)	7% (n=594)
Have Adequate or Poor Business Outlook – past 3 years*	27% (n=2605)	21% (n=2170)	14% (n=1708)	16% (n=399)
Have Adequate or Poor Business Outlook – next 3 years*	19% (n=2605)	14% (n=2170)	10% (n=1708)	6% (n=399)
Percent ranking EE as somewhat or not-at-all important**	49% (n=2605)	43% (n=2222)	32% (n=2230)	23% (n=660)
Highlight environmental issues in marketing materials?	23% (n=2,311)	27% (n=2,065)	35% (n=2,131)	43% (n=643)
Long Term Energy Plan	22% (n=2,605)	30% (n=2,170)	49% (n=1,708)	71% (n=399)
Energy Policy	25% (n=2,605)	32% (n=2,170)	43% (n=1,708)	57% (n=399)
Active Energy Management***	65% (n=2,605)	51% (n=2,169)	33% (n=1,708)	17% (n=399)
Installed EE measures through a program****	14% (n=2,605)	23% (n=2,169)	33% (n=1,708)	51% (n=399)
Aware of programs or resources designed to reduce energy use/costs	37% (n=2,605)	44% (n=2,169)	59% (n=1,708)	77% (n=399)
Participate in DR	7% (n=2,605)	13% (n=2,220)	25% (n=2,230)	46% (n=660)
Have DG equipment on-site	3% (n=2,605)	4% (n=2,221)	8% (n=2,167)	13% (n=624)
Had an Integrated	8% (n=2,605)	16% (n=2220)	34% (n=2,230)	53% (n=660)

Survey Response Distribution	Very Small	Small	Medium	Large
Audit				
Aware of Building Benchmarking	7% (n=2,605)	12% (n=2,168)	24% (n=1,708)	46% (n=399)
Aware of CFLs	65% (n=2,558)	64% (n=2,183)	75% (n=2,064)	86% (n=576)
Installed CFLs	46% (n=2,269)	50% (n=1,937)	54% (n=1,934)	61% (n=568)
Aware of LED	84% (n=922)	90% (n=965)	94% (n=1,118)	99% (n=230)
Installed LED	9% (n=799)	17% (n=847)	23% (n=704)	42% (n=60)

\*Other choices were Excellent, Good, Fair, Refused, Don't Know.

\*\*Other choices were: essential to your business, and very important.

\*\*\*Assign management of energy costs to an individual or group of staff, or outside contractor

\*\*\*\*Self-reported data

## 6.2 The Small Commercial Population and IDSM Adoptions

This section presents a characterization of IDSM adoptions within the commercial/industrial population frame by size. As detailed above, the data used in this analysis were assembled as part of the 2010-2012 CSS/CMST study and reflect IOU customer populations circa 2010.

Figure 21 below shows the distribution of the 2010 commercial/industrial population by establishment size.<sup>45</sup> The figure displays the percentage of total (aggregate) annual kWh consumption within each size category, as well as the percentage of total establishments and the mean annual kWh consumption per establishment. Establishments that are classified as large comprise nearly half of total annual consumption but only about 1 percent of total establishments. In contrast, very small establishments make up just 7 percent of consumption, but about 70 percent of total establishments. Small and very small establishments together make up nearly 90 percent of all commercial/industrial establishments, but just 28 percent of consumption.

<sup>45</sup> Consumption-based size categories are defined as follows:

- Large Sites: Yearly kWh > 1,750,000
- Medium Sites: 300,000 < yearly kWh ≤ 1,750,000
- Small Sites: 40,000 < yearly kWh ≤ 300,000
- Very Small Sites: Yearly kWh ≤ 40,000
- Unknown: Sites where billing data were unavailable

**Figure 21: Commercial/Industrial Frame Distribution by Size Category: Annual kWh Consumption, Number of Establishments and Mean Annual kWh Consumption**

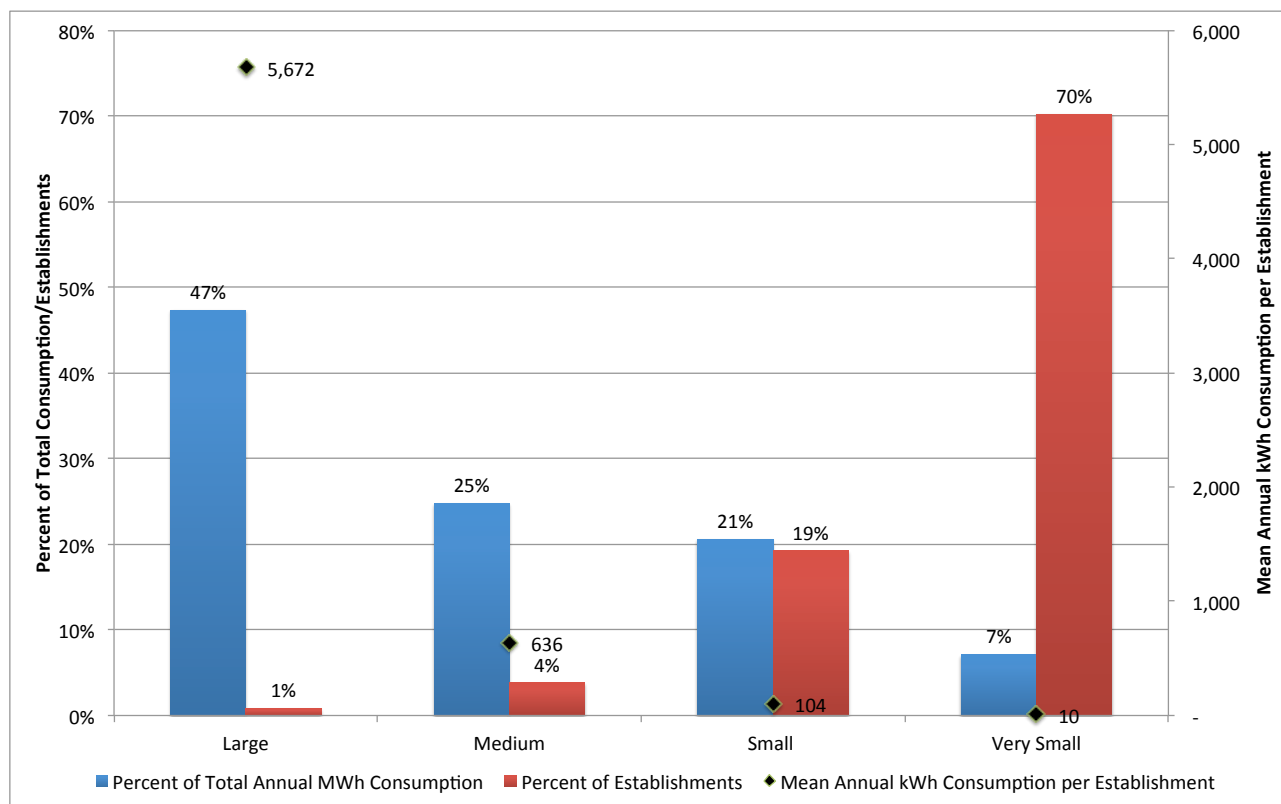
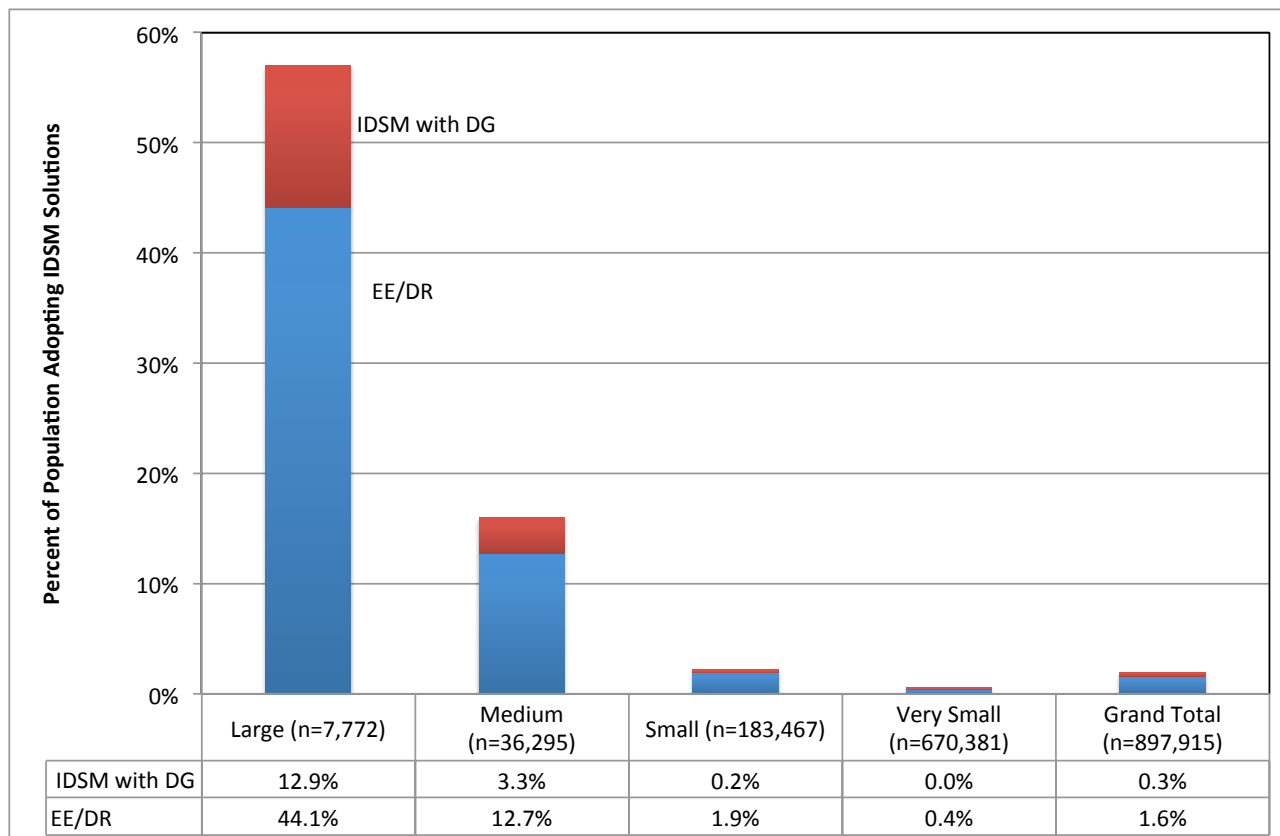


Figure 22 below shows the percentage of total establishments that adopted multi-DSM solutions within the 2009 to 2012 period—that is, establishments that participated in IOU programs including more than one of the following DSM strategies: energy efficiency, DR and DG. The data show that the great majority of establishments adopting multiple DSM strategies adopted energy efficiency and DR but not DG. Adoptions of both energy efficiency and DR have size-specific penetration rates ranging from 44 percent (for large establishments) to 0.4 percent (for very small establishments). Adoptions of DSM combinations that include DG are much less common; they range from 13 percent (for large establishments) to near 0 percent for very small establishments.

**Figure 22: IDSM Adoptions by Establishment Size and Presence of Distributed Generation (DG)**



As illustrated in the previous figures, there are substantially more small/very small establishments than there are medium and large establishments. In fact, for every one large establishment there are more than 86 very small establishments in the population. Similarly, mean kWh consumption values vary by three orders of magnitude when comparing consumption of large establishment to very small establishments. For these reasons, in Figure 22 above, it is somewhat difficult to compare the distribution of IDSM adoptions by type across the size categories. Figure 23 below provides a normalized comparison of the relative propensity of establishments to adopt IDSM solutions with DG for each size category. That is, the figure shows the ratio of the number of establishments adopting IDSM solutions with DG to the total number of establishments adopting IDSM solutions of any kind. The data show that even when normalized to the total number of adoptions within each size category, very small establishments have a much lower propensity to adopt IDSM solutions that include DG. Just 6 percent of the IDSM adoptions among very small establishments include DG, versus 21 percent of medium establishments and 23 percent of large establishments.

**Figure 23: Percent of IDSM Adoptions with Distributed Generation**

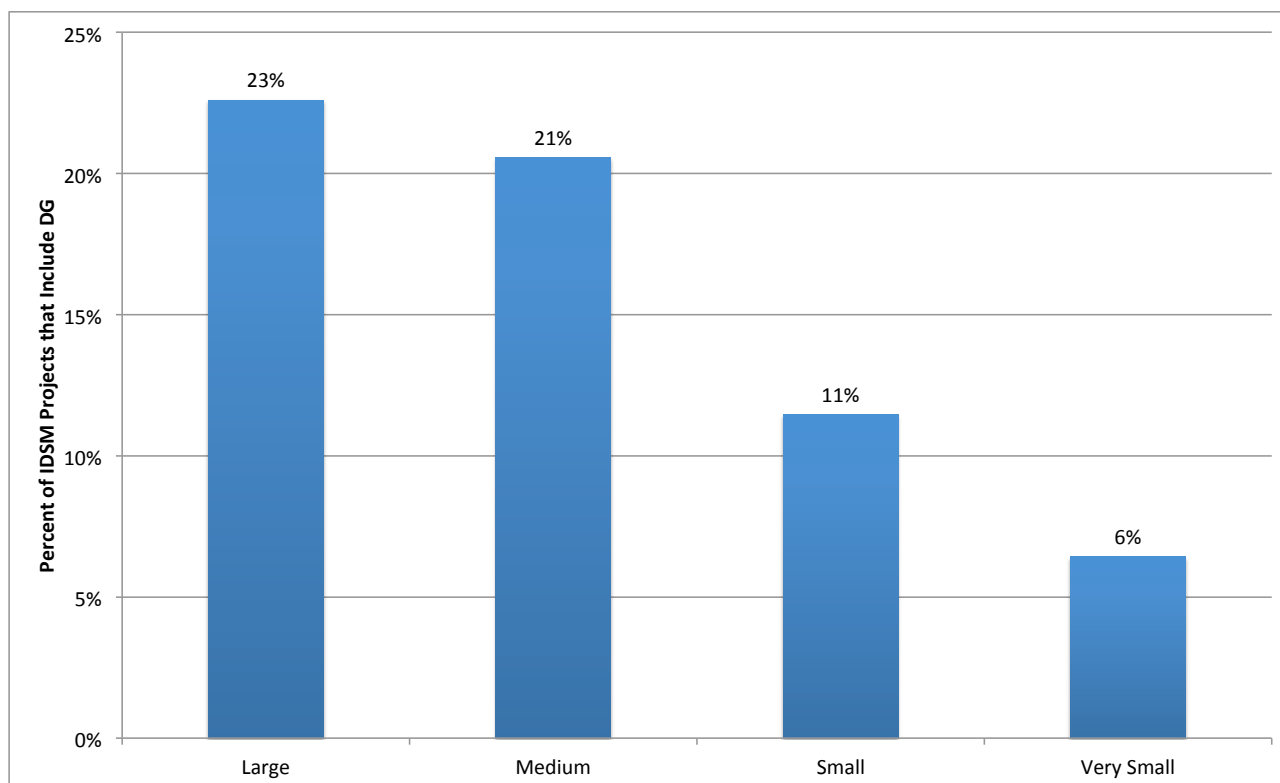


Figure 24 below delves further into the small establishment category, to show the rate of small commercial IDSM adoptions by business type, as well as the portion of those adoptions that included DG. The figure demonstrates that within the small commercial category, schools stand out as having by far the greatest relative frequency of IDSM adoptions (11.3%), surpassing the second highest rate (food/liquor, 5.5%) by more than two-fold. Schools also have the greatest uptake rate for of IDSM solutions that include DG—at 3.5 percent. This rate surpasses all other business types by a large margin, with the second highest uptake rate at just 0.3 percent for warehouses.

**Figure 24: Small Commercial Establishments: Penetration of IDSM Solutions by Business Type and Presence of Distributed Generation**

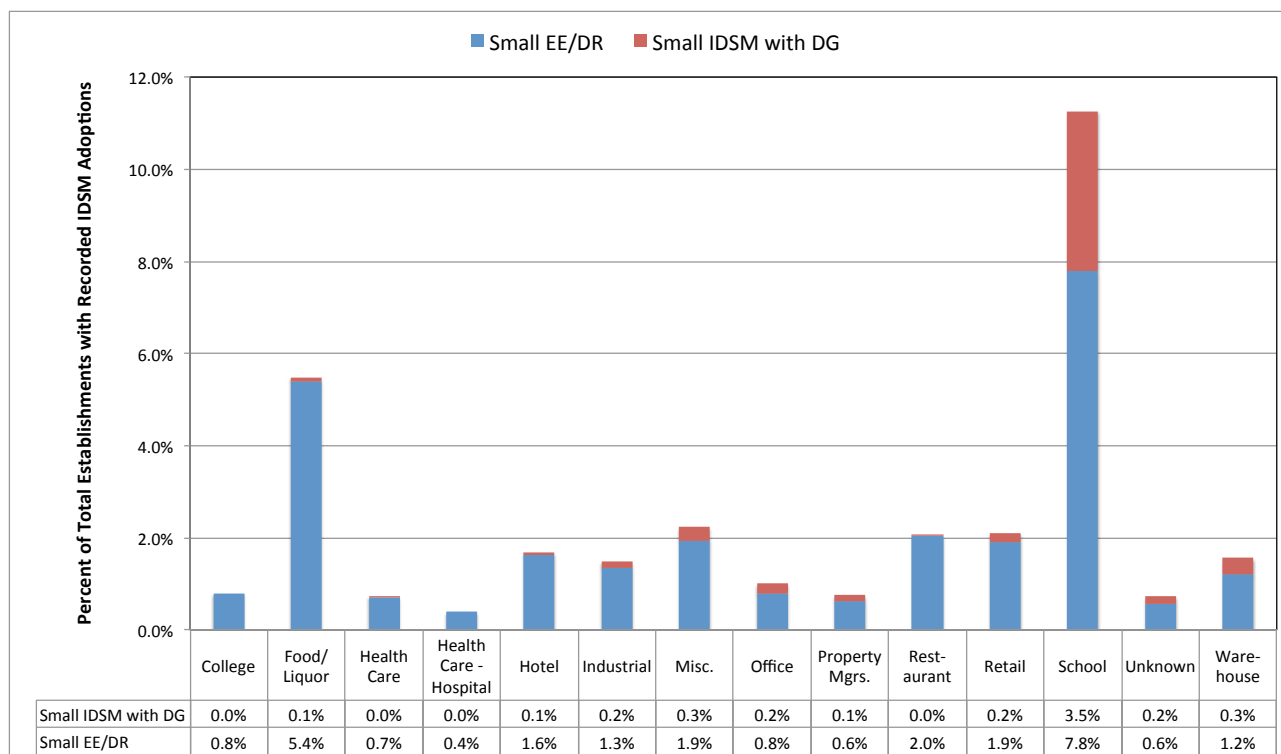


Figure 25 below is designed to highlight the relative over- and under- participation of the various business types in IDSM adoptions. The figure displays the difference between the percentage of total establishments that are classified into each business type, and the percentage of total IDSM adoptions that fall within each business type. For example, schools represent only about 3 percent of the small commercial establishments but nearly 36 percent of the total IDSM adoptions that include DG. The “IDSM with DG” category is the difference of these two, or 34 percent. Due to the dominance of schools in contributing to small commercial IDSM adoptions that include DG, only two other business types exceed a proportional rate of IDSM with DG adoption (warehouse and misc.). Two other categories meet a proportional rate of IDSM adoptions with DG (college and healthcare/hospital). All other business types fall short of a proportional share of IDSM adoptions—with restaurants standing out with a 20 percent difference between the percentage of establishments and the percentage of adoptions. The distribution of adoptions including energy efficiency and DR has a markedly different distribution. For these adoptions, food/liquor has the highest relative uptake rate (outperforming proportional uptake by 14 percentage points). Schools again outperform a proportional rate, but by only 8 percentage points. The lowest performer in this category is office, which misses a proportional uptake rate by 7 percentage points.



**Figure 25: Small Commercial Establishments: IDSM Adoptions by Business Type, Comparison of Establishments to Adoptions**

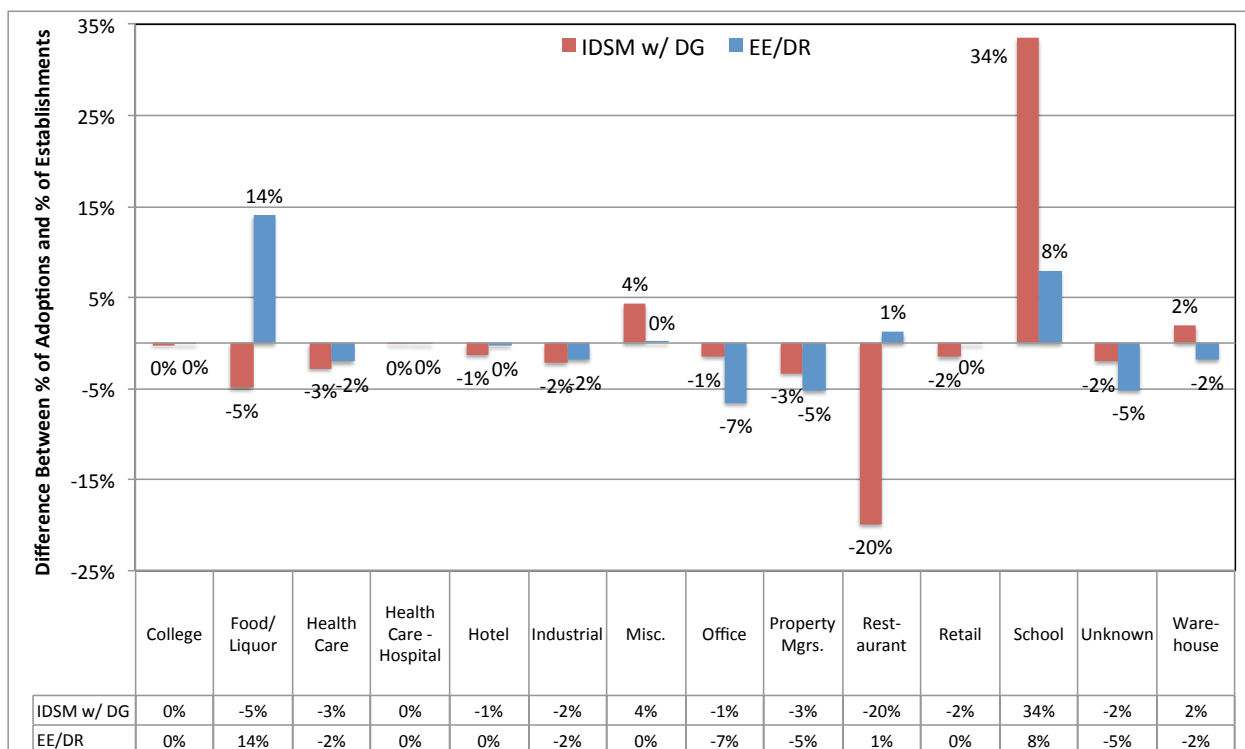


Figure 26 below shows the percentage of very small commercial establishments within each business type that adopted IDSM solutions, and the proportion of those adoptions that included DG. Unlike the small commercial category, very small establishments are more evenly distributed across business types, with the leaders (college, food/liquor, healthcare, restaurant, retail and school) all fairly comparable, ranging between about 0.8 and 1 percent. However, uptake of IDSM that includes DG is disproportionately concentrated in colleges (0.4%) and schools (0.2%).

**Figure 26: Very Small Commercial Establishments: Penetration of IDSM Solutions by Business Type and Presence of Distributed Generation**

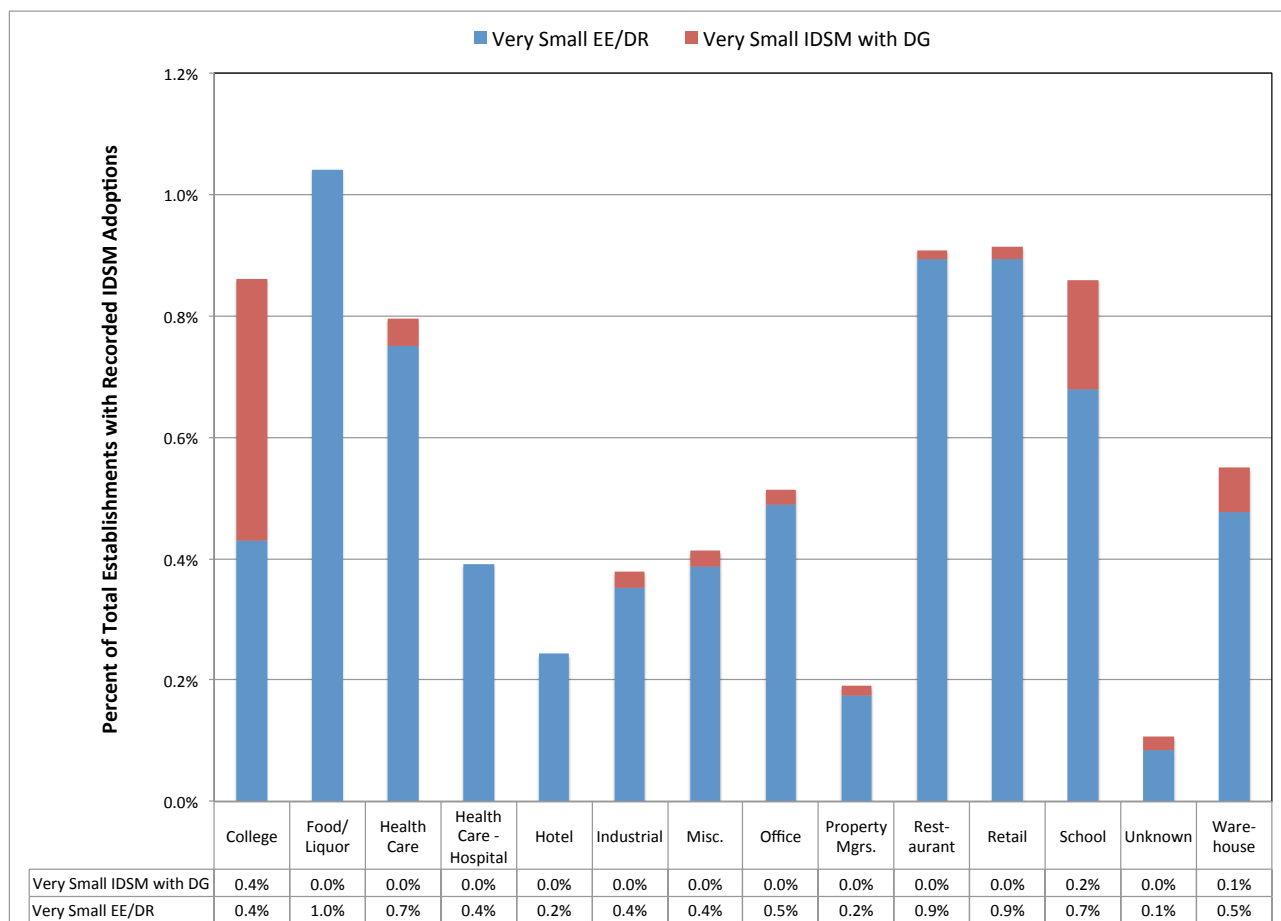
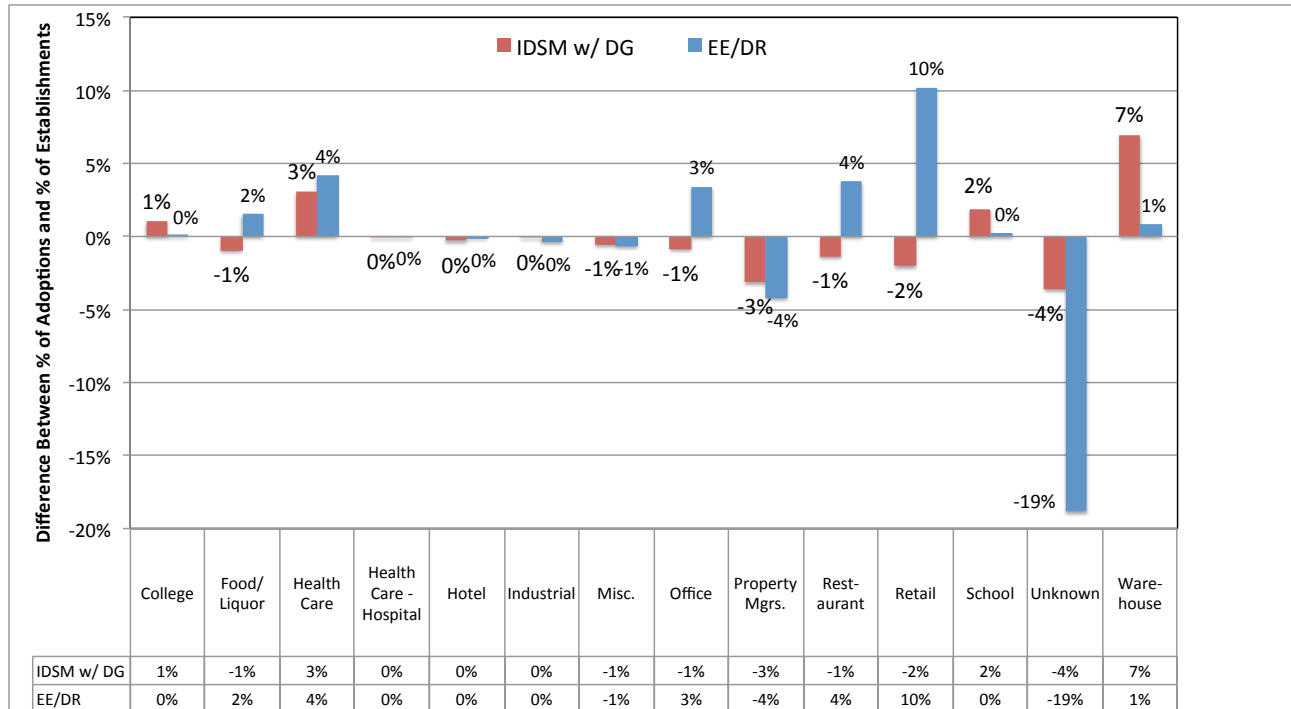


Figure 27 below is designed to highlight the relative over- and under- participation of the various very small business types in IDSM adoptions. The figure displays the difference between the percentage of total establishments that are classified into each business type and the percentage of total IDSM adoptions that fall within each business type. The figure shows that warehouses (+7%), schools (+2%), healthcare (+3%) and colleges (+1%) outperform a proportional rate of IDSM adoption. Property managers and retail establishments underperform a proportional rate by -3 and -2 percent, respectively. The 'unknown' business type also underperforms a proportional rate, by 4 percent.

**Figure 27: Very Small Commercial Establishments: IDSM Adoptions by Business Type, Comparison of Establishments to Adoptions**



## Appendix A: Customer Telephone Survey Instrument

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Appendix\_A\_SurveyInstrument.docx

## Appendix B: In-Depth Interview Guide

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IDSMS\_RoadmapResearch\_InterviewGuide\_Cus

## Appendix C: Survey Results Tables

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Appendix C Survey Banner  
Tables.xlsx