EVERGREEN ECONOMICS

Integrated Demand Side Management Market Characterization Study

Residential and Small Commercial Markets

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Prepared for SDG&E

Study Abstract

The Integrated Demand Side Management (IDSM) statewide program is a strategic planning program implemented by all four of California's investor-owned utilities (IOUs). This program ensures that the IOUs work together to pool their resources and share their lessons learned to develop and promote programs and strategies that seek to provide integrated demand side energy solutions to customers in all market segments (residential, commercial, agriculture, and industrial). As a statewide program, the IDSM Program has a dedicated budget and specific objectives and goals; the IOUs must report on the progress of these activities to the Energy Division of the California Public Utilities Commission on a quarterly basis.

For the evaluation, measurement and verification efforts associated with the 2013–2014 program cycle, specific research—including this study—was charted to build on the efforts of previous studies. The IDSM Market Characterization Study for Small Commercial and Residential Segments is a market assessment that documents customer preferences, behavior patterns and decision-making with respect to IDSM. It characterizes key features of both supply and demand for IDSM in the open (non-program) marketplace. The findings herein provide foundational knowledge from which effective program designs and enhanced IDSM marketing efforts may be constructed. This study was managed by SDG&E and implemented by Evergreen Economics.

Table of Contents

1. Executive Summary

1.1 Introduction and Background

The Integrated Demand Side Management (IDSM) statewide program is a strategic planning program implemented by all four California investor-owned utilities (IOUs). Through this program, IDSM provides benefits to the customer through the delivery of the optimal integrated solutions to customers independently of how the programs are organized and administered on the IOU side. This report presents the findings of an assessment of the residential and small commercial markets for IDSM solutions. The purpose of this study is to improve understanding of customer preferences and behaviors in the markets for integrated solutions, such that DSM resources can be targeted most efficiently to maximize their impact. This research is comprised of the following data collection and analysis tasks:

1. ***Literature Product and Marketing Reviews.*** We reviewed existing research and evaluation to aggregate and assess current research related to IDSM solutions in the small commercial and residential markets. This effort was supplemented with a thorough review of IDSM products and services to gather an understanding of market trends and perceptions. In particular, we focused on product features and marketing messages designed to attract residential and small commercial customers to the IDSM solutions in the market today.
2. ***Data analysis.*** We reviewed existing and available databases from the California Public Utilities Commission (CPUC) and the IOUs that reflect customer IDSM interest and adoptions, and help to distinguish the characteristics and unique preferences of IDSM adopters.
3. ***In-depth interviews*** We conducted in-depth interviews with IOU staff working to promote IDSM solutions in the small commercial and residential markets. We interviewed IOU staff that design and deploy programmatic and marketing strategies to increase knowledge and uptake of IDSM. In addition, we interviewed numerous private sector vendors working in IDSM markets today, selling a variety of IDSM-related technologies and services. These market actors provided valuable insight into the markets for their IDSM products and the preferences of their customer base. Finally, we identified and interviewed representatives from trade organizations and institutions that represent swaths of IDSM vendors or reflect aggregate consumer interests in IDSM.

1.2 Key Findings

1.2.1 Summary of Customer IDSM Needs and Wants

Results of our research indicate that customer needs and wants with respect to IDSM solutions are oriented toward the personal; monetary savings, long-term energy savings, convenience, ease-of-use and low risk with respect to return-on-investment top the list of

priorities. There are also clear consumer preferences for receiving IDSM education and information. Consumers and small business owners demand simple information and when initiating an IDSM inquiry themselves, consumers want answers quickly. Customers are more likely to act if there is a clear benefit and only simple tasks required to obtain that benefit. Furthermore, customer behavior is more likely to be impacted by a high degree of personalization in messaging.

We also identified some emerging IDSM-related trends drawing from advancements in technology and communications. In particular, there is growing interest in the access to and use of real-time energy consumption data that is IDSM-enabling, and a growing number of products and services built around web-connected building monitoring and controls.

1.2.1.1 Customer Preferences Versus IDSM Characteristics

The core value of IDSM solutions is in allowing for customer optimization over all available energy management opportunities, which demands an understanding of the ways performance and costs change with various bundles of DSM options. However, we found the markets naturally gravitate towards single-DSM options and even measure specialization within a DSM strategy area. This tendency is observed from both a market demand and supply perspective, with consumers and suppliers alike focused on a rather narrow field of energy management expertise. The natural inclination of the market is not to be integrated—instead it tends towards fragmentation or compartmentalization into areas of interest or long-developed expertise. The skills required to successfully navigate markets for Distributed Generation (DG), Energy Efficiency (EE) and Demand Response (DR) are highly specialized and complex. There has been a lot of time spent honing consumer awareness and supply-side skills, so it will take a lot of time and concerted effort to develop market capabilities to build supply and demand for IDSM solutions. It will require a lot of consumer and contractor education, but perhaps more importantly, clear and persuasive motivation.

We did find some exceptions to this natural tendency toward a narrow DSM strategy focus—such as in the building monitoring and control technology and in building architecture and design for major remodels or new construction. However, even in these areas there are missing elements that fall short of a fully integrated approach. Issues surrounding time-of-use and load-shifting/demand response are not well represented in the efficient new construction market. Some building monitoring and control software has capabilities to consider DG, EE and DR, but mass-market versions accessible by residential and small commercial customers rely largely on user choice and behavior to achieve energy management gains of any sort. In order to pull this naturally segmented market together into an IDSM market the best option may be to rely on government and public policy to create enough of a motivation to generate a significant market response. The IOUs are on the frontlines in the deployment of policy-driven IDSM efforts, and take primary responsibility for educating customers about DSM options and synergies across measures and strategies.

Our research indicates there is an underlying incompatibility of customer preferences and IDSM messaging goals. Customer preferences lean toward the simple and easy, while IDSM solutions tend toward the complex. To bridge this gap the IOUs have adopted a potentially

successful strategy in what they term "Continuous Engagement". If successful, this approach meets the needs and wants of the mass market, while working consistently toward providing an IDSM education to customers to enable them to create an integrated energy plan and strategy. Furthermore, it establishes the IOUs as information and support resources, where customers can find references and information easily. A similar approach to DSM in the large commercial and industrial sector—termed Continuous Energy Improvement—can be found across many regions, utilities and agencies, including California, the Northwest Energy Efficiency Alliance, and Efficiency Vermont. Continuous Energy Improvement establishes a working relationship with customers to promote energy conservation and management solutions.

1.2.1.2 Need States

As the IOUs strive to leverage the short span of attention that residential and small commercial customers typically have for IDSM-related material, they have learned that customer receptivity to IDSM information is highly dependent on customer "need states". In fact, interviewees report the single biggest determinant of receptivity to information is the customers need state—a term that refers to events or triggers that change an individual's receptivity and desire for IDSM information. These points in time are also sometimes referred to as "market entry points". Successfully targeting and messaging customers that are in a highly receptive need state—or market entry point—will drive the impact of IDSM information.

1.2.1.3 Technology: Energy Management Systems (EMS), Smart Thermostats and Home Area Network (HAN), In-Home Displays

One of the primary drivers in the IDSM market arises from technology developments that leverage advanced connectivity and communications, including the EMS, smart thermostats and HAN/in-home displays. Markets for these products are growing and evolving rapidly but face some very real hurdles.

There remains strong IDSM potential in building monitoring and controls in both the commercial and residential sector, though it is difficult to know how the markets and products will evolve and whether they will capture the full energy management potential. The Achilles heel in both sectors with respect to capturing energy savings is in the inherent reliance on how the products are used by the consumer, especially given that they are more likely to be motivated by things other than energy efficiency (e.g., increasing comfort or convenience).

Vendors of commercial and residential monitoring and controls equipment are facing business challenges related to low 'barriers-to-entry' for the industry. Well-established companies compete with a host of new competitors offering a wide variety of unique and innovative products. This dynamic has created not only business uncertainty for vendors, but also a confusing array of products for buyers to consider, and greater purchase risk associated with the proprietary nature of these systems and longevity of the vendor. These issues are compounded by a lack of communications protocol standards that limits interoperability.

There are reasons to be optimistic about the commercial EMS market. Hardware and software advances have led to many cost effective products available for the small commercial sector, opening up a large new customer base. The products offer attractive non-energy benefits as well, with behavioral monitoring, and easy-to-use automation and security features. The outlook for monitoring and controls equipment in the residential sector is not as bright. The products and services on the market today battle a number of counter-forces, including consumer indifference to potential savings, high perceived first costs, and equipment complexity, to name a few.

1.2.1.4 Policy: Building Codes and Time-of-Use (TOU) Rates

Among the leading market drivers for IDSM are changes in public policy that affect energy costs and building codes. California has set aggressive goals for building new Zero Net Energy (ZNE) homes and commercial buildings. In a ZNE building, the annual energy consumption is equal to its annual production of renewable energy. The ZNE approach mandates integrated solutions and so has been one of the major drivers of IDSM solutions and integrated new construction designs in the market. The ZNE building design is a particularly strong driver for EE and DG. It is also a driver for DR, but much less so. This is challenging because greater saturation of DG increases the value of effective DR, which has the ability to offset variability in renewable production. Furthermore, with more EE present, DR can require greater numbers of participants since per unit consumption on peak will be generally lower.

The mandatory transition to time-of-use rates in the commercial sector is a major development for DR and is also viewed by IOU staff as an important IDSM driver and marketing opportunity. All commercial accounts will default or have the option to go with time-of-use rates over the next couple of years. This statewide transition of small commercial customers to peak day pricing has created a platform for the IOUs to approach customers about their rates and ways to save energy and money. This is particularly useful for the small commercial segment because historically it has been a relatively non-engaged segment, facing greater rates of split incentives, cash flow restrictions and short planning horizons.

1.2.1.5 Challenges of the Solar Photovoltaic (PV) Market

In California, half of all solar capacity installed to-date was added in 2013, including 607,689 California homes that installed a PV system. The relationship of Solar PV to utilities and regulatory systems is evolving and rapidly taking shape, as are embedded issues related to EE, DR, storage and the smart grid. The pace of change creates a challenging environment to create and implement policies supporting optimized integration.

The importance of the loading order (i.e. minimized DG system size) and the critical role of load shifting and DR in the successful integration of renewables is not at the front and center of the agenda of the private sector companies distributing PV systems to the residential and small commercial sectors. This is particularly limiting with regard to the institution of policies and processes to minimize system sizing and implement cost-effective energy efficiency opportunities at each site prior to DG system installation.

The solar industry has taken off more rapidly than markets for either DR or EE for a number of reasons. Renewables have a number of distinct advantages in their ability to appeal to customers relative to EE and DR. First, solar has the benefit of being tangible and not suffering from the elusive and difficult-to-measure nature of EE and DR (i.e. the elusive 'negawatt'). Its physical nature and prominent display on buildings provides a cultural and social value to the owner. Tax incentives, no-money-down options, guaranteed production levels and aggressive marketing tactics also contribute to the growing success of the solar industry.

1.3 Recommendations

Based on the findings discussed above, we recommend the IOUs and the CPUC consider the following to help better understand and promote IDSM in the small commercial and residential sectors:

- We recommend that the IOUs and the CPUC consider utilizing existing and/or future research to support efforts to establish continuous engagement with customers via online tools and complementary outreach efforts. More specifically, consideration should be given to analyzing tracking data and gathering feedback from customers regarding:

    - The frequency and motivations behind their use of IOU online tools, with a focus on identifying drivers for repeated exposures;
    - The success and accuracy of personalized features—including whether business types and household features reflected in the tools are accurate, what types of information are most important to the perceived degree of personalization, and the role of personalization in driving repeated use of the tools;
    - The role of energy consumption feedback on a customer's degree of continuous engagement. This could include presence of in-home displays, Home Energy Reports, and other Advanced Metering Infrastructure (AMI)-enabled and/or Green Button applications.
    - Whether information is clear and successful in communicating IDSM solutions, with a focus on measuring the educational success of the tools, particularly for frequent users;
    - What the primary motivations are for creating tool-based long-term energy plans and updating them; and
    - Feedback regarding the usability of the tools for customers seeking both basic and detailed IDSM information.

- We recommend the IOUs and the CPUC consider investigating the power of various events or circumstances in predicting highly receptive IDSM need states. The events or circumstances relate in different ways to DG, EE and DR, and some relate to only a subset of the three DSM areas. Many do not apply to DR, though replacement of failing HVAC equipment and perhaps installation of solar PV –and associated rate change – have some potential for DR. The data available to support targeted marketing to customers

experiencing those events or circumstances should be considered in parallel, and may largely drive the focus of this research area. We recommend considering research into the following events that may correlate with more receptive need states:

- Recent changes in household occupancy, such as marriage/co-habitation, a new baby, or a son/daughter leaving home;
- Customers entering the housing market;
- Refinancing of customers' homes;
- Applications for home equity loans by customers;
- Planning a roof replacement;
- Addressing old or failing heating, ventilation and air conditioning (HVAC) equipment;
- Customers considering installation of Solar PV;
- Starting or expansion of customers' businesses;
- Application for business loan or line of credit; and
- Subscribing to architecture and design journals or magazines.

- We recommend the IOUs continue to leverage the opportunity presented by the transition of small commercial customers to TOU rates to raise IDSM knowledge and awareness. This transition offers both a rare instance of IOU focus on this relatively hard-to-reach customer segment, as well as a 'teachable moment' where customers may be more receptive to energy management information than during times where energy procurement is 'business-as-usual'.
- We recommend the IOUs and the CPUC consider rate-based and integrated programmatic changes. Due to the compartmentalization and narrowly defined fields of DSM specialization, success in creating IDSM awareness and promoting the uptake of IDSM solutions may require a combination of policy and programmatic support. Recent updates to Title 24 building codes and ZNE initiatives are both very positive developments for promoting IDSM. These changes present an opportunity to leverage new levels of attention on the importance of energy management and IDSM solutions, but to be successful they will also require strong programmatic support. We recommend the IOUs leverage changes in Title 24 building codes as a platform for IDSM education, as well as to facilitate greater levels of code compliance and intelligent IDSM uptake. Given the history of low levels of code compliance, there could even be a justification for direct program support to bring customers up to code, especially as the code becomes more stringent. Otherwise significant IDSM opportunities may remain untapped. We recommend the IOUs and the CPUC create and enhance programs to support successful implementation of these policies:
  - New construction programs offering design assistance, as well as workforce education and training efforts will help to ensure the codes are implemented intelligently and consistently with their intention.
  - We recommend the IOUs and CPUC consider placing greater attention and increased program resources on ensuring code compliance. We recommend consideration be

given to setting compliance goals and investigate programmatic options that financially incentivize measured improvements in compliance rates. Workforce education and training efforts have the potential to improve industry knowledge and accuracy in implementation of codes and standards, and could be another effective programmatic vehicle for enhancing compliance rates.

- Consider enhancing the DR and load shifting elements of ZNE goals in the small commercial and residential sectors. The design and construction of ZNE buildings offers opportunities for DR education and deployment, along with EE and DG.
- Consider adding a DR element to California's Quality Installation and Quality Maintenance programs. Residential air conditioning makes up a substantial portion of summer peak usage, and with control features such as pre-cooling and small temperatures changes, DR may offer measurable peak curtailment potential in the future.
- If not already in place, consider bolstering DR and/or load shifting incentives for solar PV owners by instituting a TOU rate that more closely reflects true time-specific costs of net consumption.

2. Introduction

This report presents the findings of an assessment of the residential and small commercial markets for integrated DSM solutions. The purpose of this study is to improve understanding of customer preferences and behaviors in the markets for integrated solutions, such that DSM resources can be targeted most efficiently to maximize their impact.

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.
- Identify channels or marketing efforts and messaging that are most effective in the residential and small commercial segments for promoting awareness and adoption of integrated DSM measures and improvements.

2.1 Background

The CPUC directed the California investor-owned utilities (IOUs) to promote the integration of programs and technologies for customers in the Energy Efficiency (EE), Demand Response (DR) and Low Income Energy Efficiency (now Energy Savings Assistance Program) Distributed Generation (DG) programs' proceedings. These integration efforts are designed to promote EE, DR and DG improvements and measures. The CPUC further emphasized this Integration directive in the California Long Term Energy Efficiency Strategic Plan (Strategic Plan) with specific strategies to improve integration across IOU programs. IDSM will help ensure that the IOUs work together and pool resources to develop and promote programs and strategies that provide integrated demand side energy solutions to customers in all market segments.

The IDSM statewide program is a strategic planning program implemented by all four IOUs. Through this program, IDSM provides benefits to the customer through the delivery of the optimal integrated solutions to customers independently of how the programs are organized and administered on the IOU side. The strategy of offering a suite of DSM programs and offerings will therefore help facilitate a customer's decision process and enable easier comprehension of their overall energy savings, cost reductions, operational improvements, greenhouse gas reductions, capital investments, and return on investment (ROI).

The delivery of integrated solutions is relatively new in California. Given its newness, there is likely opportunity to optimize resources through an improved understanding of the markets

and customer preferences regarding integrated solutions. The objective of this assessment is to understand characteristics of customers and opportunities with higher potential for integrated solution uptake. For example, a small retail customer using rented space may be interested in a small lighting retrofit but may not find discussion of DR or DG compelling. On the other hand, a customer having an air conditioner serviced may find the technician offering information about AC Cycling programs to be relevant and useful. While blanket messaging and awareness-raising is one mode of promotion that will be pursued, a well-informed, targeted effort is another important plane of promotion. The results of this study will be used to inform a more targeted marketing effort.

With this IDSM background as context, the research overview for the IDSM market assessment is presented below.

2.2 Market Assessment Overview

This research was conducted between November 2013 and June 2014, and was comprised of the following data collection and analysis tasks:

1. ***Literature Product and Marketing Reviews.*** We reviewed DG, DR and EE research and evaluation studies to assemble a representative set of current research findings related to IDSM. We also conducted a thorough review of IDSM products and services, as well as trade organizations supporting IDSM markets, to gather an understanding of market trends and perceptions. We focused on product features and marketing messages associated with IDSM products, in particular, marketing messages that were designed to attract residential and small commercial customers to IDSM solutions in the market today. These IDSM marketing messages reflect vendors' assessments of their customers' needs and wants, and thereby provided us with an indication of the same for the purposes of this research. We reviewed marketing material to identify likely customer targets and the factors that are emphasized to promote IDSM.
2. ***Data analysis.*** We reviewed existing and available databases from the CPUC and the IOUs that reflect customer IDSM interest and adoptions; these databases helped us define the characteristics and unique preferences of IDSM adopters.
3. ***In-depth interviews.*** We conducted in-depth interviews with IOU staff that design and deploy marketing strategies to increase knowledge and uptake of IDSM in the small commercial and residential markets. We also interviewed numerous vendors that are working in these markets today, selling a variety of IDSM technologies and services. These market actors have a very good understanding of the demand for their product and the feature preferences of their customer base. Finally, we identified and interviewed representatives from trade organizations and institutions that represent groups of IDSM vendors or reflect aggregate consumer interests in IDSM.

3. Evaluation Approach and Methods

This section provides an overview of the evaluation methods used to conduct the market assessment activities.

3.1 IDSM Literature, Commerce and Product Review

We began this research activity by collecting information on IDSM-related trade organizations, blogs, research papers, government websites, institutions and other resources that contained aggregated information related to products, services or businesses operating in the IDSM area. We then worked through the content of these listings, which led to product specific websites. The process of looking through individual company and product websites sometimes led to new findings, as did searching key integration terms.

Given the size of the marketplace and somewhat limited resources of our study, our compilation of IDSM products/services is not an exhaustive accounting of the marketplace. However, it is a general sampling and as such can be considered indicative of the activities and trends in the residential and small commercial IDSM market.

This investigation of integrated solutions led to the uncovering of some ambiguous 'edge' cases, where IDSM attributes were suggested but also unclear. This created a need to determine definitional boundaries for purposes of adhering to the initial scope. Below are two cases that we determined were outside the boundary:

- We found technological features that have multiple DSM attributes, but it was less clear that the product or service met the conceptual intention of integration. Examples include advancements in photovoltaic technology that allow more electricity to be produced per solar panel. Such enhancements include the addition of temperature controls surrounding the cells and advanced materials that allow for better control of the energy and fewer losses. Similarly, many demand response programs have energy savings attributes, but these are only by-products of peak curtailment efforts. Some edge cases were kept, such as solar thermal panels, solar inverters and hybrid AC units, because they represent a clear dual purposing and/or offset of electricity consumption with distributed generation.
- We found cases where technologies served as a clear precursor or prerequisite to integration, but were far enough removed from DSM of any kind to be a questionable addition to our review frame. Examples of these technologies include such ubiquitous devices as smart meters and the many products and services that encompassing energy management related financing.

Each IDSM product and service was entered into a database along with marketing messages. These data were then categorized as either a technology/physical product or a service; they were further divided as integrated in and of themselves (i.e. incorporated multiple DSM options) or whether they were designed to enable integrated solutions. All the IDSM products/services were categorized as IDSM Enabling Services, IDSM Enabling Technology, or

Integrated Technology. The primary technology and service types within each of these categories is shown in Table 1 below, along with the number of distinct offerings we uncovered in our search.

Given the size of the marketplace and somewhat limited resources of our study, our compilation of IDSM products/services is not an exhaustive accounting of the marketplace. However, it is a general sampling and as such can be considered indicative in a broad sense of the activities and trends in the residential and small commercial IDSM market.

Table 1: IDSM Products and Services

IDSM Product/Service Category	Products in Database
Integrated Technologies	**16**
Integrated Distributed Generation	7
Solar-Thermal hybrid PV System	1
Hybrid HVAC	6
Ground Source/Geothermal Heat Pump	2
Waste Heat Recovery and Cogeneration	7
Exhaust Flue Unit	1
Heat Recovery Ventilator	3
Working Fluid for Org Rakine Systems	1
Micro-CHP	2
IDSM Enabling Services	**6**
Building Design/Construction	3
Green and Sustainable Business Consultants	3
IDSM Enabling Technologies	**45**
Energy Management Systems (EMS/HAN)	22
In-home display	3
Load Pattern Analysis	1
Smart appliances	1
Energy Storage	7
Thermostats	11
Total	**67**

3.2 Data Analysis

3.2.1 Commercial Saturation Survey/Commercial Market Share Tracking

We analyzed a portion of the data assembled in support of the 2010-2012 Commercial Saturation Survey (CSS) and the Commercial Market Share Tracking Studies (CMST). More specifically, we analyzed the CSS/CMST telephone survey data for the sampled small

commercial segment (less than 100 kW) as well as respondents statistics related to historical program participation in the IOU's EE, DR and DG programs.

The CSS/CMST telephone survey was designed to refine business type classifications, collect energy-related knowledge and attitudinal data, and collect information on other non-observable site attributes such as dates of recent retrofits or remodels. The instrument was designed to collect data on the saturation of targeted equipment types, as well as the current market share of efficient equipment for other equipment types of interest.

As detailed in the CSS/CMST reports, the telephone survey data suffers from errors surrounding inaccuracy in self-reported equipment holdings and efficiencies. Self-reports related to equipment holdings ultimately did not align well with on-site inspection data. Still, the business type, attitudinal and knowledge related attributes of the telephone survey data provided some insight into the current set of integrated small commercial sites and related market trends and customer preferences. Using the data reflecting historical program participation across EE, DR and DG, along with attitudinal and business type information, we report on the small commercial sector's patterns of IDSM uptake, as well as differing levels of awareness and interest across business types.

3.2.2 Integrated Audit Tracking Data

We reviewed tracking records for 26,000 PG&E residential customers that completed the online integrated audit. These data reflected the household characteristics collected through the audit tool and also indicated which EE, DR and DG recommendations had been provided to each audit participant. Further, the dataset reflects customer response to each recommendation offered. Audit participants were asked to provide a response to each recommendation, indicating if the recommendation had 'already been done' (i.e. is complete) or if it 'accepted' as part of the customer's energy plan, or is unappealing and 'rejected' by the customer from consideration. These data allowed us to segment the population of online audit recipients into the following subsets for review and comparison:

- IDSM solution information recipients: or customers that received recommendations from 2 or more DSM strategy areas
- IDSM Willing Customers: or those customers that accepted recommendations from 2 or more DSM strategy areas
- IDSM Unwilling Customers: or those that received recommendations from 2 or more DSM strategy areas, but rejected all but one type of DSM
- Single DSM solution customers: or those customers that received only energy efficiency recommendations

We analyzed differences in household characteristics and the propensities to both receive and accept various DSM across these segments.

3.3 In-depth Interviews

The literature, commerce and product review informed the selection of sales and commerce market actors, trade organization representatives and IOU personnel for in-depth interviews. The interview guides were customized to each market actor and designed to test and enhance our understanding of customer IDSM preferences and behaviors. The objective of this task was to assemble, for leverage, the knowledge of market actors that act as hubs for large numbers of small commercial and residential customers in the IDSM market. The market actor interviews were divided along technology lines to triangulate between the characteristics of the technologies and the perspectives shared with respect to customer preference.

3.3.1 Utility Staff

In depth interviews were conducted with staff from each of the four IOUs. The interviews focused initially on understanding research needs and priorities, as well as the current program strategies of the IOU's IDSM Program Managers. Our focus then moved on to collecting a snap shot of the working knowledge, marketing strategies and research needs from specialized IDSM personnel. We held in-depth interviews with IOU staff focused on the small commercial and residential markets that focus on the following functions:

- Staff responsible for the design and deployment of marketing strategies to promote IDSM in small commercial and residential markets,
- Staff that create and manage the online tools designed to promote IDSM knowledge and uptake for small commercial and residential customers.
- Data management experts that understand the inner-workings of the integrated audit tool and are familiar with the related data resources.

Table 2 details the number of interviews done with the number of staff by topic and utility. In total, 12 interviews were conducted with 19 utility staff members, as follows.

Table 2: IOU Staff Interviews

	PG&E	SDG&E	SCE	SCG
IDSM Program Managers	• 1 interview with 2 staff members	• Discussion at Kick-off call	• Discussion at Kick-off call	• 1 interview with 1 staff member
Marketing Focused	• 1 interview with 5 staff members	• 1 interview with 1 staff member	• 1 interview with 2 staff	
Data Focused	• 2 interviews with 1 staff member	• 1 interview with 3 staff members	• 2 interviews with 2 staff members	• 2 interviews with 2 staff members

3.3.2 Market Actor Interviews

We conducted in-depth interviews with market actors involved in delivery of IDSM products and services to the residential and small commercial markets, as well as with representatives of trade organizations working in the IDSM market. We took a similar approach to the

interviews as we did to the product reviews, beginning with trade resources (e.g. trade publications), associations and industry groups. These groups understand the goals, activities and interests of their constituents well, and were able to provide insights reflecting IDSM preferences of customers. However, these contacts proved more difficult to recruit for in-depth interviews. Of the 11 organizations we identified, we were able to complete interviews with 4, as shown in Table 3.

Table 3: IDSM Related Institutions, Trade Associations and Industry Groups

Organization/ Institution	What They Do	Interview Conducted
Utility Communications Architecture International User Groups	Members are helping to evolve the standards that constitute the Green Button within its OpenADR task force. This support includes accelerating the development of testing and certification processes and the instantiation of a new working group to manage the brand - defining the minimum collection of standards and capabilities that sporting the Green Button logo on a web page implies.	1
California Geo	Trade association of Geothermal contractors, list contractors, etc.	1
Home Energy Magazine	Home Energy Magazine: The Home Performance Magazine - may have insight into integration	1
National Association of Energy Service Companies	Trade association promoting benefits of the widespread use of EE for over 25 years	1
Total Interviews		**4**

The organizations we identified but did not interview include:

- Independent Energy Producers Association
- Solar Electric Power Association
- Communications Architecture International User groups
- Greentech Media
- California Energy Storage Alliance
- Cleantech Group
- LBNL Environmental Energy Technologies Division (EETD)- Energy storage and distributed resources group
- Zero Net Energy Homes

In addition to representatives from the organizations listed in Table 3, we interviewed individuals working for companies selling the IDSM products and services compiled in the product and marketing review database. The objectives of the sample design for this portion of the interviews included:

1) Broad representation across a broad spectrum of product/service types.
2) Balancing across the residential and commercial segments.
3) Emphasis on high volume or growth areas of the market.

To achieve the first objective listed above, we used the database of product/service types as a general guideline and planned to cover all the categories with at least one interview. The number of completed interviews is shown in the two far right columns of Table 4 below. The column titled "Completed Company Interviews" contains the sum of interviews and the column titled "Completed Products Interviews" accounts for interviews where multiple products were discussed that fit into multiple categories.

Table 4: IDSM Products and Services

IDSM Product/Service Category	Products in Database	Completed Company Interviews	Completed Product Interviews
IDSM Enabling Services	**6**	**3**	**3**
Building Design/Construction	3	2	2
Green and Sustainable Business Consultants	3	1	1
IDSM Enabling Technologies	**44**	**8**	**10**
Energy Management Systems (EMS/HAN)	21	3	3
Energy Storage	7	2	2
In-home display	3	0	1
Load Pattern Analysis	1	1	1
Smart appliances	1	0	0
Thermostats	11	2	3
Integrated Technologies	**17**	**6**	**8**
Ground Source/Geothermal Heat Pump	2	1	1
Integrated Distributed Generation: Hybrid HVAC	5	2	2
Integrated Distributed Generation: Solar-Thermal hybrid PV system	2	1	2
Solar Cooker	2	1	1
Waste Heat Recovery and Cogeneration: Heat Recovery Ventilator	3	0	1
Waste Heat Recovery and Cogeneration: Micro CHP	2	1	1
Waste Heat Recovery and Cogeneration: Working Fluid for Org Rankine Systems	1	0	0
Total	**67**	**17**	**21**

4. Literature, Commerce and Product Review

Integrated Demand Side Management (IDSM) is defined by a comprehensive approach to saving energy. An IDSM solution is one that considers all available DSM measures and strategies and selects the optimal and multi-DSM solution that meets building needs and customer preferences. In some cases this manifests as a project that combines elements from different DSM areas. In other cases, it is a single technology that embodies multiple DSM strategies, and finally it can be an ancillary technology or service that allows for a close enough connection between DSM strategies that it can be considered as providing for integrated solutions.

IDSM solutions incorporate at least two of the following in its fundamental design: energy efficiency (EE), demand response (DR), energy storage and distributed generation (DG). These technologies, independently developed to provide solutions to the needs of the evolving smart grid and growing concern for the environment, can combine synergistically to create unexpected gains. The following is a review of IDSM solutions and related marketing material for the residential and small commercial sectors.

The IDSM technologies were reviewed for the content of their marketing material. Figure 1 below summarizes the marketing messages for each major technology area. Most products emphasize either monetary savings or benefits in energy efficiency or to the environment. However, control and flexibility were present in nearly one-third of product messaging, and were found to be particularly frequent among IDSM Enabling technologies such as EMS and home area networks. Ease-of-use, security and aesthetics were also common selling points for many IDSM technologies. In general we found that residential and small commercial customers most wished for simple energy management solutions that make their lives and businesses cheaper, faster and easier to manage.

Figure 1: Summary of IDSM Product Marketing Messages

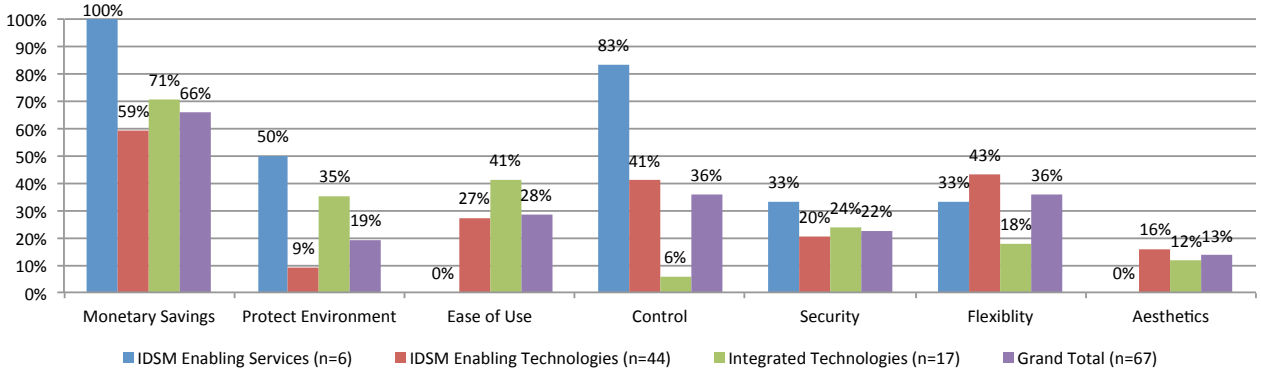


Figure 2 and Figure 3 below summarize marketing messages for each major technology area by segment; Figure 2 shows residential product messaging, and Figure 3 summarizes commercial products. Both groups use messages concerning monetary savings more frequently than any other message type. Commercial IDSM product marketing emphasizes security, control and monetary savings more consistently than the residential products. Residential products tend to emphasize flexibility, ease of use and protecting the environment.

Figure 2: Residential IDSM Product Marketing Messages

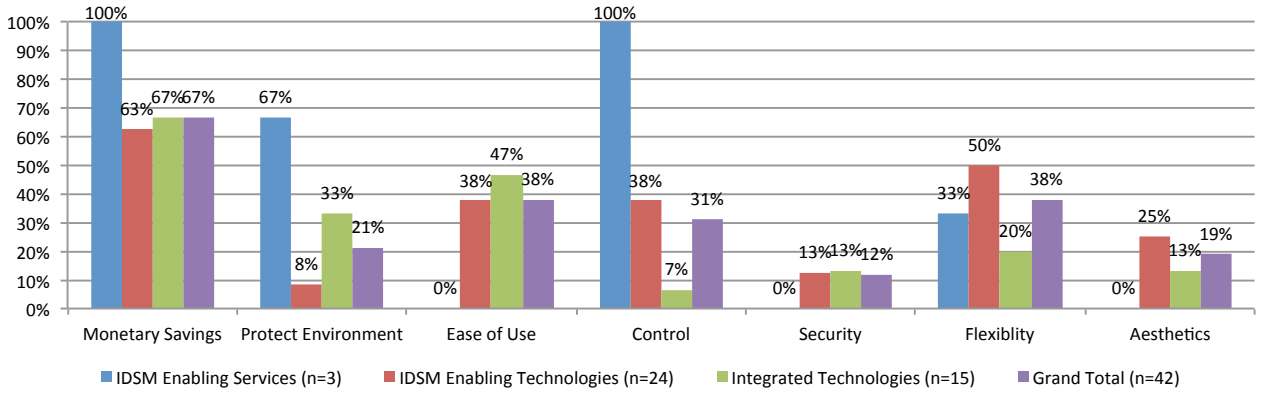
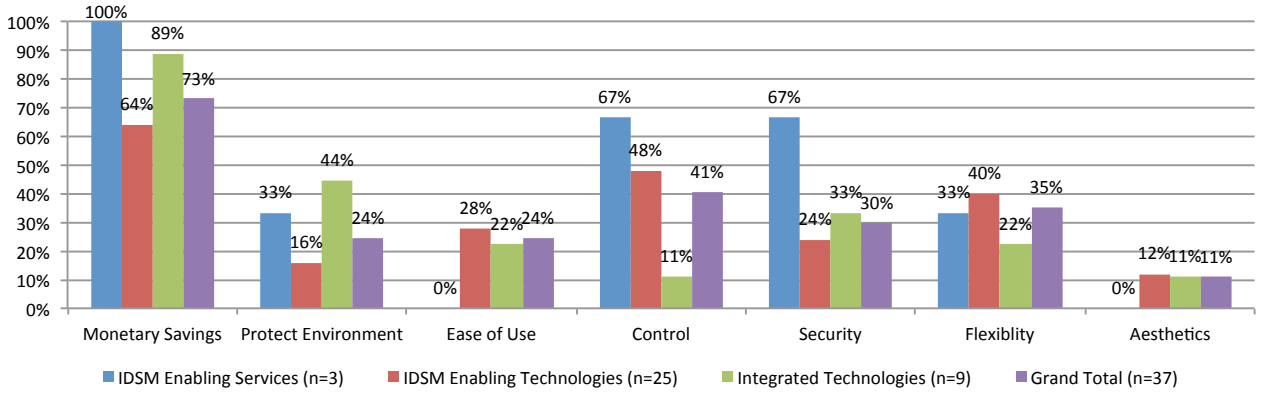


Figure 3: Commercial IDSM Product Marketing Messages



4.1 IDSM Technologies

This section summarizes information we reviewed about IDSM technologies, which are technologies that embody multiple DSM strategies. We categorized the technologies as follows:

- **Integrated Distributed Generation:** These include efficient packaged air conditioners that utilize photovoltaic power directly without the use of inverters, heat pumps that use energy from the earth, and ovens that use thermal energy from the sun.
- **Waste heat recovery and cogeneration:** These are equipment types that provide a service and also convert waste heat from one process into energy or heat for another process. Heat recovery ventilators provide required ventilation for buildings while extracting heat from the air to provide indoor heating and/or cooling. Micro-CHP burns fuel to create electricity and utilizes the resulting waste heat from combustion to meet thermal needs of the home or facility.

Subsequent sections discuss IDSM *enabling* services and technologies.

4.1.1 Integrated Distributed Generation

We describe five integrated distributed generation technologies below. These are illustrative of a larger number of technologies, as undoubtedly there are more ways to utilize environmental heat and light to power equipment. For example, there are flashlights and radios powered by friction and solar energy, and there are many kinds of solar-powered outdoor lights including walkway, landscape and accent lights. There are a number of solar-powered cell phone chargers and portable solar-powered battery chargers, as well as a myriad of solar technologies designed to provide heating, ventilation and air conditioning (HVAC) and water heating service for those dwelling in RVs, boats and trucks.

4.1.1.1 Solar Electric/Thermal Hybrid Panels

Solar Zentrum introduced solar electric/thermal hybrid panels, which take advantage of both power and heat from the sun, to the U.S. from Germany in 2009. Conventional panels can get very hot as they operate, reducing the amount of power they generate and shortening the useful life of the equipment. The solar/thermal panels include a heat exchanging fluid that removes the heat from the panels, allowing them to operate more efficiently and to last longer. For homeowners and businesses, the thermal energy can be used for hot water, heating, and cooling. Businesses that are targeted for this product are those with high hot water use: hotels, restaurants, aquatic centers, office buildings, apartment complexes, laundries, car washes, fitness centers and others.

4.1.1.2 Hybrid AC Units

Some air-conditioning units are now being equipped with solar panels. These so-called *Hybrid AC Units* are energy efficient models with distributed generation modules, and, in some cases, a thermal storage unit, attached. Early models consisted of a normal rooftop AC unit with

panels attached. More recent versions are hybrid technology, and accept DC power directly when the sun is out, with no inverter or batteries needed. These units claim to use more than 80 percent solar during the day and have a SEER rating of 35. At night they rely on standard AC power and have a SEER rating of 19.

So far, manufacturers seem to be either companies that are already involved in AC production and want to expand their product lines (for example, LG and Lennox), or new companies (such as SolAir World and Greenflow) that are springing up around the manufacture of a single innovative product. The former are generally selling to their usual audiences and emphasizing ROI and monetary savings; the latter, on the other hand, are marketed chiefly to residential customers with small commercial customers as a side note, and have very scattered marketing messages. All of them mention electricity savings, though one product focuses exclusively on comfort and luxury, while the other two emphasize durability, ecological friendliness and automation.

As for market size, only Lennox provides any data—it touts itself as "the first and only commercial HVAC system that integrates directly with solar power." It seems that the industry has room to grow as new technology develops, marketing messages become clearer, and more companies add energy storage or DR components to their systems.

4.1.1.3 DC Solar Circulation Pump for Solar Hot Water Systems

These are PV-powered circulation pumps for closed-loop solar water heating systems. The pumps are used to circulate fluid for heat exchange or distribution, often as part of a solar hot water system. They connect directly to a PV panel and use the DC power natively, so there is no need for an inverter. The pump speed varies according to the amount of sunlight, and these pumps replace conventional pump controller, sensor and thermostat technology. When combined with battery storage, these pumps can be used for nearly any circulation pump application such as hydronic radiant floor space heating. This technology was introduced in the 1980s.

4.1.1.4 Solar Cookers

Solar cookers are ovens that work chiefly from solar energy; parabolic mirrors focus solar energy directly on a food item, or reflectors focus solar energy through a lens into a chamber lined with heat-absorbent material. Since these ovens generally use no electricity and emit no greenhouse gasses along with using off-grid solar energy, they are universally IDSM technologies by construction. Though solar ovens were initially conceived as a way to cut down on wood use in developing countries, or as an emergency measure for refugees, commercial models using higher-performance materials are now being developed. Due to the relatively elementary construction, plans for hundreds of cookers are accessible online to the do-it-yourself enthusiast.

Manufactured solar cookers are created by specialty companies, often non-profits, which market chiefly to outdoorsy or survivalist segments of the residential population. Indeed, some models are in the process of receiving a patriotic “Made in USA” rebranding, complete

with prominent flag insignia. Simpler, collapsible designs receive less marketing and seem to assume that the purchaser is already sold on the solar cooker; the more complex ones sell based on the features of the solar cooker in comparison to a conventional system. In general, the more the cooker looks like a conventional oven, the more the company provides a persuasive argument to use the cooker as a replacement for everyday use.

Key features that the five manufacturers we researched emphasize include that the solar cooker, as a slow-cooking system, cannot burn food and leaves meals hot and moist; that it can be used in case of emergency and rising fuel prices (thus removing the conventional difficulty of stockpiling fuel in survival plans); and that solar power is free. In addition, there are frequent messages involving getting children to play outside (by serving them food there), and side notes on environmental protection.

A recent development has led to a hybrid solar oven, the SunFocus, which draws some grid energy to supplement a largely solar-powered system (grid usage is rated at 25 percent of that of a conventional oven through typical use). It also boasts the largest cooking capacity of any solar cooker on the market, and a superficial search implies that it is unique in its class.

4.1.1.5 Geothermal Heat Pump

Geothermal heat pumps (marketed under the GeoExchange name) take advantage of the relatively constant temperature of the ground beneath the earth's surface to reach high efficiencies in heating and cooling buildings and (sometimes) water. This technology uses the earth as a heat source in the winter and as a heat sink in the summer. Systems can be either closed (horizontal, vertical, pond/lake) or open, and have a payback period of five to 10 years.

Geothermal heat pumps are more efficient than air source heating options. In addition to the energy efficient traits, approximately 70 percent of the energy the system uses is renewable energy from the ground. The electricity used to power the geothermal heat pump can also come from a renewable source such as solar. Newer units can be tied to the smart grid and utilities can dial back the equipment to reduce demand.

The technology has been around since the 1940s. According to GeoExchange, more than one million units have been installed in the United States. There are over 50 brands that have Energy Star-qualified units. The current Energy Star specification was created in 2009 with updates in 2011 and 2012. A federal tax credit of 30 percent is available through 2016.

Geothermal heat pumps are marketed to both commercial and residential customers. The technology has been used in schools and other commercial applications but more marketing material exists for residential customers. Messaging topics include: carbon emission reduction, money and energy savings, renewable generation characteristics, comfort and aesthetics. Energy efficiency programs have incentivized this technology for many years. These pumps have high capital costs and achieve greater advantages over air source heat pumps and other heating systems in more extreme climates.

4.1.2 Waste Heat Recovery and Cogeneration

We describe four waste heat recovery and cogeneration technologies below. The many variants of technology using heat recovery and cogeneration technologies incorporate various means of capturing and repurposing waste heat. These are illustrative samples of the technology types and applications in the residential and small commercial markets. They include exhaust flue heat recovery, heat recovery ventilation, combined heat and power and a super-efficient working fluid for heat exchange.

4.1.2.1 Exhaust Flue Heat Recovery Unit

A Waste Heat Recovery Unit installs in a flue and captures heat from exhaust to convert into electricity. It can be thought of more generally as an air-to-air heat exchanger. They are versatile in applications and are marketed for commercial, residential and industrial applications. Some companies provide standard products and other companies build units to order. The unit adds to the overall efficiency of building thermal systems, generating heat from system losses. Marketing messages are minimal, focusing on a simple idea: that energy lost in inefficient exhaust management is a waste of already purchased resources. Other marketing messages speak to ease of use—the product is easy to install and clean, and is corrosion-resistant.

4.1.2.2 Heat Recovery Ventilation

The tight envelope of an efficient home generates both moisture and pollutants. The moisture comes from cooking, washing, showering and breathing. At excessive levels, moisture condenses on windows and can cause structural deterioration. Areas of excessive moisture are also breeding grounds for mold, mildew, fungi, dust mites and bacteria. In addition, appliances that utilize combustion have the potential for allowing gases, including carbon monoxide and other pollutants, to escape into the air. Some common sources may include gas ranges and water heaters, unvented space heaters, leaky chimneys and wood-burning appliances. Even breathing can add to the problem when carbon dioxide reaches excessive levels, creating stale air.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) sets the standard for residential ventilation at a minimum of .35 air changes per hour, and not less than 15 cubic feet per minute (cfm) per person. An old home may very well exceed these values—especially on a windy day. However, on a calm winter day, even a drafty house may fall below the recommended minimum ventilation standard.

The preferred whole-house solution is to create balanced ventilation. This way, one fan blows the stale, polluted air out of the house while another replaces it with fresh air.

A heat-recovery ventilator (HRV) is similar to a balanced ventilation system, except that it uses the heat in the outgoing stale air to warm up the fresh air. A typical unit features two fans—one to take out household air and the other to bring in fresh air. What makes an HRV unique is the heat-exchange core. The core transfers heat from the outgoing stream to the incoming stream in the same way that the radiator in your car transfers heat from the engine's

coolant to the outside air. It is composed of a series of narrow alternating passages through which incoming and outgoing airstreams flow. As the streams move through, heat is transferred from the warm side of each passage to the cold, while the airstreams never mix.

Depending on the model, HRVs can recover up to 85 percent of the heat in the outgoing airstream. HRVs are ideal for tight, moisture-prone homes because they replace the humid air with dry, fresh air. In climates with excessive outdoor humidity, an energy-recovery ventilator is more suitable. This device is similar to an HRV, but dehumidifies the incoming fresh airstream.

4.1.2.3 Micro-CHP or Combined Heat and Power

Natural gas–fueled combined heat and power systems produce thermal energy and electrical power together to reduce a home's operating costs. An emerging natural gas-fueled technology called micro-CHP, or combined heat and power, has the potential to significantly reduce operating costs for homes and businesses where it is installed.

CHP, also known as cogeneration, has been in use in industrial settings for decades, but recently manufacturers have developed micro-CHP units suitable for home and small commercial applications. The technology works as follows: an internal combustion engine powered by natural gas generates thermal energy for a home's space heating or water heating, or to heat a backyard pool or spa. While the unit generates that thermal energy, it is also generating electricity, which can be used to supplement or offset electricity coming from the grid.

Marketing materials from Yanmar America and Marathon Engine Systems promise this solution "…actually saves money and reduces the carbon footprint." Yanmar offers a 10-kilowatt model, the CP10WN, and recently introduced a 5-kilowatt model, the CP5WN, suitable for homes ranging from about 2,500 square feet to 8,000 square feet. Marathon Engine Systems offers the "Ecopower" micro-CHP unit that produces 2 to 4.7 kilowatts of electricity.

Micro-CHP systems are generally installed with a buffer storage tank and a complementary gas-fueled boiler. Whenever there is demand for thermal energy in the building, the buffer tank sends heat to where it is needed—for instance, the fan coil, baseboard radiator, potable water supply or swimming pool. The boiler provides supplemental heat for any thermal needs not provided by the CHP unit.

4.1.2.4 Working Fluid for Organic Rankine Cycle Systems

Along with their industry-leading line of thermostats, refrigerants and other HVAC paraphernalia, Honeywell has developed Working Fluid for Organic Rankine Cycle Systems. These systems are used to convert waste heat from other processes into power, thus constituting a sort of DG, and this fluid in particular is marketed as decreasing GHG output. The Genetron 245a is non-toxic and non-flammable, described on the company website and marketing material as popular and universal, and good for both business and the

environment. A higher-efficiency fluid can decrease the size of the needed Rankine Cycle System and operating costs.

Though Honeywell says they are selling to commercial and industrial businesses[1] of all sizes, the tone of the marketing in general suggests that the intended customer would have a good idea of what a Rankine Cycle System is already, and would also have a sense of the other available products on the market. In general, it seems that the market has established itself, and target customers understand the technological problems and challenges the system is trying to address. However, the market remains small and static in size and customer base. If gains in Rankine Cycle System size and efficiency continue, they may begin to be routinely bundled with heat-inefficient appliances, or as part of industrial systems and supercomputers.

4.2 IDSM Enabling Services

IDSM Enabling services provide the information and analytical services needed to integrate strategies available across all DSM areas. Sustainability and green business consultants work from a highly integrated platform but suffer somewhat from their broad mandate and the generality of key terms. 'Energy managers for hire' is a way for established energy management firms to share expert human resources at critical junctures to monitor installations and performance of equipment. There are emerging load pattern analysis software offerings that utilize smart meter load data to generate detailed information regarding elements of energy consumption and opportunities for savings. Finally, there is an industry built around architecture, design and construction of minimal carbon footprint buildings. These services pull from many disciplines and DSM resources to provide roadmaps for new construction and major remodels.

4.2.1 Sustainability and Green Business Consulting

There are uncountable numbers of consulting and advisory firms offering services to commercial enterprise related to creating green and sustainable business facilities and/or practices. These generally involve strategies for reducing the carbon footprint of businesses, achieving carbon neutrality and maximizing energy conservation; they also include consideration of ecology and social issues. The meaning and intent of the key terms 'green' and 'sustainable' can get murky, particularly 'sustainability', which is sometimes used as a synonym for enduring and really only indicates continuing viability of the business itself. In some cases sustainability is defined as achieving business success without negative impact on the environment or people.[2] In other literature, sustainable or green businesses must go beyond neutrality and "adopt principles, policies, and practices that *improve* the quality of life

[1] While we focused our research on those sectors, some of the technologies are also applicable for larger businesses and industrial facilities.

[2] http://www.earthshare.org/greening-business.html.

for their customers, their employees, communities, and the environment".[3] A sampling of typical consultancy services are described as:

- Green Strategy Development and Refinement
- Financial/Environmental Return on Investment (ROI) Analysis
- Green Business Audits
- Carbon/Environmental Footprint Assessments
- Market, Competitive and Legislative Sustainability Research
- Sustainability Competitive Positioning
- Customer, Supplier, Vendor, and Employee Outreach Programs
- Sustainable Business Change Consulting
- Corporate Environmental Training Programs
- Implementation and Program Management
- Financial/Environmental Measurement and Reporting

Marketing messages are varied. Some focus on convincing the customer that services will enhance their process efficiency, cash-flow and security; others focus on 'doing it right' and/or creating effective marketing strategies that convince consumers of the green/sustainable goals of the business. Either way, there exists a stable of firms capitalizing on a business-to-business consultancy market aimed at achieving reduced GHG —along with social and ecological goals.

4.2.2 Energy Managers for Hire

Honeywell offers Energy Managers for Hire as part of its Honeywell Energy Management Services program, in addition to its work with thermostats and HVAC systems. The energy managers help install energy-efficient equipment, monitor existing systems, analyze consumption and utility rate data, and recommend energy purchasing options. In particular, they can work to make facilities more cost-effective in light of peak pricing conditions.

Honeywell's core message, even when making financially-motivated points, is one of flexibility and control. The company can work with different kinds of systems whether spread across multiple locations, a campus or a single building to develop a custom solution. However, the opening message is that energy costs are high but are taken as a fixed, uncontrollable expense—when instead, Honeywell cannot just decrease costs, but will guarantee their decrease with a contract.

In general, there seems to be a market movement towards these sorts of services; for example, we found a site (www.greenlancer.com) offering green engineers for hire.

[3] http://www.greenbusinessnetwork.org/about/whats-a-green-business.html

4.2.3 Load Pattern Analysis

Load Pattern Analysis is precisely that—given a year of usage data, recorded by either the customer's EMS or the local utility's Green Button system, Energy AI provides information on load patterns. For example, their system is apparently capable of complex enough disaggregation to compute how much energy usage per year comes from phantom loads. The loads are analyzed both in terms of gross usage (EE) and in terms of peak usage (DR), and specific recommendations are then given to shave both.

In general, these products are fairly new, spurred by the Green Button Initiative and DOE's challenge for energy applications. There is space for market development and growth as automated software solutions emerge, so that for the first time software—rather than individual reports—is being sold. Energy AI is one of a very small number of companies we found that does this kind of work, and its marketing messages mesh with previously established initiatives. Its argument is that energy use data is widely available, an untapped resource that can be used to save the customer quite a bit of money.

This message is interesting in that a great many monitoring devices have been sold, with the point of view that utility bills are opaque and receiving usage data empowers the consumer to change their situation. In this case, it seems that a need is emerging for software analytics bundled with the monitor itself, should the manufacturers decide to cut out the middleman.

4.2.4 Building Design/Construction

4.2.4.1 Policy Context

The California Public Utility Commission established Zero Net Energy (ZNE) new construction goals in its Long Term Energy Efficiency Strategic Plan.[4] The California Energy Commission's 2011 Integrated Energy Policy Report creates parallel ZNE new construction goals (CEC, 2011). Those goals establish a 2020 target for all residential new construction to reach ZNE and a 2030 target for all commercial new construction to reach ZNE.

In support of this goal, programs providing incentives and support as well as research have been implemented. There are a few challenging building types, and the dependency of ZNE on solar energy will make many sites impractical. But overall, research suggests that a wide portion of California's new construction can move to ZNE by 2020 for homes and by 2030 for commercial buildings.

4.2.4.2 Zero Net Energy Homes

Although there has been some debate surrounding the term, the current working definition of a Zero Net Energy (ZNE) home is one where the societal value of the amount of energy provided by on-site renewable energy sources is equal to the value of the energy consumed by

[4] California Long Term Energy Efficiency Strategic Plan, California Public Utilities Commission, September 2008

the building annually at the level of a single "project" seeking development entitlements and building code permits, measured using the California Energy Commission's Time Dependent Valuation (TDV) metric. A ZNE Code Building meets the Energy Use Intensity (EUI) by building type and climate zone that reflect best practices for highly efficient buildings.[5]

ZNE homes include energy efficiency measures and renewable energy generation, typically solar. Utility and state incentive programs for energy efficiency and solar are designed to offset a portion of these costs to motivate higher market adoption levels for these measures and practices.

Design elements begin with selection of land, configuration of the building, framing and insulation, ventilation, HVAC, water heating and distributed generation elements such as solar PV and solar thermal.

According to the Draft New Residential Zero Net Energy Action Plan, several large and mid-scale builders are beginning to capitalize on green homes and are leveraging ZNE homes to differentiate themselves in the marketplace. Engaged builders include but are not limited to KB Home, ZETA Zero Energy Communities, DeYoung Properties, Wathen Castanos Hybrid Homes, Inc., Elliot Homes and Meritage Homes.

The study's central finding is that ZNE buildings will be technically feasible for much of California's new construction market in 2020.[6] The McGraw Hill 2012 SmartMarket Report on new and remodeled green homes[7] reports that the demand and interest by homebuilders to develop green homes is increasing substantially and is forecasted to represent 90 percent of all homes by 2016 nationally.

4.3 IDSM Enabling Technologies

IDSM Enabling technologies are technologies that provide for synergies between DSM strategies. For example, energy storage allows renewables to be more efficiently and completely utilized, and ultimately to offset greater amounts of energy consumption. Storage can also provide a direct source of peak load reduction, allowing for demand management. Similarly, monitoring and controls allow homeowners and facility managers to optimize their use of energy equipment and also provide tools to effectively respond to demand curtailment

[5] *DRAFT New Residential Zero Net Energy Action Plan*, California Energy Commission, California Public Utilities Commission, Energy Upgrade California, October 2013.

[6] *The Technical Feasibility of Zero Net Energy Buildings in California*, December 2012. Prepared for PG&E on behalf of SCE, SDG&E and SCG, Prepared by ARUP, Sun Light and Power, New Buildings Institute, Engineering 350, Sustainable Design and Behavior.

[7] New and Remodeled Green Homes: Transforming the Residential Marketplace, McGraw Hill Construction Research and Analytics, Copyright 2012, http://www.wm.com/documents/pdfs-for-services-section/New%20and%20Remodeled%20Green%20Homes%20SMR%20(2012).pdf

requests. Energy monitoring technologies provide information to customers to help them stay apprised of changes in their energy consumption and to manage it more effectively.

4.3.1 Energy Storage

Energy storage is experiencing substantial industry growth. The current period of growth arose initially from AB 2514[8] (2010), which called for the CPUC to open a proceeding to determine appropriate targets (if any) to procure viable and cost-effective energy storage systems and if appropriate, to adopt energy storage system procurement targets. The greater use of grid-connected renewables and the attending variability of energy supply increases the value of energy storage. Storage offers the flexibility and control needed to connect variant renewable energy supply to the similarly variant but unrelated energy demand and avoids the expense and GHG associated with utility 'peaker plants'.[9]

Energy storage at the individual facility or home typically takes the form of lithium-ion batteries. There are also some thermal storage options for small-scale applications generally in the form of thermal storage tanks, insulated hot water tanks or hard heat-retaining substances that allow for a relatively short delay between heat absorption and release. Large scale energy storage has a much more varied set of technologies to draw from, including large scale batteries equipped with sophisticated software, ice plants that store cooling capacity for large buildings, and pumped storage hydroelectricity.[10]

4.3.1.1 Policy Context in California

Assembly Bill 2514 was introduced in February of 2010 by the California legislature and under guidance from the California Energy Commission (CEC), the agency primarily responsible for California's energy policy and planning. The bill put into place new policy requirements aimed at emphasizing the development of energy storage in California's energy resource strategy and planning. More specifically, the bill initiates the development of 5-year energy storage portfolio procurement plans and requirements, and mandates electric utilities comply with the plans and report certain information to the CEC. The energy storage procured through this process must be designed to meet a specified minimum percentage of peak electrical demand.

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[8] Assembly Bill Number 2514, Chapter 469. Skinner. Energy storage systems (2009-2010). Approved by Governor September 29, 2010. An act to amend Section 9620 of, and to add Chapter 7.7 (commencing with Section 2835) to Part 2 of Division 1 of, the Public Utilities Code, relating to energy.
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100AB2514&search_keywords=

[9] A "peaker plant" is a power plant that operates intermittently and as needed to accommodate periods of high electricity demand. Due to the cost of building an efficient power plant and the short run times expected of a peaker plant - it is economically prohibitive to make the peaker plant as efficient as a base load power plants. In addition, peaker-plants must come online and offline as needed, which is incompatible with the requirements of the equipment and fuels used in base load plants.

[10] The energetic implications of curtailing versus storing solar- and wind-generated electricity, August 14th 2013, RCS Publishing, Energy & Environmental Science, Charles J. Barnhart, Michael Dale, Adam R. Brandt and Sally M. Benson

As a result of AB 2514, a new CPUC Proceeding was launched in 2010 dedicated to the procurement of energy storage. The Proceeding defines four general categories of use: renewables firming, demand-side management, distributed energy support, and transmission-like ancillary services. In October 2013, the CPUC invoked the first mandatory energy storage procurement targets in the nation.[11] Furthermore, these targets stipulate that a majority of storage resources be owned by third parties; the CPUC expressed a strong preference for utility-owned storage to be independently developed.

On June 20th of this year, through language of Section 156 of Senate Bill 861[12] the California IOU-administered Self-Generation Incentive Program (SGIP) was extended through January 1, 2021. The language of SB861 is specifically supportive of energy storage indicating there may be additional increases in energy storage investments due to SGIP incentives:[13]

With this decision the CPUC has created substantial new growth in the market for energy project developers and energy storage equipment vendors.

The targets currently apply to the four California IOUs, which are now required to collectively procure 1,325 MWs of energy storage capacity by 2020, with an installation deadline of the end of 2024. The decision also sets a target for Community Choice Aggregators (CCAs) and Electric Service Providers (ESPs) to procure energy storage equal to 1 percent of their yearly 2020 peak load by 2020, also with installation no later than 2024. Storage procurement targets for each of the state's municipal utilities must be established, if appropriate, by the governing board of the municipal utility no later than October 1, 2014, and reported to the California Energy Commission.

Customer-side storage may be procured through existing programs and new programs created through other rulemakings, such as the Self-Generation Incentive Program, the 2015 demand response application, the distributed generation/California Solar Initiative rulemaking, and the alternative-fuel vehicle rulemaking.

4.3.1.2 Venture Capital Investment

There are now more than 30 storage startup companies in the San Francisco Bay Area[14] and venture capital investment in energy storage has experienced substantial growth since 2010.

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[11] http://www.reedsmith.com/California-Public-Utilities-Commission-Adopts-Energy-Storage-Procurement-Targets-10-23-2013/

[12] http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml

[13] SB 861, Section. 156. http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml "Section 379.6 of the Public Utilities Code is amended to read: 379.6. (a) (1) It is the intent of the Legislature that the self-generation incentive program increase deployment of distributed generation and energy storage systems to facilitate the integration of those resources into the electrical grid, improve efficiency and reliability of the distribution and transmission system, and reduce emissions of greenhouse gases, peak demand, and ratepayer costs. It is the further intent of the Legislature that the commission, in future proceedings, provide for an equitable distribution of the costs and benefits of the program."

[14] According to CalCharge, a clean technology consortium.

Industry research shows that storage companies raised $630.5 million between May 2011 and May 2012. Investment dollars grew 13 fold from 2010 levels and now represent about 11 percent of California's clean tech venture capital investments.

4.3.1.3 Energy Storage Systems for Residential and Small Commercial Applications

While there are a myriad of energy storage technologies that can be applied to large commercial, industrial or utility scale operations, energy storage on the residential and small commercial scale generally come in two types: lithium battery energy storage and thermal energy storage. Both of these function somewhat like a normal battery, except on a larger scale.

Lithium battery energy storage operates much as a normal battery does, with all its usual attendant problems from the inefficiency of converting between alternating and direct current. Modern concerns surround safety, performance, and cost- effectiveness[15] for small scale operations. However, spurred by off-grid demand, as well as the value of uninterrupted energy service and the ability to avoid demand charges (together with incentives and tax breaks) has led to at least four different companies to enter the market for battery storage systems geared toward small residential and commercial customers.

Leveraging research and development funding from the CPUC, two technology companies—Solar City and Tesla Motors—worked together to develop and launch to market a storage system for small commercial and residential use. In addition, Samsung is also marketing a residential energy storage system that is being subsidized by the Japanese government and is offered to customers as a packaged solar PV and Energy Storage System (ESS).

The messaging for residential customers[16,17] focuses on reduced peak usage charges and the promise of backup power during emergencies and power outages. Related benefits include minimizing loss of refrigerated food, and keeping phones charged and lights on for communication and safety. Marketing messages also simply relate the ability to use the energy generated by the local DG system when it is needed. Finally, the technology is touted as "safe, durable and compact".[18]

Lithium battery energy storage systems are also being sold for commercial purposes based on the promise of reduced demand charges and energy during grid outages. More specifically, marketing points include:

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[15] Aquion Energy, Aquion Blog, September 12, 2013. Professor Jay Whitacre Founder and Chief Technology Officer, http://www.aquionenergy.com/blog/three-reasons-why-lithium-ion-battery-chemistry-challenged-long-duration-energy-storage

[16] http://www.solarcity.com/residential/energy-storage

[17] http://www.samsungsdi.com/ess/residential-commercial-solution

[18] http://www.solarcity.com/residential/energy-storage

- Delivery of higher reliability and consistency;
- Reduction of peak electricity demand charges;
- Creation of future budgetary security;
- Promotion of higher utilization of energy infrastructure (meaning that cheaper energy allows for more energy consumption);
- Preparing for smart grid interaction; and
- Providing potential tax break incentives.

The current cost of lithium storage is estimated to be between $800/kWh[19] and $2,000/kWh.[20]

4.3.1.4 Thermal Storage Unit

A Thermal Storage Unit is an encapsulated cylindrical tank with two phase change materials (PCMs) that can absorb waste thermal energy from other processes, like solar systems, Micro-CHP and solid fuel boilers. There are not many manufacturers of this product: we found only one, Solar Zentrum.

There are a number of scientific articles on the benefits of thermal storage coupled with Micro-CHP. The articles explore the concept of improved efficiency of micro-combined heat and power (micro-CHP) systems through decoupling the production of electricity and heat by means of thermal energy storage (TES) systems where heat that is not needed during the production period can be stored for later use. This storage technology has not gained a strong foothold in the residential or small commercial market, likely due to its complexity and high capital cost. Solar Zentrum's unit is marketed on its slow heat-loss rate, long warranty, savings on fossil fuel energy and the fact that it fits through standard doors.

4.3.2 Monitoring and Controls

Monitoring and Control technologies are DR and EE-focused; they provide the customer with a way to monitor and manage the loads in their home or facility. In general, the market displays a post-DR, reactionary temperament. Auto-DR is seen to take control out of the user's hands and risk irreparable damage to a business, whereas opt-in DR requires supervision and specific routines programmed into a building automation system. Both of these so-called solutions are expensive and risky. Some companies are beginning to address these issues by producing devices that will automatically participate in DR events but remain open to user input—or make auto-DR events more tolerable by slowly dimming lighting systems and pre-cooling environments.

An interesting development on the residential front is the "Internet of Things," as more and more electronic devices are hooked up with basic computers, sensors and communications.

[19] http://cleantechnica.com/2013/10/09/point-will-small-scale-solar-energy-storage-become-viable/

[20] http://www.greentechmedia.com/articles/read/the-numbers-behind-tesla-and-solarcitys-solar-home-energy-storage-play

This is part of the home automation process, and proponents hope to enable communication between all of the networked devices to permit a house that responds automatically or through voice-activated interfaces to the user's needs and wishes. Utilities also have a stake in that putting all electrical loads on controls provides a prime site for auto-DR. There are issues at hand, however: many manufacturers are developing proprietary protocols, with a number of other companies working on their own attempt to unify these (which in turn creates a larger number of competing protocols). These developments present challenges to the planning of IDSM programs, as it is risky for programs to align /invest in a technology or protocol that may become obsolete. At the same time, there are important considerations and programmatic opportunities related to moving these markets toward IDSM solutions as they develop.

One downside to the evolution of technical functionality of communication devices concerns the possibility of security breaches, enabling cyber criminals to hack into home networks and take control of all devices on the system. In January of 2013 Reuters reported an incident of hacking that involved more than 750,000 malicious email messages routed through more than 100,000 everyday consumer gadgets such as home-networking routers, multi-media centers, televisions and at least one refrigerator. These devices had been compromised and used as a platform to launch the malicious emails. Cyber-security firms such as Proofpoint Inc, are working on a new generation of software packages to address the issues.

Since DR is an emergent property[21] and arises from the combined action of many different devices, controls and systems, some load-shifting technologies were inevitably missed. In general, the technologies discussed here tend towards providing control over an entire subsystem, such as HVAC or lighting. Smaller controls, such as dimmable ballasts for luminaires or individual plug controllers, often failed to mention end usage and were not explicitly designed or marketed for IDSM purposes. As such, they convey only that DR is still a tool peddled by middlemen, rather than being open to the average customer. Our review of technology below focuses on systems purveyed to the end-user, sometimes in direct contrast to those sold to utilities and the like.

Building Code – Title 24

A recent change in California's building code is reported by some to have the potential to spur use of not only advanced thermostats but other building automation technologies in both the residential and commercial sectors.[22]

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[21] "Emergent property" definition: any unique property that "emerges" when component objects are joined together in constraining relations to "construct" a higher-level aggregate object, a novel property that unpredictably comes from a combination of two simpler constituents. http://dictionary.reference.com/browse/emergent+property

[22] http://www.zondits.com/article/4374/california-spurs-building-automation-building-code-requirements?utm_source=List+%233&utm_campaign=d00f22d222-Industry+%26+Efficiency+Excel+When+Working+Together&utm_medium=email&utm_term=0_80bcb2d78c-d00f22d222-135719789

As part of Title 24, California's building code, the state will begin requiring thermostats, HVAC systems, lighting controls and building automation systems to be able to communicate with the grid for demand response purposes. Devices will be required to use OpenADR or ZigBee-based protocols to receive and respond to utility messages. Although the requirement is mainly oriented toward demand response, it may also promote growth in the building automation sector.

In addition to DR companies, makers of smart hubs and gateways that control HVAC, lighting, smart appliances and other systems will also benefit from the Title 24 requirements. These systems will not only be able to communicate with the grid for demand response purposes, but they can independently serve as light building management systems and also as a means for collecting and analyzing building performance data.

4.3.2.1 Energy Management System

An Energy Management System (EMS) provides tools to aggregate and monitor individual electrical loads throughout a facility in the commercial and/or industrial sectors. In general, this is a device that monitors facility energy use and offers remote monitoring and sometimes control. Some integrate with existing building automation systems (BAS) and provide analytics and supporting software alone. Solutions can focus on single-facility management or management across a group of facilities such as a franchise or a campus. Some are proprietary, controlling only the parent company's other manufactured systems; others are designed to be compatible with most systems. We discovered 15 total EMS products during our research including both software-only and bundled hardware options. These are largely offered by companies focusing on manufacturing of EMS and building control systems, and some are segment focused, explicitly naming their commercial audience as grocery stores, retail and fast food chains.

Nine of these systems did not specifically mention that they could aggregate data from separate buildings; of those, three were software-only without any hardware component. Most bundle fine-grain reporting and controls with basic analytics such as alerts for unusual energy usage. Two companies, Comverge and EnerNOC, offer a system as a perk for enrollment in DR programs. Though these systems are exclusively offered to commercial and industrial organizations, the distributor often marketed directly to the facility manager. All but one offer behavioral monitoring, and half also offer the ability to program energy-efficient building automation; two also offer controls over diesel generators in order to shave peak demand. Two other systems have no ability to communicate with utilities directly—their systems only have automatic internal controls to implement peak shaving.

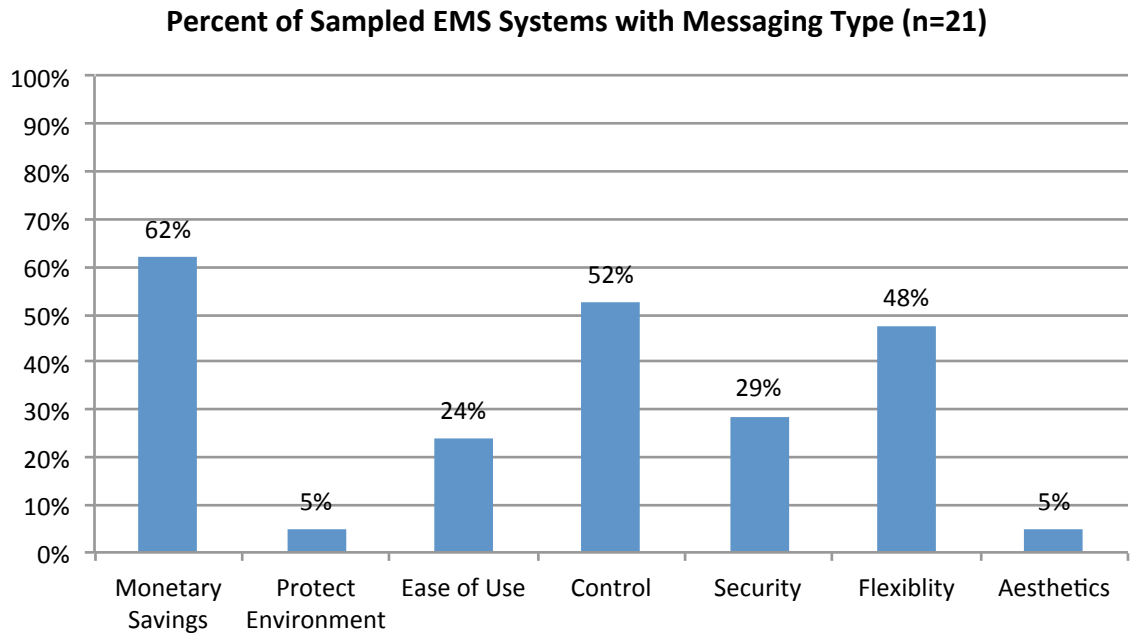
Messaging consistently focuses on lowering bills and establishing control over energy use, though one firm in particular (PowerIT Solutions) marketed itself specifically on integration as a way to maximize savings and accelerate ROI. Marketing also specifically spoke to a lack of trust, whether of utilities or of workers themselves. Remote controls and energy monitoring are sold as a way to keep control in the hands of managers, while report analytics could be used to dispute utility bills. One company, in particular used taglines like "puts your business

rules first and smart grid second" or "are you tired of experimenting with demand response programs?"

Six more companies offered cross-facility EMS. The marketing points for these systems were roughly the same as those without cross-facility control, but there was increased messaging on freedom and flexibility added to the usual money, control and security notes. The following are taglines from three separate manufacturers: "Anywhere, anytime demand management," "The information you need when you want it, where you want it," and "Easily access YOUR data, after all it is YOUR data."

Figure 4 below summarizes the features emphasized in the EMS marketing materials that we reviewed. Monetary savings, control and flexibility are the most common features that were emphasized, included in messaging for about half of the EMS products reviewed.

Figure 4: Marketing Messages for EMS



4.3.2.2 Home Area Network

"Home Area Network" is a relatively newly coined term. Strictly speaking it refers to the digital connectivity and interoperability of in-home "smart" devices and computers, such as mobile phones, entertainment technology, thermostats, home security systems and smart appliances. Networking devices can be used in a variety of ways, such as to automate repetitious tasks, increase personal productivity, enhance home security, and provide easier access to entertainment. In the context of electric utilities, HAN has developed a slightly different meaning – referring to the extension of utility metering and communication systems to interface with equipment in the home to results in enhanced energy monitoring or management. The term has evolved within the utility space to include any in-home technology

networked to utility systems and communications. For example the California IOUs HAN pilot programs included deployment of devices that were connected to the home's real time energy consumption data, but not to any other devices or equipment in the home. These devices would present real-time information on energy consumption to the homeowner, but were independent of any connections or interoperability between smart devices and computers in the home. While this is a relatively basic example of HAN, this category of technology includes the extension of utility systems communications to include two-way communications with smart thermostats, direct load control appliances, and smart appliances, as well as to enable demand response (DR) and energy efficiency programs.

In this section we discuss HAN in its generic (non-utility) sense, i.e. as a localized system of hardware and software that enable connectivity and interoperability of a home's digital equipment and devices. One could consider Home Area Network as a building automation system on the residential scale. Though in general modern remote-control thermostats and smart appliances are increasing the ability to automate the home, the end goal of the HAN is to integrate systems and connect disparate devices with user-created logical programming. For example, a light might be programmed to turn on when an intruder enters the house.

In the current marketplace, we could identify only one retailer, Lowe's, selling such a packaged system, though many vendors sold components that could be assembled into a HAN if one shopped in enough stores and were willing to do enough work developing the controls oneself. The Lowe's system, "Iris", comes in three different versions: one focused on "safety and security," one on "comfort and control" (energy efficiency), and a third package combining the other two. In general, Iris focuses on convenience, lowered energy bills and peace of mind—that it is reliable and easy. However, the packages are fairly rudimentary; the "comfort and control" package offers only a single smart plug and smart thermostat. Customers communicate with their devices through ZigBee, z-wave, Wi-Fi, PLC lines, or pagers. These devices can be controlled and programmed for efficiency through the Iris platform, which Lowe's says is the only one to function with all three major protocols—ZigBee, z-wave, and Wi-Fi. The platform is offered free with limited functionality, though it also has a premium version with which one can set up automatic peak shaving and various other amenities.

The issues facing both the HAN and the EMS right now are the same: controls are available for individual loads and appliances, but—much like the internet in its early days—there are issues with protocols and proprietary formats. Some companies offer subscription services; building control platforms often only integrate well with proprietary devices. Simultaneously, large companies with stakes in provider-agnostic controls—such as DR aggregators or companies that focus almost solely on EMS—are pushing towards a single protocol. But unified creation protocols create business security issues for manufacturers who have never before specialized in that kind of computing. The 2013 Black Hat USA conference demonstrated methods to hack into z-wave protocols and open networked locks remotely.[23]

[23] Slashdot http://slashdot.org/story/13/06/26/1339253/black-hat-talks-to-outline-attacks-on-home-automation-systems, accessed 1/17/2014.

That is to say, a hacker with access to such methods would be able to physically enter any home with the door locking mechanism controlled by z-wave (and the same persistent security flaw present). Selection of a single protocol before development of robust security measures could prove catastrophic.

As such, the "Internet of Things" is having the same growing pains initially experienced by the regular internet. The question in the years to come will likely be: “Is the expense worth it?” The SDG&E study found the return on investment to be marginal for most customers, and interest in purchasing the technology was moderate to low.

4.3.2.3 DR-Enabled Efficient Lighting

Historically, it has been difficult to implement DR with Lighting Systems. Unlike large appliances controlled by a single plug, lights require control of a number of loads distributed to different sockets. Traditionally, establishing this control would require rewiring a building—and, once that building had been rewired, there is the consideration that light is essential to worker productivity. Lights cannot be cycled like AC systems in areas where people are working, but must rather be dimmed—preferably in such a way that the occupants do not notice.

Some companies have been working on developing a solution, like Philips Lighting Electronics. It sells not just bulbs, but a line tantamount to a complete office lighting system. This system is set up to comply with California’s new Title 24 regulations for new buildings of size 10,000 square feet and greater—specifically, that their lighting be both energy-efficient and wired for auto-DR, as well as being set with dimmers and occupancy sensors. Philips’ marketing messages center around compliance with Title 24 explicitly, along with reducing energy costs, promoting sustainability and enhancing occupant comfort and productivity.

The residential lighting solutions offered by Philips are coupled with an artistic bent for creating “scenes” with smart phone-controlled colored lights, thus making what is traditionally a simple spending choice (“does it light my house or not?”) into a question of entertainment, fun and individual preference. Philips is also an international manufacturer of medical and consumer LED screens, sound/recording systems, and other consumer electronics.

Given that Philips has recently partnered with Disney to introduce a new line of lighting (sold through Apple stores), it seems expectations for success are high, for high-end consumers and technology enthusiasts. And, since DR-enabled lighting is now law for new and renovated larger buildings, there will likely be growth in this sector going forward—whether through emerging companies or existing companies retooling their products to comply with new standards.

4.3.2.4 Smart Appliances

Adding smart functionality through Tridium’s Niagara Appliance allows any piece of electronic equipment to be added to the so-called “Internet of Things” and be controlled

remotely or through a local network hub. Though this small bundled hardware and software solution is not explicitly marketed as EE or DR, IDSM applications for these sorts of controls are very common (see the Smart Thermostat or EMS sections). The bundle is meant for manufacturers to place into appliances, which are then sold to consumers.

Tridium positions itself as a knowledgeable industry insider concerned with the customer's bottom line. It argues that smart functionality is in high demand by end users but difficult to implement—and that therefore the manufacturer should use Tridium's solution to cut development, R&D costs and time to market. Furthermore, adding smart functionality will open new markets, increase sales and improve the bottom line by supporting advanced service offerings and reducing support costs.

Selling such a device is an interesting choice on the part of Tridium, the creator of Niagara AX. It is a manufacturer-agnostic EMS platform that markets itself on its ability to unify different communications protocols and link together different proprietary systems. Increased adoption of Niagara Appliance implies fewer proprietary formats, and in turn, neater solutions for Niagara AX.

For example, Whirlpool sells a line of smart appliances called "6th Sense Technology Appliances." The key feature of this line of refrigerators, washers, driers and dishwashers is that they can be controlled remotely by smartphone, though they also have a variety of sensors installed to give periodic updates—for example, on whether or not the dishwasher needs more soap or has finished its cycle. The systems are also installed with energy-efficient programming with the ability to track time-of-use (TOU) rates and respond accordingly. The systems also have other luxury features such as refrigerator ventilation systems to reduce stale air and the like.

In this case, it seems that this line of technology is a fairly normal outgrowth of already extant appliances. Unlike machinery designed to run on solar power, which require great developments in operational efficiency, no radical redesigns appear necessary in order to install the computer hardware in question. All the same, they are high-end, expensive appliances, which will be beyond the reach of most consumers.

Marketing messages are overwhelmingly focused on security, repeatedly referencing peace of mind, confidence and the ability to not wonder about the state of one's home. Secondary messages reference the ease of lowering energy bills and the appliances' modern aesthetics, as well as a consumer-oriented feature rundown.

When it comes to adapting new technology, it seems that minor improvements in core functionality can have a large impact if they save the customer anxiety and the need to plan ahead. For example, many smart phones are purchased based solely on the ability to check email and look up directions. Using this same reasoning, it seems probable that the additional security of smart appliances (and smart homes) could drive them to become essentials for the high-end consumer.

4.3.2.5 Energy Monitoring Devices and Home Area Networks (HAN)

Policy Context

In October 2012, the California Public Utilities Commission (CPUC) directed the state's investor-owned utilities to ensure interoperability between in-home energy monitoring devices and installed advanced meters. In conjunction, the CPUC directed the state's largest utilities to facilitate a competitive, third-party retail market where customers can select from a variety of in-home energy management devices capable of communicating utility-sponsored energy conservation measures and enabling consumers to respond to demand response events.[24]

IOU HAN Pilots

In accordance with CPUC Decision 11-07-056, and as part of the smart meter funding Application, each of the IOUs have launched or completed HAN pilots. These pilots and programs offer customers devices that monitor energy use and prices in real time, similar to the In-Home Display device discussed below. SDG&E's HAN pilot included In-Home Display functions along with appliance monitoring and direct control.

In April of 2013, SDG&E published an emerging technology study of a HAN with DR enabled Smart Appliances. For this study, electrical home appliances were networked to a control hub that received pricing signals from the smart meter and then sent signals to appliances to initiate control. The hub also tracked appliance and whole house consumption. Appliances were pre-programmed to respond in a specific way to pricing signals, though there was an optional override offered to the consumer on each appliance interface. The study found the HAN did result in power reductions during critical price events, but that the system was marginally cost effective and not an attractive purchase overall from the customer perspective.

In-Home Display

An In-Home Display is an electronic device that attaches to the wall much like a thermostat, but which has no in-home control functionality. Instead, it acts as a way for utilities to display messages in the home. In particular, it can provide information on the home's energy usage (behavioral monitoring) along with TOU pricing.

The Wiser™ In-Home Display is the central component of the Wiser home energy management solution. It allows homeowners to easily monitor and control home energy use through informative displays and color changing screens that alert users of changes in home

[24] California Public Utilities Commission (CPUC), Resolution E-4527, Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E), September 27, 2012. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M028/K949/28949960.PDF

Note the CPUC resolution directs investor-owned utilities to satisfy the intent and requirements of Ordering Paragraph 11 of the CPUC's Customer Data Access & Privacy Decision, 11-07-056, Issued July 28.

energy use and pricing. Just like the smart thermostat, the display also shows general interest information such as time and temperature. The Wiser In-Home Display is designed to operate with Wiser energy management system components including the Wiser Smart Thermostat and Wiser Load Control devices.

In home display can also serve as an alternative to smart thermostats, so that rather than purchase a new thermostat, a customer might add an in-home display to the device already present. As the market trends toward adding more and more functionality to thermostats, it is difficult to know which technology will prevail.

4.3.2.6 Thermostats

Thermostats were one of the most varied types of products we studied, with a total of eleven entries. The standard thermostat controls the HVAC system to maintain indoor temperatures, though some models now also control humidifiers. Models can be manual or programmed to cycle temperatures at set times. "Smart Thermostats"[25] have radio or Wi-Fi capabilities in order to communicate with utilities, and yet others come bundled with a smartphone app for consumer remote control. Furthermore, an emerging variant called the "learning thermostat" allows a customer to provide some basic information, from which the learning thermostat gleans its owner's preferences and programs itself.

All of the IDSM-technology thermostats we reviewed were both capable of some kind of DR and programming, the latter serving to cut down heat waste and make a household more energy-efficient. In general, messages about DR capabilities were directed to utilities, while messages to the consumer focused on energy efficiency. Most of such cases even had the information on separate pages, sometimes with notes on DR functionality buried deep within the website. Some thermostat offerings, not reviewed here, vaguely stated that the device was ZigBee-compatible or supported the smart grid without any further explanation anywhere of what this meant.

A total of six thermostats surveyed were so-called smart programmable thermostats without tie-in smart phone apps. Of these, five were marketed to utilities for consumer use; the Chinese company Computime Limited sells the other one, with no marketing aside from the most bare-bone list of functions. Those marketed to utilities emphasized being "future-proof," i.e. scalable and capable of flexibly working with a variety of different protocols and programs. One also addressed readability, and another its sleek design.

These companies also tended to be large, with a focus on HVAC systems and building controls; some had a very long line of legacy thermostat models. Comverge states that it services 60 percent of the existing residential DR base; Cooper calls itself the "industry-preferred demand

[25] In the domain of home automation, including the green technology subset thereof, any product that can be remotely controlled by the *consumer* is called "smart." That is not necessarily the case here—most "smart thermostats" can be remotely controlled only by the utility.

response solution with over half a million deployed across North America."[26] ComfortChoice Touch is recorded at selling 200,000 units through the United States. Some of the companies appeared within the past ten years, with some older and well established across a variety of industries.

Three more models had an associated smart-phone app but no learning capabilities, with one (by Energate) marketed to utilities and the other two directly to the consumer (Radio Thermostat Company of America and ecobee). Energate works in demand response and home energy management solutions, while the Radio Thermostat Company of America (RTCA) deals exclusively in thermostats. Again, Energate emphasizes its support for a variety of utility DR programs, whereas RTCA argues that traditional programmable thermostats are too hard to use, and that their smart app makes it fun to control the device while out and about so that energy is not lost by a program on autopilot. The bottom line is monetary savings on the part of the consumer.

The ecobee Smart Si, on the other hand, is a recent update on ecobee's original design. Its marketing tagline is "Easy. Smart. Green," and it is sold more on its function as a convenient remotely-controlled device than its ability to automatically adjust to TOU rates. The thermostat also comes bundled with a web portal for easy analytical tracking and review of energy savings, access to weather updates and alerts on system function. The company also sells accessories like vanity thermostat faceplates and has begun a tentative foray into home animation, with plugs that can be remotely controlled from the online thermostat interface.

According to a 2013 report by Navigant,[27] ecobee is the fifth most prominent thermostat vendor worldwide, with Energate taking the sixth position and RTCA coming in at ninth.

Finally, there are two learning thermostats, by Honeywell and Nest. According to Navigant's report, Honeywell leads the thermostat industry, followed with Nest in second place. Honeywell also sells a wide variety of HVAC and refrigerant paraphernalia. Nest, which was founded by the lead engineer of the original Apple iPod and iPhone in 2010, sells a thermostat and a smoke/CO alarm, branded throws and reusable water bottles, and has recently piloted a DR aggregation program. Both of these companies market directly to the consumer but take different tactics. Honeywell, as the market leader, has an extremely extensive and varied line of thermostats from manual versions to a learning thermostat that interviews the user and can change its color display to match home décor. The size of their line and their position in the market allows them to sell almost completely on features alone, as though it were

[26] http://www.cooperindustries.com/content/public/en/power_systems/products/demand-response/programmable-thermostat.html

[27] Energy Manager Today. http://www.energymanagertoday.com/honeywell-tops-navigant-smart-thermostat-ranking-096874/, accessed 1/15/2014

guaranteed that the customer is already prepared to purchase a thermostat from Honeywell—and the only ambiguity being which one the customer would choose. The Prestige 2.0 Comfort System is distinguished further by its ability to automatically respond to TOU scheduling and by its readability. It learns the occupant's preferences through an interview system.

The Nest thermostat, on the other hand, has the owner answer an initial interview, and from there allows them to treat it like any manual thermostat. It then learns the occupant's schedule and preferences from these manual inputs, and in conjunction with an occupancy sensor and remote control via app, works to keep the house heated comfortably when there are people in it, and save energy when they are out. Users can also receive a monthly energy report with an energy use summary and tips to help save. The Nest also marks energy use below the programmed norm, and since continually keeping temperature below the average will drive that mean down, the thermostat acclimatizes users to more natural temperatures through time. In other words, they have brought low-impact gameification to the household thermostat.

The key to Nest marketing is using language similar to that usually directed at parents purchasing items for newborns or beloved pets. The customer does not "get," "own," or "buy" a thermostat, but rather "bring [theirs] home." More crucially, the user is admonished to teach the Nest thermostat well. The programming process is treated as organic, rather than mechanical. The shift in tone completely rebrands the thermostat's primary function as a friendly artificial intelligence rather than as a necessary tool to control the HVAC system. Indeed, almost all of the thermostat and EMS systems specifically used control and security language, but Nest focuses on comfort and ease. They also do not use global warming scare tactics or mention the environment at all—the language is very geared to personal choices, customization and individual comfort rather than the "join the movement " slogans found elsewhere. The packaging for the product is even based on traditional Japanese giftwrapping.

This persistent rebranding continues into their auto-DR programs, grouped under the friendly title of "Auto-Tune." The company is careful to distance itself from demand response, and even goes so far as to say that what it is offering is not demand response at all, despite the fact that it involves utility equipment adjustment during peak use periods. Instead, whereas opt-in DR usually requires manual adjustment and auto-DR leaves consumers feeling that they do not control their own environments, Nest promises that the adjustments will be automatic and tailored to personal preferences—but that the user can change the thermostat at any time, just in case.

5. In-depth Interview Results

5.1 Utility Staff Interviews

This section presents findings from the in-depth interviews conducted for this market study. Interviews were conducted with

- Utility staff, with expertise in IDSM marketing, and IOU IDSM products, services and data management;
- Private sector market actors working with IDSM products and services; and trade organization representatives.

5.2 Utility Staff Interview Findings

We conducted interviews with IOU staff to help meet a number of study objectives. We wanted to begin by gathering existing knowledge from staff about residential and small commercial IDSM customer preferences.

The IOU IDSM program managers are responsible for their organizations' efforts to support and promote the implementation of integrated solutions in the small commercial and residential markets. We interviewed these staff to better understand current and planned strategies to reach these markets and to gather perspectives and feedback on the proposed research approach.

IOU marketing staff are working to develop online tools and integrated marketing strategies, and have amassed a body of knowledge from that experience related to those markets. We also wanted to understand their information needs and priorities surrounding IDSM customer wants and needs so that we might refine our research approach to better reflect those priorities.

The IOU data management staff responsible for the data sources and uses related to the integrated online tools understand those resources well. We interviewed these staff to determine current data resources and how they might be leveraged to better understand the IDSM customer wants and needs.

In total, we conducted 12 interviews with 19 IOU staff members. Three interview guides were developed to support the IOU staff interviews, one for each of the following types:

- IDSM program managers
- Marketing/Market research staff
- Data managers

Detail on the number of interviews done with the number of staff by topic and IOU is shown below in Table 5.

Table 5: IOU Staff Interviews

	PG&E	SDG&E	SCE	SCG
IDSM Program Managers	• 1 interview with 2 staff	• Discussion at Kick-off call	• Discussion at Kick-off call	• 1 interview with 1 staff
Marketing Focused	• 1 interview with 5 staff	• 1 interview with 1 staff	• 1 interview with 2 staff	
Data Focused	• 2 interviews with 1 staff	• 1 interview with 3 staff	• 2 interviews with 2 staff	• 2 interviews with 2 staff

5.2.1 Marketing Principles

The objective of this study—to characterize residential and small commercial sector wants and needs with respect to IDSM—is also a basic element in any effective marketing strategy. For the sake of considering our study objective from a broader perspective, the following section presents some basic elements of an effective marketing strategy:[28]

- **Understand your customers' wants and needs:** The wants and needs of the target market influence the way products and services are best designed and how to best market them.
    - Segmentation allows for greater accuracy in defining wants and needs, and provides the basis for targeted messages that address those wants and needs.
    - Customers' wants and needs change over time, leading to different "need-states". Need states often change due to life-events, business milestones and a myriad of other factors.
- **Provide relevant products and services**: Position and promote your products and services so that they are attractive to the target market.
- **Emphasize solutions and benefits**, ***more than features***: Solutions and benefits are the true value of any offering and will more likely ignite emotion and ultimately move customers to take action.
- **Build a relationship with your customers**: Demonstrate an ongoing benefit to engagement. Make customers rely on you, and know that they are better off because of what you can offer them.
- **Be consistent in branding products and messages**: The key here is to build familiarity and appreciation, to leverage the value of consistent delivery on promises, and to maintain a consistent overarching branding message.
- **Marketing is an ongoing process; it never stops**: A business that wants to be sustainable and profitable should continually invest time and energy in marketing.

[28] Adapted from Thrive Business Center, a business marketing consulting organization. http://www.thrivebusinesscenter.com/1/post/2013/05/7-fundamental-marketing-principles.html

These basic marketing principles were developed for the private (unregulated) product/service market, but provide a good general framework for considering the objectives and outcome of this study within the greater context of IOU efforts in providing effective IDSM information and services.

5.2.2 Continuous Engagement

One of the central goals of the utility IDSM offerings to the small commercial and residential sectors is to engage customers in an ongoing way, so they are continuously interacting with IOU resources and information. The goal is not a single-moment market intervention to achieve a specific retrofit or measure adoption; the goal is to engage them over time as supporters and partners in their energy management—being present through critical 'need-states' to ensure customers find the best opportunities for IDSM improvements through both behavior and measure adoptions.

Continuous engagement has other energy conservation benefits. It provides the utility a reliable and effective channel to reach customers with information in real time. This can be a useful tool for demand control, as well as for the dissemination of new information for managing energy. Moreover, it provides a platform for the customer to become educated, so that when a 'trigger' or a 'need state' arises, the customer has a good foundation of understanding from which to draw.

As evidenced by a plethora of current product offerings—some of which are nearly ubiquitous—customers are interested in metrics that reflect their actions, behaviors and accomplishments. There are wristbands that track steps taken, hours slept and heart beats. There are many sport-related apps to track minute details of each endeavor, elevation, length, speed and acceleration. We also track grocery consumption, spending, goals, communications and more. Given this, it is highly likely that consumers will both want and *expect* there to be an application to track their energy use in real time. Furthermore, nearly all of these tracking applications also provide avenues for sharing these tracking data with others.

We can be sure that people are interested in tracking personal metrics and sharing them with others. Getting consumers to really care about saving energy is more challenging. For this there is documented success in leveraging the social aspect of tracking—such as with community competitions, or "gameification". In a recent presentation by a program manager working in Massachusetts,[29] community engagement works by first understanding the social networks that exist in a community, then finding the trusted organizations and information/social hubs and enlisting them in a shared goal. The third step is giving ownership of the efforts and rewards to the community organization, so they are empowered to design and deliver their promotion—or reach their goals, as they choose. This allows them to build strategically from within existing networks rather than establishing new ones.

[29] PG&E's 19th Annual Conference – "Building an Energy Efficient Future: A National Perspective", April 2014.

The objective of the PG&E online tools is to draw customers into a circular loop of "Awareness > Education> Actions> Continuous Engagement> Education". The strategy employed to meet this goal is grounded in data—in the acquisition, analysis and use of customer and energy consumption data.

SDG&E emphasizes that the underlying goal of IOU efforts is to inspire customers to take actions they have not considered before or to revisit their conservation options and continue taking actions as they have in the past. The strategy is not simply to be present as a resource, but to be proactive and continuously encourage those behaviors through communications, social media and financial incentives.

> *"What we are doing is trying to either a) jumpstart the customer to do something they haven't considered before, or b) promote behavior that they have exhibited in the past by participating in other offerings…we want to continue the encouragement of those behaviors…Rather than waiting for the customer to contact us, we reach out to them and give them options to start with. And then if we tag a coupon on that we can really make a difference in the choices people make."*

SCE notes that the current commercial online audit tool is limited in its ability to achieve its goal of continuously engaging customers. However, the new product—scheduled for release in September—offers the potential for improvements. Meanwhile,
SCE is working hard to incorporate community-based strategies to inspire continuous engagement, including gameification and social media.

5.2.2.1 PG&E

PG&E considers its suite of commercial tools to be a path of sorts, for customers to walk on an "energy management journey," which begins with very basic information and proceeds to escalate the level detail and personalization based on user behavior. Logistically, the journey begins by guiding customers through the Business Energy Checkup and then moves towards being able to provide the very specific thing the customer is after. The underlying concept is that it does not work to talk to all customers the same way. Customers are at different stages in their journeys, and it is important to begin any interaction by establishing where those customers fall in the journey. For example, a customer may be a beginner who has not even participated in a rebate program, or they may have LED lighting and a green roof. If the customer wants more opportunities, PG&E might suggest DR programs they could be involved with. Or, if the customer has done a major custom retrofit project, PG&E may offer to bring a representative in to talk to them about DG. The key to the PG&E approach is knowing that customers are in different places with respect to their IDSM wants and needs, and having the ability to provide a range of services and information from basic to complex.

5.2.2.2 SCG and SDG&E

SCG and SDG&E launched their residential tools in 2012 and nonresidential tools in 2013. Both utilities worked with the same vendor, Aclara, to develop the software. IOU staff emphasize that while the previous HEES was a one-time event, the new tool is integrated and

is interactive so that customers can go back in and modify or create their energy action plans. Also in keeping with the continuous engagement approach, the tool is designed to develop and maintain a custom energy management plan for each audit recipient. The tools are relatively new, and both utilities are working to refine and enhance their functionality and the data management aspects.

At a high level, the tools use monthly billing data along with information from utility databases, in combination with information entered by the customer into the tool to construct a breakdown of energy consumption. The energy consumption profile is provided graphically to the user as a pie chart and provides the foundation for savings recommendations. When users enter additional or updated information, the consumption profile is updated, as are the energy savings recommendations. The tools present behavior-based recommendations and water-saving recommendations; provide information about available rebates, alternative rates and demand response programs; and offer a solar calculator. The user is asked to respond to each recommendation indicating their level of interest—from a refusal to consider to a note that the action is implemented.

Both SCG and SDG&E report having been successful in attracting substantial numbers of customers to use the tool (approximately 40,000 for SDG&E and 100,000 for SCG). However, at some point in the process of assembling their customized energy plan, customers tend to drop off, and only about 5 percent have completed and saved their energy plan. It is worth noting that the CPUC goals and reporting requirements are based on the number of unique customers assembling a plan, and so the tools' accomplishments in terms of continuously engaging any single customer are not currently tracked or incorporated in the IOU goals.

5.2.2.3 SCE

SCE currently offers integrated online audits to both the residential and small commercial segments. They offer a "Home Energy Advisor" tool to residential customers and a "Business Energy Advisor" tool for small commercial customers. These tools provide integrated IDSM solutions across EE, DR, and DG (primarily solar PV). At the time of our interview, SCE was in the process of expanding their online audit tool, and in particular they are working to enhance the customer engagement aspects of the tool.

> *"We are trying to maintain a relationship with our customer on an ongoing basis—more so than in the past—to create a continual interactive approach that goes beyond what we have already been providing."*

SCE reported it is working with vendors to specify software features and requirements for a new generation of online Energy Advisor tools. It is considering an array of functionality, including those functions exemplified in the other IOUs' online integrated audit tools. It anticipates the new tool will use customer profile data, usage data and building type data to offer recommendations and potential opportunities for customers. It anticipates tracking what type of information is sought and received, and what actions customers take as a result

of SCE efforts. A high priority for the business efforts is to be successful in customizing messages to customers. SCE is running a pilot program through its 365 program to examine the accuracy and relevancy of IDSM marketing messages. The pilot will include a close look at these as well as the customer response for a sample of 120 small commercial customers.

5.2.3 Basics of IDSM Marketing

This section presents the themes garnered from our conversations with IOU staff that reflect the concepts, approaches, strategies and principles that guide a successful IDSM effort.

5.2.3.1 Keep it Simple

It is well understood among the IOU staff interviewed for this study that one of the big challenges in reaching residential and small commercial segments is simply the size of these segments—the sheer quantity of customers. With segments of this size, mass marketing efforts are the cheapest method of reaching customers and have been historically proven to be the most effective route. Furthermore, with mass marketing, *simpler messages resonate more clearly*; therein is the crux of the challenge. The core value of IDSM is in creating an understanding of *all the energy management options available* in order that the customer may optimize their selection(s). One interviewee states the problem well:

> *"In the mass market the major challenge is that you're not able to provide the one-on-one support. IDSM options can seem complicated and one of the requirements of a good mass marketing strategy is to keep messages simple. "*

> *"… when you want to present something more complicated—more choice, more measures, and/or more money invested, it is difficult to accomplish effectively without a one-on-one interaction. For the IOU, it is hard to justify that kind of one-on-one attention, due to the cost and the size of the market."*

Without using one-on-one communication, IOUs strive to provide information in a way that is comprehensible and usable to the customer. Both the Aclara (SCG and SDG&E) and the Opower (PG&E) tools focus on clear, basic information, and allow customer interest to initiate and guide themselves to more detailed data.

> *"The integrated audit in some ways has a broker role. It doesn't really provide services or product but it helps the facility leverage the different offerings; it answers questions and provides a roadmap."*

IOU staff relate that customers want both simplicity and ease of use. The more keystrokes, clicks or apps it takes to manage energy affairs, the more confusing and complex that management becomes. People are drawn to resources and solutions that they can trust to address a breadth of everyday wants and needs, in a simple and intuitive way. The IOUs are working toward achieving this, with a new focus within EE pilots and programs on

establishing centralized information resources and support—such as the "single point of contact" approach in the Energy Upgrade California pilots.

We learned from IOU staff that customers want information fast, and they want it to be clear. They do not want ambiguity or complexity—at least with respect to their energy. They do not want to navigate through a long form before finding answers; they want answers immediately, or they will drop the effort and try Google instead. That is part of why the Energy Star program works so well.

> *"It is a binary rating system; either the equipment is efficient or it is not—and the label is right there, it's all you need to know. "*

The current strategy to address these needs effectively is to provide guidance through the portfolio of efficiency options by distilling complexity into sets of simple, clear axioms, at various levels of detail, and then offering them in a staged approach using customers' indications of interest to trigger the provision of more detailed information—while providing a consistent stream of basic clear, information all the way along.

5.2.3.2 Clear Benefits

Another axiom of customer preference surrounding efficiency solutions is related to outcome; the needs to perceive a clear benefit from the action or investment.

> *"We have promoted a wide range of EE and DR to customers. Some very basic communications theories have played out very strongly in these communications.* ***You have to make sure you have a benefit that you are talking about to the customer or they won't listen****."*

This general principle underscores the importance of understanding the customer perspective, to know what challenges they face and what outcomes are perceived as a clear benefit.

> *"If you know the challenges that face them, it's much easier to offer them solutions."*

This is consistent with the general marketing principle cited previously, to "Emphasize solutions and benefits, more than features". The principle states that solutions and benefits are the true value of any offering, and will more likely ignite emotion and ultimately move customers to take action.

With respect to IDSM/energy management solutions, communicating benefits is critical because energy consumption is not something customers consider in a direct way, as indicated by an interviewee:

"You don't invite people over to see your new AC. You'll talk about the benefits of the AC but you don't talk about the energy usage. The benefits have to be very clear cut to customers."

Further, IOU staff experience and market research to date indicate that financial benefits are the most important and most broadly applicable:

***"Financial benefits outweigh everything else** and that has been true since I started working in the 1980s. Environmental benefits are good for some people if they are properly segmented, and you can reach them with targeted messaging."*

5.2.3.3 Personalize

The continuous engagement cycle involves moving customers in a cycle from awareness to education to actions to greater education, and more awareness, in an ongoing way. When we were shown this structure, we asked,

"What is the main driver that moves customers from awareness to action?"

The immediate and direct response was,

"The information has to be specific to them."

Another interviewee notes

***"Messages that are personal (resonate) better** than those that are societal. While the societal messages are important and do motivate some people they aren't as strong as the personal messages."*

The importance of personalized messaging was emphasized repeatedly during our marketing staff interviews; that is, if information and messaging is highly personalized, it will be highly effective. The more customized and directed the information is, the more time and interest it will garner from the recipient. Technology has provided the IOUs and customers access to a whole new level of personalized information regarding energy. Real time access to usage and Advanced Metering Infrastructure (AMI) data, in combination with existing building science, provides the IOUs with the foundation to offer insights and real-time feedback specific to each customer.

Interviewees noted the success of the Opower Home Energy Reports, pointing out that customers are interested and responsive to these because they reflect their own *personal* energy use. Personalization is just as important in the small commercial sector as it is in the residential sector.

For the small commercial sector, personalization begins with accurate and narrowly-defined business type segmentation. It is generally agreed upon by IOU staff that accurate business type segmentation is critical to the success of the commercial online integrated audit; it provides the initial customized profile of the business entity that the online tool begins with, and good segmentation will allow the tool to fit more closely with the particulars of the business receiving information.

Businesses vary greatly by their operations, products, services and customer base; these variables also effect the businesses' equipment and operational requirements and ultimately, the guidelines and priorities that govern their energy use. PG&E noted that it places a high priority on accurate business type segmentation in its selection of a vendor to develop its small commercial online audit tool. A PG&E Interviewee says:

> *"… with businesses you have to talk to them in the way that they understand themselves… the nail shop is different than the hair shop. Our customers will say to us "Your report is not right, you had us down as a salon and we do nails, so this report isn't accurate". Pulse (selected vendor) was really strong with their segmentation."*

The IOUs leveraged information they already have about customers, including information about the business activities and facilities, previous program participation, and energy usage and practices, in order to make the customer contact as personalized and customized as possible. Each contact is designed to build on the previous one. For example, if a customer completes an online audit during a first visit, and three weeks later returns and enters additional information, the software will add the new information to the previously collected information and reformulate the audit estimates of costs and savings, recommendations and other outputs.

> *"Our (small commercial) strategy is to target a well-defined subset, such as restaurants within a certain square footage. Then to send comparative reports on energy use that show—for example, 'Dan's Burger Joint uses one-and-a-half times the energy of Ted's Burger Joint just up the road'. That gets peoples' attention. If this is paired with an actionable recommendation and a financial incentive, such as a pre-arranged coupon the customer can take to their Home Depot—that is the most effective combination. The behavioral approaches being developed now, including the energy comparison reports, segmentation and audit technologies, provide all the needed pieces for this approach."*

5.2.3.4 Easy Implementation

IOU staffers understand that residential and small commercial customers prefer very clear, easy directions to implement any energy management action. A key element in promoting customer DSM actions and adoptions is to make the steps very simple, very clear and quick to implement, particularly with small business customers, where time and money is usually in short supply. Even the forms and waiting time associated with rebate programs can be a

deterrent to participation. In a recent national conference on energy conservation efforts,[30] a speaker representing a trade organization for appliance sales and manufacturing notes that in some cases appliance contractors will lend the utility cash rebate to the customer upfront so the customer does not have to wait or fill in any paperwork themselves. These quotes from IOU staff interviewees illustrate the point well:

> *"It is very important how information is packaged so there **is a very clear call to action or step** because energy overall is not exciting and it is a low involvement thing."*
>
> *"Programs need to be nimble … you literally have to tee up the (project) for them… so that all they have to do is apply. If you don't do that, you won't get follow through, it is just a black and white fact. "*
>
> *"With small business customers, time is their most precious commodity… we lose them a lot quicker if it takes a lot of steps (to implement the retrofit/action)."*
>
> *(Simplicity) is the secret to the success of the Direct Install program—the customers just have to sign on the dotted line and the rest is taken care of."*

5.2.4 IDSM and Timing

Timing is a critical element in the implementation of IDSM: the timing of information, decision-making, designs and installations are all ubiquitous throughout discussions of IDSM, and some timing-related issues are highly debated. One of the core goals and values of IDSM is in providing customers' access to the full spectrum of DSM options, along with information about how the options may work together synergistically, to improve performance or reduce cost. This can be accomplished through well-timed and successful communications. The concept of IDSM does not require that energy conservation solutions be implemented at a single point in time, but that the synergies across equipment and retrofits that improve performance and lower initial design and/or installation costs are known and considered, and leveraged per customer preference.

5.2.4.1 Planning Ahead

Converting an existing commercial building to Zero Net Energy (ZNE) requires implementation of integrated solutions. ZNE literature can serve as a resource for understanding implementation of IDSM. Literature indicates that integrated planning is a key element to success. A strategic plan to enhance required, or budgeted, building upgrades with complementary upgrades, can result in an optimally cost effective solution, though upgrades may be staggered over time rather than installed at once.[31] Furthermore, staggered

[30] PG&E's Building a More Energy Efficient Future: A National Perspective

[31] "Reinventing existing Buildings: Eight Steps to Net Zero Energy" Issue Brief published May 2013 by Rocky Mountain Institute and Johnson Controls

installation may be more attractive from a budgetary perspective, and more likely to be implemented.

The need for a retrofit in an existing commercial building is often prompted by degradation or failure of a key piece of equipment. The scheduled or required replacement of building equipment often presents an opportunity to consider complimentary measures that enhance efficiency and/or have lower installation costs when paired with a required upgrade. Having a plan in place that calls for replacement of required equipment and upgrade of complimentary equipment can be a helpful guiding tool to move the building toward its goal efficiency.

Integration objectives are not compromised when investments are staged over time, if there is strategy and planning that guides each step to a final state which takes full advantage of available synergies in efficiency and installation costs, to maximize energy savings and cost effectiveness within customers' bounds of preference and budget. In the end the building systems are integrated in a way that makes sense.

However, residential and small commercial customers are highly unlikely to have the time or resources to construct such a detailed long-term energy plan. A robust plan should include designers and engineers who can design across systems and understand whole building benefits.

5.2.4.2 Education and Strategy, Not Just Information

As discussed above, planning ahead is a useful tool in the implementation of IDSM solutions. Formal energy plans guide building owners through each incremental step in keeping with a comprehensive solution that leverages measure synergies and overall cost effectiveness. In the same vein, a well-educated customer will have a general understanding of the savings potential of various upgrades and an awareness of synergistic relationships between measures. An educated customer will know what information and support resources are available and what questions should be asked of those resources. Thus, education can be enough to guide customers successfully through opportunities and/or choice in building systems upgrade or repair.

An effective education surrounding energy management and strategy is key to the success of IDSM because customers are able to tap into the increased savings and cost effectiveness from available DSM synergies. The value of integrated solutions is in the ability to draw strategically from the full set of DSM opportunities.

Some interviewees note that the simple marketing messages, when considered together, can become fragmented and in sum under-emphasize the need for energy management and strategy. They also note it is challenging to construct a marketing approach that reflects the importance of strategy because of customer preferences for simple, clear, easy messaging, and they are confounded by budget constraints that preclude a one-on-one or truly customized approach.

"Of course, customers don't care which DSM area any measure or action comes from. They want to save energy, money or the environment; that's the end goal. The IOU marketing goal is to equip the customer with the tools and education to formulate an energy strategy that makes sense for their particular situation. It isn't possible to provide one-on-one support to each residential /small commercial customer."

Interviewees indicate they continue to strive toward providing customer IDSM education; education that will guide customers to the right solutions and information sources when they need them.

"Educating the customers is not an unrealistic goal, but a fine-tuned approach is needed."

Interviewees expressed a desire to utilize outreach in a way that moves toward prompting customers to think strategically about managing their energy use.

"Tying decision-making to IDSM requires a strategy. It isn't just about (simple/one-dimensional) messaging and hoping that customer can piece EE/DR/and DG together. It requires incorporation of an (overarching) strategy. There is a strategic, methodological process (to sound energy management). If a customer just puts up a Solar PV system, they should understand how that might change the overall picture for EE and DR. If they do solar first and EE later, they may find their solar system oversized. For DR, the customer should understand how to plan (DR events) into day-to-day activities and how those needs are changed by solar (production)."

"(We want to) educate (customers) and make them think and explore all the opportunities and possibilities. More often than not a lot of the EE and DR (marketing efforts) are mostly about penetrating the market and getting the sale which isn't always the best point."

One interviewee states their perception of educating customers as:

"…(We want customers to think about) What is their strategy? Rather than what feels good at that moment. Solar (adoption) is driven by tax incentives and rebates, and that is all good, but are they doing the right steps prior to that? (We want them to consider the question) 'Have you done enough to your house so you can maximize the capacity and optimize whatever you are going to install."

"The bottom line is that we want the end user to be a smart energy user."

5.2.4.3 Understanding "Need States"

Timing has other roles as well; the timing of information is a crucial factor in how it is received. As the IOUs strive to leverage the short span of attention residential and small commercial customers typically have for energy efficiency, they have learned that receptivity is dependent on "need states". In fact, interviewees report the single biggest determinant of receptivity to information is the customers 'need state'—a term that refers to events or triggers that change an individuals' receptivity and desire for information on IDSM options. These points in time are also sometimes referred to as market "entry points". Identifying a customer in a highly receptive need state or at a critical market entry point will drive the impact of IDSM information.

The IOUs also study personas and observe how IDSM uptake correlates to life events to find the ideal point of interaction.

> *"When do we think the customer may be in the right space to interact with energy information? When they apply for a home loan? When they get a new job, move, have a baby?"*

However, interventions targeted to customers in specific need states—or at well-defined market entry points—are relatively expensive. The data required to support such an effort often need to be purchased from a third party provider and demand the IOU have a good understanding of investment payback. There are a lot of options in terms of data that could be leveraged for IDSM marketing. The IOUs are interested in research to guide the selection of data elements that would best predict customer receptivity to IDSM solutions, and still be cost effective. IOU interviewees tell us that it is important to understand the relative frequency of the different need states that lead to uptake, and how those states correlate with IDSM uptake. Data is expensive, and ROI is important.

> *"We look to optimize—to find the right points to bring data in for customer segmentation and analytics. We also want to look at what the ROI is. You just can't buy all that data, it costs too much."*

IOU staff are somewhat stymied by the array of possibilities, the costs and the overarching needs. They ask:

> *"What are the right data elements that we should pull in? We don't know if (the data resource is) a new opportunity or if it is one of those things that requires to testing and learning to figure out if you rely on these data or not. You can't (leverage) it all. You can't always (leverage every data point) because you couldn't operate that way. We wouldn't be able to deliver at all, if we tried to process each and every interaction. (We really need to know) What are the right points to bring that data in for segmentation and customer analytics?"*

One way the IOUs regularly tap into customers' need states is at the time of account inception.

> *" If someone calls us to set up service, that is the best time to ask a number of leading questions to determine the best rate plan and the best awareness driving vehicles based on what they tell us when they are setting up their system of the first time."*

It is generally accepted as true that life events like buying a home and having a baby will affect ones' need states with respect to integrated solutions. The IOUs agree this is a useful dimension to view product offerings and marketing strategy. However, as one interviewee notes,

> *"There are a variety of people going through (these states) and they are all in a different place with regards to their demographics, and their approach and the way they behave. That is where we get into segmentation by 'persona'—Understanding the individual and how they respond to messaging. We try and look at the need states when we put the product up on the pedestal. We are also taking a look at where is the customer first, and how we communicate with them."*

The incremental cost of energy-efficiency measures are typically lower than the total measure cost (though for measures that are purely efficiency oriented they are equivalent) . As such, when efficient equipment is considered at the time of a planned or required equipment upgrade, the costs associated with the efficiency upgrade are lower, which can make the proposition more attractive to customers. These periods of decision-making are also considered need states.

If major systems or structural replacements are planned or immediately required, additional energy efficiency measures and renewable energy can be designed at lower installation cost and perhaps higher performance due to synergies between measures.

In addition to required replacements, owners' discretionary or investment upgrades offer an opportunity to consider IDSM solutions. That is, a good time for a building owner to consider IDSM solutions is when they are planning a redesign or remodel aimed at enhancing the market value of the building or the business that operates in it. Further, it is generally understood that the tendency toward discretionary remodeling is higher when there is a change in ownership or tenancy in a building.

The same things can be said for residential properties. The incremental costs of integrated projects can be lower if they are incurred in conjunction with a complimentary pending retrofit, such as upgrading insulation when a homeowner is required to replace electrical or plumbing systems.

Moreover, the events that inspire single system or single DSM retrofits, may similarly inspire more comprehensive retrofits. Customer surveys implemented as part of the 2009 California

Solar Initiative Impact Study found that 35 percent of residential participants installed their PV system within five years of a major retrofit or remodel. Similar to the commercial sector, major retrofits and remodels are more likely to occur after a change in ownership.

5.2.5 Segmentation

IOU marketing staffers note that when customers are divided into different groups it is possible to customize marketing messages to those groups, which allows for more effective communication. The goal is to divide customers in a logical process that leads to homogenous groups that will likely react in the same way to IDSM marketing messages.

Dividing customers by these characteristics creates subgroups that share similar needs regarding IDSM information and rebates. The goal is to create groups with enough similarity such that messaging can be addressed more specifically to the unique features of the group and will be perceived as highly personalized—and therefore taken more seriously.

The flip side of this is that segmentation that is too fine will result in difficulty finding the resources to understand and address the needs of each segment individually.

In the small commercial sector, IOU segmentation criteria may include:

- Location (rural versus urban, climate zone)
- Building characteristics (location, building size, multi-family versus single family, warehouse, strip mall)
- Business type (e.g. industrial, manufacturing, restaurant, office)
- Occupant Ownership (public versus private enterprise, franchise, owner occupied versus leased, leased by individual versus property manager)
- Fuel Types (gas, electricity and Distributed Generation)
- Energy consumption (size/patterns)
- Program participation history (Rebates, audits, DR, AMI-enabled behavior programs, integrated audits)
- Interaction with IOU resources (call center, website, green button)

IOU residential segmentation criteria is varied, and may include:

- Geographic and demographics (gender, age, location)
- Attitudes/lifestyle
- House type and characteristics (multi-family, single-family, mobile home)
- Own versus rent
- Fuel types (gas, electricity and DG)
- Energy consumption (size/patterns)
- Program participation history (Rebates, audits, DR, AMI-enabled behavior programs, integrated audits)
- Interaction with IOU resources (call center, website, green button)

With the appropriate segments, the IOUs can customize messages to be more directly relevant to the segment. The more relevant the message to segments is, the more customers will feel that the communication is personalized and speaking to them, and the more likely they will be receptive.

The optimal segmentation will depend on the goal of the messaging. For example, to make a marketing push for Smart AC signups, the IOUs might segment by location and summer energy consumption to narrow in on customers likely to have AC and high summer energy bills. The integrated audit tool itself also provides a data source for very fine segmentation. In this example, the audit tracking data stores information that would allow the IOUs to identify customers that received a recommendation to participate in Smart AC and indicated interest in pursuing the option.

According to Philip Kotler,[32] an effective marketing segmentation exercise should result in segments that are measurable, relevant, accessible, distinguishable and feasible. These are aspects that ensure that the marketing segmentation has been done on relevant parameters and that further action on these groups is practical.

The IDSM marketing approach begins with segmentation by personas—which are generally descriptive of attitude and lifestyle, such as "tech-savvy", "habit-driven" and "house-focused". The personas also indicate what kinds of communication channels are preferred. Tech-savvy customers prefer social media or online interaction, while the house-focused and habit-driven segments prefer direct mail or phone. Personas also inform the messaging itself; while the house-focused segment customers appreciate tips and tricks to shave their monthly bills, tech-savvy customers may respond better to a promotion of HAN or phone applications that monitor and control energy use.

5.2.6 Channelling and Targeting

The IOUs find that delivering the right information to the right person at the right time is based on targeted communication, which is a combination of the channel—or the medium—and the message. Channels have unique features that lend themselves better to some objectives than others. For example, email is not considered a good creator of general awareness, but it is a good channel to target a specific message to someone for a specific action. Other online marketing channels provide for messaging to more narrowly defined targets, because the message is viewed one recipient at a time and therefore can be tailored using any and all available information about the customer. Even with growth of online-accessible information, TV is still the dominant tool for reaching the mass market. Television communications are generally segmented by simple variables such as age, gender, location, income and married versus single. There are also some 'psychographic' segments that develop through the association of products and services with interests. Psychographic generally refers to a combination of characteristics including attitudinal, political and behavioral. IOU

[32] Principles of Marketing, Kotler & Armstrong, 9th Edition

marketing staff note,

> *"… mass media tends to be built up around selling products and services (and thereby) naturally develops psychographic segmentation…are you interested in car racing or not? How about outdoor activities and sports?"*

The IOUs note that while they have seen some media segmentation develop that relates to energy and environmental attitudes, such as through recycling behavior, there is little in the mass media in the way of segmentation that relates to highly-targeted energy savings attitudes and behaviors.

The IOUs have long had what they term *eternal segments,* which include psychographic elements including behavioral characteristics and political orientation—for example, "engaged greens", "disengaged greens" and "environmentalists". However, since the mass media does not segment that way, it is difficult to apply the eternal segments to mass media communications. The IOUs historically have attempted to gather information on segments such as new families for targeted messages, but found it was too difficult to target those customers. They found that while new families do tend to use certain types of media more frequently than others, there is still going to be a lot of wasted effort since most recipients will not be the targeted segment. However, one segment IOUs do have information on is people who have newly moved in to their homes or business facilities; the IOUs implement targeted messaging to those customers.

The IOUs note that marketing strategies might benefit from gathering information and feedback on what types of promotional offers are being used in the marketplace and how successful they are—that is, in the general marketplace, including outside of energy. Such an inquiry can help to inform an understanding of what types of offers people are responding to today, which reflects the state of consumer perceptions and priorities and reflects what approaches engender real response.

5.2.7 Barriers and Drivers

This section describes IDSM barriers and drivers noted by IOU staff during the in-depth interviews.

5.2.7.1 Limitation of a self-guided integrated audit

Utility staff shared their concern or acknowledgment of the inherent limitations of self-guided tools in planning IDSM solutions.

Self-Reported Data

The online integrated audit tool is inherently limited in its capacity to provide accurate and detailed information by its reliance on customer self-reported data. The customer may not have enough knowledge to understand the more detailed audit questions, let alone the ability to answer them accurately. Inaccurate inputs can result in inaccurate costs and savings

information, and either missed opportunities or unrealistic expectations. One IOU staff member working on the audit tools for small commercial notes:

> *"..the whole premise of the self guided tool (has inherent problems). It is asking someone who doesn't know about energy to decide what energy solutions they want. It's a little bit crazy I think. Asking people about the efficiencies and capacities of their equipment is unrealistic, and we don't know the accuracies of their work. And it is garbage in, garbage out in the (audit) report. In my experience doing (energy) projects for the past 10 years, even at the corporate level, people don't understand how energy works; their job is just to keep (the facility) running not just to understand how its power works."*

Consideration of Custom Measures

The risks associated with data input errors in the online audit are mitigated by a focus on rebates. Rebates are simpler and the expected costs and savings are generally well understood. However, there may be custom retrofits that would serve the customer even better than rebated measures but do not get the same consideration. As one interviewee points out:

> *"Right now, the tool considers what equipment you have and indicates the available rebates. That isn't to say that someone in a midsize office building wouldn't benefit from custom solutions. So there is a lot of (potential) custom (retrofit) business that is lost."*

Deep Retrofit and the Importance of Expertise

Interviewees note the limitation of an online tool or mass marketing approaches in general in their ability to specify or promote comprehensive/deep retrofit projects, even if the tool is customized with usage and customer histories. They note that the expertise of the engineers that do retrofit specification work is critical to project success. One interviewee notes that when he was working with customers on retrofit projects:

> *"… I took into account intangible things like things being mechanically possible and things being economically purchasable –two totally different things. The (engineers) need to have real world experience. To me project risk is managed by employing people that have the knowledge and the real world experience (to make the right decision). While these measures (may) look good on paper (some are not feasible). I'm saving the people who would have chosen those measures some real grief."*

Another concern raised by IOU staff was in regards to the proper management of project implementation. Assembling the right execution team is critical to success and the team should include designers and engineers who can design across systems and understand whole building benefits. The right team will also be able to identify and mitigate risks that may arise during the project.

"When projects are implemented by independent contractors hired by the customer, there is a high likelihood that the contractor won't have a good enough working knowledge of energy to ensure the installation is optimized over the whole project and facility for efficiency. Their primary job is to install the widget—put it in and make it work. They don't necessarily have any idea how it ties to energy."

5.2.7.2 Title 24 and Zero Net Energy

In the new construction sector, there are aggressive goals set for building new homes and commercial buildings that are Zero Net Energy (ZNE). In a ZNE building, the annual energy consumption is equal to its annual production of renewable energy. ZNE construction mandates integrated solutions and so has been one of the major drivers of IDSM solutions and integrated new construction design in the market. The ZNE building design is a particularly strong driver for EE and DG. It is also a driver for DR, but much less so. This is troublesome because greater saturation of DG increases the value of effective DR, which can offset the variability in renewable production. Furthermore, with more EE present, DR can require greater numbers of participants, since per unit consumption on peak will be generally lower.

The ZNE building design approach is textbook IDSM with respect to EE and DG. The first design step is to focus on reducing energy consumption through architecture and design elements (such as placement of windows, skylights, wall thickness, trees and landscaping), smart technologies (such as smart thermostats, occupancy sensors, plug load controls) and energy efficient technologies (efficient refrigerator, HVAC systems, water heat). The second design step, after minimizing the building's energy consumption, is to install distributed generation systems such as solar panels.

There are a substantial number of revisions to California's Title 24 building code taking effect in 2014. The code revisions are intended to move California's residential and commercial building stock toward its ZNE goals. Under the new Title 24, all new residential construction is to be ZNE by 2020 and all new commercial buildings ZNE by 2030.

One of the more notable updates to Title 24 for nonresidential building is a mandated integration of electric lighting and natural lighting to lower energy use. Title 24 calls for automated daylighting, which uses light sensors to measure available natural light, and adjusts supplemental electric lighting to achieve a targeted illumination.

There are some DR elements to the Title 24 changes, but they are not applicable to the small commercial or residential markets. Specifically, one new Title 24 requirement is that non-residential buildings over 10,000 sq. ft. have automated demand response lighting systems. During critical peak periods the DR-enabled lighting will be on-call to initiate pre-programmed reductions of at least 15 percent.

For small commercial and residential buildings, load shifting/demand response capabilities are not a central element to the ZNE effort. There may be a missed opportunity to raise

awareness and rewards for load control and load shifting behavior among owners and occupants of ZNE buildings. Although it has not been investigated through research, one might surmise there may be a negative effect where occupants of ZNE homes use energy without regard to time-of-use, assuming that their home will not contribute to greenhouse gas emissions because their generation system fully offsets consumption on a net basis. Of course, line losses can amount to 90 percent at peak, as discussed previously, making the relationship between TOU and energy requirements an important factor in resource management.

Depending on the construction site, the cost of electricity on peak can range substantially and many PV systems do not generate enough electricity on peak to reduce that cost. Inclusion of monitoring systems that incorporate peak time alerts, home energy management systems, possibly Auto DR or Smart AC enrollment, or even battery storage on-site, may evolve to be cost-effective solutions in the future, as the timing of generation and use become more critical. Of course there is less potential from a new ZNE home to reduce peak load than a typical home, but as renewables reach higher penetration the need for load management overall will increase. In part, this is to avoid any need to curtail generation during solar production hours.

5.2.7.3 IOU Program Portfolio Limitations

One limitation or barrier in promoting IDSM that was mentioned by IOU staff is related to the IOUs' program portfolio. Current IOU program offerings are very limited in terms of their distributed generation options, and therefore the IOUs have little involvement and/or tracking of DG installations.

The California Solar Initiative has completed the planned incentive distributions in the residential sector for solar PV, which also means the IOUs do not offer incentives or rebates for PV panels. Although the IOUs continue to track panel installations via the interconnection and net metering services, they do not deploy program tracking systems to capture details such as the system capacity, orientation, panel manufacturer or production monitoring system.

Without the feedback available via tracking systems and program-related EM&V, the IOUs are not privy to the full spectrum of trends and progress in the IDSM market. Within the current structures the IOUs have little involvement in customers' planning and decision-making, and track only interconnections and net meter installs.

5.2.7.4 Challenges of the Solar PV Market

At the national level – the U.S. installed 4,751 MW of solar PV in 2013, up 41 percent over 2012 and nearly fifteen times the amount installed in 2008.[33] Q4 2013 was by far the largest quarter ever for PV installations in the U.S., with 2,106 MW energized, up 60 percent over the second-largest quarter (Q4 2012). Solar accounted for 29 percent of all new electricity

[33] Solar Market Insight Report 2013 Year in Review, Solar Energy Industries Association. http://www.seia.org/research-resources/solar-market-insight-report-2013-year-review

generation capacity in 2013, up from 10 percent in 2012. This made solar the second-largest source of new generating capacity behind natural gas. In California, half of all solar capacity ever installed was added in 2013, including 607,689 California homes that installed a PV system.

The relationship of Solar PV to utilities and regulatory systems is evolving and taking shape rapidly, as are embedded issues related to EE, demand response, storage and smart grid. The pace of change creates a challenging environment to create and implement policies supporting optimized integration.

The importance of the loading order (i.e. minimized DG system size) and the critical role of load shifting and demand response in the successful integration of renewables is not at the front and center of the agenda of the private sector companies distributing PV panels to the residential and small commercial sector. This is particularly limiting with regard to the institution of policies and processes to minimize system sizing and implement cost-effective energy efficiency opportunities at each site prior to DG system installation.

The IOU staff shared concerns over this issue and some of the confusion and customer care issues it creates. They also made clear that the boundaries in the roles and responsibilities of the utilities really preclude instituting very much in the way of counter-measures. Most commonly, the customer works with a solar installer directly to negotiate the PV system installation, and the utility only gets involved at the time of interconnection.

> *"The goal is to get us into the conversation a lot earlier (than interconnection) but until then—at least from a customer and contractor perspective—there is no need to get utility involved."*

Customers do not always fully research the details of net metering, and solar installers often do not work to ensure the issues are clear to new owners of PV systems; this can result in confusion and disappointment for customers. The IOUs are working towards a more effective leveraging of the solar elements of the online tools to educate customers about system sizing and net energy metering.

> *"Once a customer gets on solar we have a conversation with them (about net metering). It is a very complicated conversation with the true up at the end of the year, and customers aren't (usually) aware of it until they get into it, after the panels are installed. We are trying with the solar team to change that. We have tested the usability of the website to see how that interaction with the customer goes. We want to give them the right tools to help them understand solar. We are trying new tactics, like if people are searching with Google for information about PV, we make sure PG&E comes up and says 'here's how net energy metering works and here's what you need know about PV, including system sizing and EE'. We want to get on the front end of helping people figure it out."*

"We understand that net energy metering billing is very complex. We want to set the process up with the customer so that they understand. Educate them so that their expectations are set and we are moving them along the comprehensive journey."

However, it is important to note the natural limitations in IOU roles and responsibilities. Solar installers are free to use any marketing approach, including making startling statements and grand slogans, and are not responsible for educating customers about rate structures, EE opportunities and system sizing. Here are some examples from the websites of a couple of the larger residential solar installers (Trinity and Sungevity):

"Go solar for $0 down and lock in low energy rates."

"Over time, your Solar energy plan can save you thousands. It's a breeze, we do the paperwork, financing and installation for you."

"Your system will produce enough power. No worries!"

"The costly expense of adding solar to your home is a thing of the past. Our attractive finance offers allow homeowners to get solar installed for free. With no money out of pocket, you can start enjoying the benefits of clean, renewable cost effective solar energy now."

This review on Yelp reflects on the sales approach:

"Very aggressive sales process. Materials and quotes are all shiny, but the sales process is like buying a car. (they say)

- *'Will you commit to making an appointment today?'*
- *'One day only sales price'*
- *'What do I have to do to get you to move forward today?'*

It doesn't smell credible."

Another Yelp review reads:

"Worse than used car sales men. After one meeting I would never use this company. So Shady!! If you call them out get ready for the hardest sales pitch of your life."

Overall, the reviews on Yelp are mixed. While there are many customers that are pleased, others are surprised and disappointed to find their energy bills differ from expectations:

"(solar company) is bait and switch. They get you to sign a lease then they take the money plus you pay an electric bill. There is no way to track what is given back to the grid so

they can hide behind it. We now pay more with our (solar company) payment plus our electric bill!"

"Our system was turned on February 2012. We were stoked to see $0-$10 SMUD bills the rest of 2012. BUT - that all changed when we got a bill the first week of January 2013 for over $1,000!!!"

The IOUs note that they could use big, startling messages like solar has about rates going up, and this would get customers' attention, but this is not the IOU approach, nor is it an appropriate approach for a regulated utility. This point is well-illustrated by the following comments made by IOU marketing staffers:

"(Solar companies) make startling statements that get the attention of the customers. If we could do that messaging in that sort of way we could leap frog (toward educating customers). We are taking more of a grass roots approach; acting like their partner in a day-to-day way. (The aggressive approach) isn't how the company has been set up to operate; we are an IOU serving the public, not independently owned solar installer."

"..what we found is that there is a big push from the solar companies direct to the customer, selling this big investment of energy savings without any integration attributes at all. And there are loan programs and tax incentives that spur that, but to me it seems like if a customer comes to a IOU and wants to save energy, they are going to get (recommendations for) the cost effective ordered solutions."

5.2.7.5 Transition to Time-of-Use (TOU) Rates

One IDSM driver and marketing opportunity noted by IOU staff was in the mandatory transition to time-of-use rates in the commercial sector. All commercial accounts will default or have the option to go with time-of-use rates over the next couple of years. One staffer notes they expect that around 2018, all customers will be defaulted to time-of-use (TOU).

This statewide transition of small commercial customers to peak day pricing has created a nice platform for the IOUs to go and talk to all of these customers about their rates and ways to save energy and money. This is particularly useful for outreach to the small commercial sector because historically it has been a relatively non-engaged segment, facing greater rates of split incentives, cash flow restrictions and short planning horizons. Where it may have been hard to reach these unassigned, diverse businesses in the past, the IOUs note the rate transition gives them a reason to engage with small commercial customers about their energy management and ways to successfully navigate the new rate structure.

PG&E notes that changing to TOU rates has been a major driver for its marketing program to small businesses. It has phased in different segments of the commercial customer base over the last two years to new TOU rates, and along the way has also delivered tailored marketing

to educate customers about their new rate and IDSM solutions. Moreover, PG&E perceives the window of time where customer's attention is on their new energy rates to be an opportunity to educate them more broadly about IDSM and PG&E's online resources. They do this by strategically pairing information about the new rate structure with information on ways to keep bills under control through EE and DR.

PG&E is implementing a staged approach to customer education around the transition to TOU. They are using what they terms a "two year information architecture", where the first stages are focused on rate education and building a relationship with the customer, and the later stages are intended to drive customers to online audit tools and IDSM solutions. The first stage sets the context for the rate change and introduces the notion that PG&E is a supporting resource, but does not push too much on EE or DR solutions. The later stages are geared toward delivering IDSM information and promoting IDSM uptake using the online integrated audit tool, where customers receive tips and recommendations customized to their business type, building and bill size.

5.2.7.6 Residential Rates

The tiered rate structure that most residential customers are on is a function of total energy use over the course of a month or a year, and ignores the time-of-use. The intention is to motivate customers to keep their overall use within certain bounds by increasing the marginal cost of electricity with greater overall consumption levels. However, strictly speaking there is no direct link between the marginal cost of producing electricity and the marginal increase in consumption that occurs over the course of a month. However, there are real increases in marginal costs (and per unit GHG) for providing power during critical demand peaks.

Under a tiered structure, customers in the highest rates may find solar PV a financially beneficial option. However, unless the real cost of producing power on peak is incorporated into the customer calculation, there is no guarantee that from a societal or utility perspective that the solar installation is going to be cost effective, or that GHG could be reduced more by peak-time curtailment at the site than it is by off-peak generation. Moreover, there is no guarantee that financial structures and pricing are aligned to make solar options attractive at the same sites, regardless of whether viewed from utility, customer or societal perspective.

5.3 Market Actor Interviews

5.3.1 Introduction

In conjunction with utility staff and industry organization interviews, we completed 17 in-depth interviews, covering 21 distinct IDSM products and services, and 4 interviews with leading representatives from trade organizations. Please see Section 3 for a full discussion of the sampling approach.

During these interviews we gathered firsthand information and insight regarding customer wants and needs from companies that participate in the IDSM market. The interviews were intended to draw out the perceptions and insights related to customer preference from individuals working every day to sell those customers IDSM products and services. We asked these individuals to comment on the drivers of their IDSM product/service adoptions and if there were situations or types of customers that have a higher likelihood of purchase.

As per our objective to reach a broad spectrum of IDSM products and services, every individual product category in the database was covered in the interview sample, excluding smart appliances. We were unable to reach a smart appliance company representative due in part to the small number of smart appliance companies in our database. However, overall we were able to cover over 30 percent of the products in our database.

For each company and trade organization interviewed, we always sought to make contact with the representative most familiar with their customer base and/or marketing efforts. This approach allowed us to gather the most insight into the larger IDSM customer base as a whole while providing a potential overarching framework of the products and services in the IDSM market. The companies that participated in the interviews ranged in size from one employee to several hundred employees; trade organizations had members reaching into the thousands. We were fortunate enough to primarily interview individuals with significant responsibility at their respective organizations. These individuals included multiple owners, trade organization board members and presidents, vice presidents of sales and marketing, vice presidents of business and marketing development and regional sales managers. As can be seen below, interviewees were asked questions on a variety of topics including:

- Responsibilities at the company;
- Product and marketing descriptions;
- Integration with other products and services;
- Product costs and financing options; and
- Potential trends in the future IDSM market.

Please see Appendix A in Sections 8.1 and 8.2 for the full Market Actor in-depth interview guides. The following sections summarize the key results from the in-depth interviews with the IDSM company and trade organization representatives. Consistent with the objectives of this study, the results focus on what we were learned with respect to customer IDSM-related

wants and needs. The section begins with a discussion of general or aggregate findings (i.e. those that apply across all products and services) and closes with a discussion of findings that are technology or service-specific.

5.3.2 Generalizable IDSM Preferences

Our in-depth interviews with market actors yielded a number of general insights with respect to residential and small commercial customer IDSM preferences. The themes surrounding these preferences include the desire for:

- Monetary savings and abbreviated payback periods;
- Long-term energy savings;
- Products and services that are easy to use; save time for consumer;
- Upgrades that offer non-energy benefits, such as comfort;
- On-going services instead of ownership of expensive equipment;
- Accessible, real time data and information;
- Products and services that offer greater control; and
- Appealing product aesthetics.

5.3.3 Monetary Savings and Abbreviated Payback Periods

When interviewees were asked about customer wants and needs, the most consistent response was related to saving money and having a shortened payback period for any initial cash outlay. Approximately 70 percent of the interviewees said the main message they communicate to their customers relates directly to potential monetary savings their product or service provides.

For the residential market, customers specifically desire monetary savings on their monthly utility bills. Customers are aware that purchasing IDSM products such as smart thermostats, solar panels or even ZNE homes requires paying a premium initial investment compared to traditional products. In order to justify this initial investment, customers want significant monthly savings that demonstrate a ROI over the life of the product or service. Additionally, the ROI usually must be observed in less than 10 years given that many homeowners are not interested in making a large investment with a payback period that extends beyond the time frame they plan on owning the home.

Within the small commercial market, the ROI and abbreviated payback period becomes even more important for customers because of the typically larger initial investment and risks associated with uncertain business longevity. These customers tend to make large initial purchase investments ranging from a few thousand dollars up to twenty or thirty thousand dollars. As a result, customers tend to look for payback periods that range from 5 to 10 years depending on the scale of the project.

5.3.4 Long-Term Energy Savings

Another customer desire that goes hand-in-hand with monetary savings is long-term energy savings. These two customer wants often parallel each other, as the main way to achieve monetary savings is to decrease overall energy consumption. Energy savings are especially important to residential and small commercial customers that are looking to "go green" and significantly decrease their energy consumption. However, as one interviewee said,

> *"I'd love to say that customers do it to save the earth, but if it doesn't make financial sense then none of that other stuff matters."*

While this might not exclusively be the case among all IDSM customers, several of the companies interviewed expressed the importance to not only market energy savings but to also convey how the energy savings generate financial benefits to the customers.

5.3.5 Ease of Use; Save Customers Time

In addition to monetary and energy savings, IDSM customers also want products and services that are easy to use and can potentially save them time. The representative from Home Energy Management comments:

> *"I think the future is going to be in things that are automated so that the customer doesn't have to pay attention too much."*

For example, customers do not want products that require significant training or installation time, but instead want products that are installed by professionals and require little maintenance by the consumer. For small commercial customers, the desire for ease of use also extends to limiting the amount of necessary interaction between themselves and the utility company or the IDSM company that installed the product. Typically, because store managers are busy with other commercial operations, they seek IDSM products that can be easily monitored and do not require constant visitation from utilities. However, customers in both the smaller commercial and residential markets do want clear lines of communication if questions arise or a repair is required.

5.3.6 On-going Services Versus Equipment Purchase

One of the newer emerging trends in the IDSM market is the customer desire for IDSM services instead of more expensive equipment purchases. Customers, especially in the small commercial market, are more comfortable enlisting an ongoing service for a regular fee than making a significant investment into the ownership of equipment. One reason this method is attractive, besides the savings on up-front costs, is that it hedges against the risk of the equipment itself. For example, one of the interviewees from an EMS company discussed how they are beginning to sell customers on their services versus the product itself. By promoting their software as cloud-based and managed by the EMS company as a service, the interviewee

expressed they can market their product as a service that lowers initial investment costs. As stated in the interview, "the more that you can do for them with little or no upfront costs, the better. Providing the service is critical for these types of integration to start working."

5.3.7 Non-Energy Benefits

The representative from *Home Energy Magazine* notes the importance of non-energy benefits as drivers for home energy upgrades:

> *"People don't pay for EE, they pay for comfort."*

He goes on to tell a story of a contractor in Canada whose building HVAC and insulation business was driven by the presence of black flies: "...(the flies) would get in the cracks of the building envelope, so he would seal the envelope and introduce ventilation."

The representative from the National Association of Energy Service Companies (NAESCO) notes the importance of non-energy drivers in the uptake of energy projects, and goes on to connect this aspect of customer preference to some of the difficulties the IOUs have in getting buy-in from Energy Service Companies (ESCOs) and customers with respect to program rules designed around energy savings. He goes on to say that one of the primary motivations of schools—which are among the highest in IDSM saturation—is the need for facility modernization. Schools face a lot of deferred maintenance and have little budget for upgrades, but by leveraging tax and government incentives, they can use energy projects to achieve some of those upgrades.

> *"In the school market for example, the biggest driver is the need for facility modernization and there is no money (for upgrades) so the school districts often see an energy project as a way to get (the upgrades) that they need by piecing together a comprehensive project. Say, if they need a new roof they piece together a 15 year payback EE program that blends EE measures with short term payback with things that have longer term paybacks so that they can get to the roof; (the motivation) isn't to save energy. In that respect, typically both the ESCOs and the customers view the utilities as a total pain because the utility has all these rules about baseline and stuff that drives everyone crazy, because it doesn't relate to what they want."*

5.3.8 Accessible Real-time Data and Information

A second emerging trend in the market is the customer desire for accessible real-time data and information regarding their energy consumption. However, this trend is not exclusive to the IDSM market. Technologies such as smart watches, GPS tracking and other advanced applications have allowed consumers to measure everything from heart rates and sleep patterns to running distances and tracking locations of friends and family in real time. When applied to the IDSM market, customers are looking for products and services that provide accessible real time information regarding their energy consumption. Instead of broad

monthly reports from utility providers, new technologies that provide day-by-day or even minute-by-minute information have become increasingly popular in the IDSM market.

One primary example of this can be seen by the emergence of smart programmable thermostats for residential customers. As opposed to traditional thermostats, new smart thermostats compile real time energy consumption data and provide an accessible platform to relay the information to consumers. As one interviewee from a smart thermostat company stated,

> *"Up to now, all [customers have] gotten is the equivalent of the odometer reading in a car. Now utilities are starting to provide consumers a little more information, which is helping to start the process of understanding (their) energy usage. What we do is try to provide information at real time."*

In other words, instead of a simple monthly bill that shows total energy consumption for the billing period, customers seek to access their energy consumption on a more frequent basis to have a better understanding of how much energy they are using and how much it is costing them.

While several of the other customer wants and needs focus on the product or service itself, the desire for accessible real time data pertains more to the consumer wanting *information.* This is a key distinction given that detailed energy usage information is a crucial component to the IDSM market as a whole. On a broad scale, IDSM aims to combine energy efficiency, demand response, energy storage and distributed generation methods synergistically to save energy. Part of this integration involves using real time information to help customize products and services for the consumer in a manner that addresses their individual needs and preferences.

5.3.9 Products and Services That Offer Greater Control

With the increase in accessible real time information, customers also want products and services that offer greater levels of control. Being able to access frequent usage data becomes even more useful when the available technologies allow one to act on the findings. For example, if a customer is using an EMS system to monitor activity and notices a peak rate time on their in-home display, the goal is not simply to acknowledge the peak rate but to be able to act accordingly to limit consumption during that time. This customer desire relates directly back to the notion that customers want to save time and money, but also encompasses the idea that at times, consumers like to be proactive in controlling their consumption and ultimately controlling their monthly bill.

5.3.10 Product Appearance

As the variety of IDSM products continues to expand, the ability for companies to differentiate their products becomes increasingly important. One of the ways companies are able to differentiate their products is through creative designs and unique appearances. This is especially true in the residential market, where consumers are looking for products that rival the aesthetics of the newest smart phones and tablets.

It is important to note that this customer want pertains primarily to products such as EMS, in-home displays and smart thermostats where the customer interacts, both physically and visually, on a more consistent basis. For products such as solar HVACs or geothermal heat pumps, the primary focus is almost always on monetary and energy savings. However, at least one interviewee mentioned that the logistics for installing large IDSM equipment can be complicated because customers do not want equipment obscuring their home or place of business.

5.3.11 Product Specific Findings

As previously alluded to, our research included interviewees with company representatives across the various IDSM product categories, including integrated technologies, enabling services and enabling technologies. The following sections attempt to identify certain findings that relate directly to specific products in our sample. Given the scope of our analysis, the primary focus is on monitoring and control systems, thermostats, in-home displays, solar hybrid technologies and green building design services.

5.3.11.1 Monitoring and Control Systems

Based on our company interviews, large monitoring and control systems are more commonly found in the commercial sector of the IDSM market. One of the reasons these control systems are more prevalent in the commercial sector is because of their large up front costs. According to one interviewee, a complete integrated control system that helps monitor refrigeration and freezer temperatures, along with other energy usage components, can cost between six to eight thousand dollars for a commercial customer. However, because the control systems are implemented on a large scale, the potential savings are greater than other traditional solutions. One of the ways that the systems create savings for the customers is by controlling demand during peak periods, reducing overall consumption.

In addition, commercial monitoring and control systems are among the industry leaders in terms of integration with other technologies. Part of this is due to the fact that the new technology in the systems allows for energy management on both traditional and alternative energy sources. For example, one interviewee said that their company's control system integrates with solar companies to supply alternative energy options to commercial customers using their control system.

5.3.11.2 Smart Thermostats, In-home Displays, Energy Management Systems

Among the more developed technologies in our database were the smart thermostats, in-home displays and residential EMS units. As can be seen in Table 4 in Section 3.3.2, 35 of the 67 total products in our database were categorized under these three IDSM-enabling technology categories. One of the primary reasons they represent such a large portion of our IDSM sample is because of their relative popularity in the consumer market, and subsequently, the fragmented retail market that exists due to the variety of different companies offering similar products in this market niche. However, in speaking to multiple companies that offer products in the enabling technologies market subsector, the companies themselves consider their products completely unique relative to other smart thermostats, in-

home displays and EMS systems. In fact, multiple interviewees expressed that while they recognize other similar products that exist in the marketplace, they do not necessarily view them as competitors because their respective technology is in someway unique or offers a superior consumer experience. While certain aspects of the technologies such as the visual displays and connectivity systems do differ between products, based on our market evaluation findings, the overall technologies are very similar amongst competitors. Nevertheless, the lack of recognition between competitors illustrates not only that the technology has not completely penetrated the market, but also, that currently the market remains very fragmented with no dominant player.

However, over the last year, Nest has made a significant push to become the dominant player in the smart thermostat market. When Google acquired Nest in early 2014,[34] they instantly became the most recognizable name in the smart thermostat market. However, in speaking to competing companies, the exposure of Nest may actually help the smart thermostat market as a whole. According to one interviewee, "Nest has been great in starting that process of getting a 'cool' device into homes. We love that exposure to our industry." The notion of being a "cool device" is imperative in the smart thermostat, in-home display and EMS markets because the central piece of hardware is an interactive screen or monitor. Given the recent success of other "cool devices" such as Apple products and other touch-screen smart devices, the smart thermostat industry remains optimistic about the future in the residential market, especially as the technology becomes more ubiquitous among consumers.

Additionally, because smart thermostats, in-home displays and EMS systems are less expensive than other IDSM products and technologies (generally around $200-$500), the potential uptake in the consumer market is greater. As discussed earlier, monetary savings and shorter payback periods are essential needs for consumers to buy into IDSM products. With lower initial investments, consumers are able to clearly see how technologies like smart thermostats are able to save them money over the long term and foster a positive return on investment.

5.3.11.3 Solar Hybrid Technologies

Perhaps the most well known IDSM technology, solar efficiency has been available in some capacity for several years. However, one of the new applications of solar panels and solar technology that has emerged over the last five years is in hybrid HVAC and AC units, both in the residential and commercial markets. While the technologies vary between products, the overarching concept of the technology is to use existing solar energy to power both the heating and cooling elements of HVAC units.

The main benefit of the solar hybrid technologies is similar to that of solar panels in general: to counteract the increase in traditional energy costs by consuming less expensive solar

[34] "Google closes $3.2 billion purchase of Nest" by Lance Whitney, February 12, 2014. http://www.cnet.com/news/google-closes-3-2-billion-purchase-of-nest/

energy. However, by integrating solar technology into HVAC systems, solar hybrid systems are able to not only save consumers money and energy, but also are easy to use and require a less intrusive installation process than other IDSM technologies. Currently, companies in this market are targeting customers that already have solar units in place and are looking to further decrease their traditional energy usage. Targeting these customers allows the companies to offer their products as a simple add-on to existing systems, further simplifying the installation and training process for consumers.

Despite the ease of use, the main barrier for solar hybrid technologies is the lack of consumer knowledge regarding the technology. Both solar hybrid companies we interviewed expressed this concern, with one interviewee stating that "it's difficult to educate consumers. We haven't bothered to educate anyone here in the US because electricity is still relatively cheap here." While both solar hybrid companies in our sample do operate in the United States, it is apparent that for potential uptake to occur, consumers must become more educated on the technology and the solar infrastructure must continue to expand beyond states with high-energy costs and ideal solar conditions.

5.3.11.4 Green Design and Building Services

Green building design companies are identified as enabling services as opposed to products, and are generally designed using less innovative IDSM technologies. Currently, these building services consist of using basic solar technologies, combined with efficient home amenities such as windows and appliances, to create energy efficient homes or even Zero Net Electric (ZNE) homes.

Both green building companies we interviewed acknowledged that while the consumer demand for energy efficient homes has grown significantly over the last five years, it still remains most prevalent among wealthy individuals that have the means to pay an initial premium for long term energy savings. One of the reasons that ZNE homes have not penetrated the middle class market is because the price of purchasing solar panels remains relatively high, with a payback period that may extend beyond the time frame a homeowner plans on living in their home. Additionally, despite the large investment for energy savings, homeowners may not retrieve the true value of the solar efficiency when selling their home in the future. For example, as one interviewee pointed out, consumers may invest $30,000 for a solar system that gets appraised at only $5,000 when assessing market value. The primary solution to combat this issue has been the emergence of companies like Solar City that provide leasing options for solar panels. For green building and design companies, solar leasing services provide a much more attractive platform for selling energy efficient homes, requiring a significantly lower initial investment. Both companies we interviewed are working with Solar City. In the partnerships, Solar City offers lower first cost for solar efficiency and takes responsibility for system maintenance and installation.

The representative from *Home Energy Magazine* that we interviewed noted that with respect to major remodeling and renovations, customer priorities are on indoor air quality, affordability, and health as much as they are on energy efficiency.

6. Data Analysis

This section presents finding from analysis of two data resources: the Commercial Saturation and Commercial Market Share Tracking Study, and online integrated audit tracking data from PG&E. Please see Section 3 for a full explanation of the data resources and methodology.

6.1 PG&E Residential Online Integrated Audit Tracking Data

We analyzed data provided by PG&E reflecting residential customers' online integrated audits completed from the program inception through August of 2013. The objective of this analysis is to identify distinguishing features of customers amenable to IDSM solutions from those who are not, and also to characterize customer preferences across the various IDSM solutions.

6.1.1 IDSM Recommendations and Customer Response Frequencies

Table 6 presents the customer reaction to audit recommendations for those customers who received one or more recommendations that span two or more DSM categories (energy efficiency, demand response or demand generation). Notable observations of the data presented in Table 6 include:

- A large majority of customers (93%) had completed at least one of the recommendations they received from the audit tool.
- More than half (60%) of customers rejected at least one recommendation.
    - Conversely, 40 percent of customers have acted or would act on all of the recommendations they received from the tool.
- The most commonly received recommendation among this group of customers was to participate in AC Cycling (87%). Other frequently received recommendations were HVAC related (76%). More specifically, these included strategies to avoid solar heat gain like planting shade trees and using effective window treatments, sealing ductwork, cooling in zones, performing system maintenance, and changing set points.
- The least commonly received recommendations were related to pool covers and pool VSDs (4%), pool pumps (9%), solar water heaters and strategic window placement (11%) and refrigeration equipment (12%).

The five tips that were most positively received by this group were:

- Lighting-related behavior such as lighting only areas in use; 95 percent who received the tip have or would adopt it.
- Refrigeration maintenance tips; 95 percent who received the tip have or would adopt it.
- Installation of a programmable thermostat; 95 percent who received the tip have or would adopt it.
- Installation of efficient lighting, 89 percent who received the tip have or would adopt it.

- Adopting behaviors to reduce hot water consumption such as reducing shower times or lowering water heater temperature; 86 percent who received the tip have or would adopt it.

The five tips that were least likely to be acted upon by this group were:

- Installation of a solar hot water heater; only 28 percent who received the tip have adopted or would consider adopting it.
- Installation or upgrading to efficient HVAC equipment; 42 percent who received the tip have or would adopt it.
- Installation of a pool cover; 48 percent who received the tip have or would adopt it.
- Strategic installation of new windows in remodel; 51 percent who received the tip have or would adopt it.
- Recycling of second refrigerator; 55 percent who received the tip have or would adopt it.

The response to demand response, distributed generation or solar powered equipment was mixed.

- 69 percent of 23,000 participants who received a tip to participate in AC Cycling reported that they had taken this action (31.4%) or will take this action (37.3%), indicating a significant level of willingness to participate in DR.
- 61 percent of participants who received a recommendation to install photovoltaic equipment indicated they have (20.8%) or would (40%) act on this tip.
- 78 percent said they would adopt a tip recommending installation of solar powered lighting, but only 28 percent would take positive action on the recommendation to install a solar water heater.

Table 6: Customers Receiving IDSM Recommendations: Recommendation Frequency and Response

Recommendation		Customers Receiving one or more recs from two or more DSM cats DG/DR/EE				
Category	Type	Customer Response to Recommendation			N (# of rec.'s)	Received Recommendation (% of customers)
		"Done"	"Will Do"	"Not Interested"		
Demand Response	AC Cycling	31.4%	37.3%	31.3%	23,048	87%
Appliances	Equipment	68.4%	16.9%	14.8%	10,166	38%
Behavior	Appliances	42.2%	23.6%	34.2%	9,621	74%
	Comprehensive	39.1%	41.7%	19.2%	12,139	46%
	HVAC	60.7%	23.1%	16.2%	19,892	75%

Recommendation		Customers Receiving one or more recs from two or more DSM cats DG/DR/EE				
Category	Type	Customer Response to Recommendation			N (# of rec.'s)	Received Recommendation (% of customers)
		"Done"	"Will Do"	"Not Interested"		
	Lighting	74.4%	20.7%	4.9%	14,882	56%
	Plug load	43.9%	39.0%	17.2%	7,547	66%
	Pool pump	61.1%	15.6%	23.2%	2,455	9%
	Refrigeration	47.5%	25.5%	27.0%	5,175	57%
	Water Heat	47.7%	38.1%	14.2%	6,359	62%
Controls	HVAC	80.5%	14.2%	5.3%	9,391	36%
	Lighting	52.3%	18.9%	28.8%	6,130	23%
Envelope	Equipment	39.7%	24.0%	36.3%	2,105	46%
	Other	36.8%	20.2%	43.0%	4,002	15%
HVAC	Equipment	31.9%	10.4%	57.7%	7,027	27%
	Maintenance	50.2%	29.8%	20.0%	9,971	38%
	Other	49.7%	23.6%	26.6%	20,464	77%
Lighting	Efficient Equipment	65.3%	24.2%	10.5%	11,078	42%
	Efficient Equipment (solar)	61.1%	16.7%	22.2%	4,789	18%
Monitoring Equipment	Monitoring Equipment	14.4%	43.8%	41.9%	4,584	17%
NC/remodel	NC/remodel	42.8%	8.2%	49.0%	2,820	11%
Plug Load	Equipment	49.2%	29.8%	21.0%	0,027	38%
Pool	Cover	35.9%	12.5%	51.6%	938	4%
	VSD	44.8%	19.6%	35.6%	963	4%
Refrigeration	Equipment	54.4%	8.3%	37.2%	3,120	12%
	Maintenance	50.7%	44.4%	4.9%	10,379	39%
	Other	44.8%	10.6%	44.6%	10,710	41%
Solar PV	Solar PV	20.8%	40.0%	39.2%	3,661	14%
Water Heat	Equipment	48.6%	16.6%	34.8%	6,406	24%
	Equipment (solar)	6.8%	21.4%	71.8%	2,939	11%
	Other	55.1%	20.2%	24.6%	10,414	39%
Total		**93.0%**	**75.7%**	**60.2%**		**100%**
n (column)		**24,571**	**20,006**	**15,907**	**26,429**	**26,429**

6.1.2 IDSM Willing Customers: Recommendations and Response Frequencies

Table 7 presents the responses to audit tips by customers who indicated they have done or would do at least one recommendation from two or more DSM categories. These customers have indicated they are willing to adopt recommendations across the DSM categories; we refer to these customers as "IDSM Willing". The goal of this exercise is to identify the propensity of IDSM Willing customers to receive and adopt the various audit tool recommendations.

The five least popular tips among the IDSM Willing group are:

- Installation of solar water heaters (65% not interested).
- Installation of HVAC equipment (54% not interested), as compared to 19.4 percent not interested among customers who only got EE tips.
- Installation of pool covers (49% not interested).
- Strategic window placement (49% not interested).
- Treatment of windows to improve envelope performance (40%), as compared to 13 percent who only got EE tips.

The five most popular tips for the IDSM Willing group are:

- Installation of programmable thermostats (97%)
- Refrigeration maintenance (96%)
- Lighting-related behavior (96%)
- Participation in AC Cycling (94%)
- Installation of efficient lighting (92%)

As we would expect, responses to tips related to demand response, distributed generation and solar equipment were more positive with 94 percent of customers willing to participate in AC cycling, 71 percent willing to install photovoltaic systems and 87 percent willing to install solar lighting systems. However, willingness to install solar water heating systems was still low with 65 percent not interested.

Table 7: IDSM-Willing Customers: Recommendation Frequency and Response

Recommendation		Customers Indicating "Will do" or "Done" to one or more recs from two or more DSM cats DG/DR/EE				
Category	Type	Customer Response to Recommendation			N (# of rec's.)	Received Recommend-ation (% of customers)
		"Done"	"Will Do"	"Not Interested"		
DR	AC Cycling	43.0%	51.0%	6.0%	16,804	86%
Appliances	Equipment	68.1%	18.8%	13.2%	7,796	40%
Behavior	Appliances	44.8%	26.2%	29.1%	14,459	74%
	Comprehensive	39.0%	45.4%	15.6%	8,743	45%
	HVAC	62.4%	26.0%	11.6%	14,683	75%
	Lighting	75.0%	21.2%	3.9%	10,967	56%
	Plug load	45.0%	41.0%	14.1%	12,932	66%
	Pool pump	62.7%	17.4%	19.9%	1,878	10%
	Refrigeration	48.6%	27.9%	23.5%	11,063	57%
	Water Heat	48.7%	40.0%	11.3%	11,979	61%
Controls	HVAC	80.9%	15.8%	3.2%	7,233	37%
	Lighting	54.3%	20.7%	25.0%	5,053	26%
Envelope	Equipment	40.1%	26.0%	34.0%	9,084	46%
	Other	38.2%	22.4%	39.4%	3,334	17%
HVAC	Equipment	33.2%	12.1%	54.7%	5,382	27%
	Maintenance	50.7%	32.2%	17.1%	7,715	39%
	Other	49.7%	26.2%	24.0%	15,128	77%
Lighting	Efficient Equipment	66.2%	25.5%	8.3%	8,657	44%
	Solar Equipment	68.0%	18.6%	13.4%	4,300	22%
Monitoring Equipment		15.1%	47.2%	37.8%	3,587	18%
NC/remodel	NC/remodel	44.5%	8.9%	46.5%	2,314	12%
Plug Load	Equipment	50.3%	31.1%	18.6%	7,729	39%
Pool	cover	37.5%	13.7%	48.7%	786	4%
	VSD	46.7%	20.4%	32.8%	822	4%
Refrigeration	Equipment	56.2%	9.0%	34.8%	2,611	13%
	maintenance	51.8%	44.5%	3.7%	7,509	38%
	Other	48.3%	13.0%	38.7%	7,324	37%
Solar PV	Solar PV	24.5%	47.0%	28.6%	3,116	16%
Water Heat	Equipment	48.5%	18.5%	33.0%	5,037	26%
	Solar Equipment	8.3%	26.3%	65.4%	2,397	12%
	Other	53.5%	22.5%	24.0%	8,022	41%
Total		**92.2%**	**79.3%**	**46.2%**		**100%**
n (column)		**18,045**	**15,529**	**9,045**	**19,576**	**19,576**

6.1.3 IDSM Unwilling Customers: Recommendations and Response Frequencies

Table 8 presents the responses to audit tips from customers that received recommendations for more than one DSM strategy type, but accepted recommendations from no more than one DSM strategy. These customers indicated very low or no interest in IDSM solutions and we term them "IDSM Unwilling" customers. The goal of this exercise is to identify preferences to both receive and adopt various recommendations among IDSM Unwilling customers—or those that have indicated they are not willing to adopt recommendations across the DSM categories.
As we would expect, the propensity to adopt DR or DG tips among this group is very low. 99.3 percent would not be willing to participate in AC Cycling, 99.8 percent would not install photovoltaic systems, and 100 percent would not install solar powered lighting or solar hot water systems.

The customers who responded positively to EE tips in this group would have rejected all DR and DG tips. EE tips that remained popular among this group included:

- Lighting related behavior such as only using lights in occupied areas (93%)
- Refrigeration maintenance (92%)
- Installation of programmable thermostats (88%)
- Installation of efficient lighting (81%)
- Installation of efficient appliances (80%)

Table 8: IDSM-Unwilling Customers: Recommendation Frequency and Response

Recommendation		Customers Indicating "Not Interested" to all recs from two or more DSM cats DG/DR/EE				
Category	Type	Customer Response to Recommendation			N (# of rec's.)	Received Recommend-ation (% of customers)
		"Done"	"Will Do"	"Not Interested"		
Demand Response	AC Cycling	0.3%	0.4%	99.3%	6,244	91%
Appliances	Equipment	69.4%	10.6%	20.0%	2,370	35%
Behavior	Appliances	35.1%	16.5%	48.4%	5,162	75%
	Comprehensive	39.3%	32.2%	28.5%	3,396	49%
	HVAC	55.8%	15.0%	29.2%	5,209	76%
	Lighting	72.9%	19.5%	7.6%	3,915	57%
	Plug load	40.8%	33.4%	25.8%	4,615	67%
	Pool pump	56.0%	10.1%	34.0%	577	8%
	Refrigeration	44.4%	19.2%	36.5%	4,112	60%
	Water Heat	44.9%	32.8%	22.3%	4,380	64%

Controls	HVAC	79.0%	8.7%	12.3%	2,158	31%
	Lighting	43.1%	10.5%	46.4%	1,077	16%
Envelope	Equipment	38.8%	18.0%	43.3%	3,021	44%
	Other	29.8%	9.1%	61.1%	668	10%
HVAC	Equipment	27.7%	5.0%	67.3%	1,645	24%
	Maintenance	48.6%	21.5%	29.8%	2,256	33%
	Other	49.8%	16.1%	34.1%	5,336	78%
Lighting	Efficient Equipment	62.1%	19.4%	18.5%	2,421	35%
	Efficient Equipment (solar)	0.0%	0.0%	100.0%	489	7%
Monitoring Equipment	Monitoring Equipment	11.8%	31.6%	56.6%	997	15%
NC/remodel	NC/remodel	34.8%	4.9%	60.3%	506	7%
Plug Load	Equipment	45.6%	25.4%	29.0%	2,298	33%
Pool	Cover	27.6%	5.9%	66.4%	152	2%
	VSD	33.3%	14.9%	51.8%	141	2%
Refrigeration	Equipment	45.2%	4.9%	49.9%	509	7%
	Maintenance	48.0%	44.0%	8.0%	2,870	42%
	Other	37.3%	5.3%	57.4%	3,386	49%
Solar PV	Solar PV	0.2%	0.0%	99.8%	545	8%
Water Heat	Equipment	48.8%	9.6%	41.6%	1,369	20%
	Equipment (solar)	0.0%	0.0%	100.0%	542	8%
	Other	60.7%	12.6%	26.8%	2,392	35%
Total		**95.1%**	**65.2%**	**100.0%**		**100%**
n (column)		**6,526**	**4,477**	**6,862**	**6,862**	**6,862**

6.1.4 Comparison of IDSM Willing and IDSM Unwilling Customers' Recommendations and Response Frequencies

In order to identify the most prominent differences in responses to recommendations, we compared the "IDSM Unwilling" group (
Table 8) to the "IDSM Willing" group (Table 7) that accepted tips across DSM strategies. Although all of the differences noted below are statistically significant,[35] the selection of a

[35] Significance testing was for the null hypothesis that the expected value of each statistic is the same across the two groups. The null hypothesis was tested using a two-tailed t-test, with probability of Type I error (alpha) set to 5%. Type I error occurs when the null hypothesis is true but is rejected.

customer into one group or another is partly a function of their response to recommendations, and so contributes to differences in patterns of response frequencies. Still, these statistics are presented to characterize the most prominent differences between the groups in order to shed light on the more specific measure/recommendation preferences of one group versus the other.

- IDSM Unwilling customers were more likely to receive a recommendation to recycle a second refrigerator than IDSM Willing (49 versus 37 percent), and –of course—were much more likely to reject the recommendation (57 versus 39 percent).

- IDSM Unwilling customers were more likely to receive AC Cycling recommendations (91 versus 86 percent) and comprehensive behavior recommendations such as having an integrated audit or making New Years resolutions for saving energy (49 versus 45 percent). Almost by definition, nearly all IDSM Unwilling rejected AC Cycling (99%), while only 6 percent of IDSM Willing rejected the idea. IDSM Unwilling customers were also more likely to reject the comprehensive behavior recommendations versus IDSM Willing (29 versus 16 percent).

- IDSM Willing were more likely than IDSM Unwilling customers to receive efficient lighting recommendations (44% versus 35%) and solar lighting recommendations (22% versus 7%) as well as lighting controls (26% versus 16%). Across these lighting options, efficient lighting equipment recommendations were relatively well received by both IDSM Willing and Unwilling customers, with 8 and 19 percent rejection rates, respectively. Recommendations for lighting controls were less popular —rejected by one-quarter of IDSM Willing and nearly half of IDSM Unwilling customers. Solar lighting recommendations were generally well received by IDSM Willing (13% rejected) but summarily dismissed by the IDSM Unwilling (100% rejected).

6.1.5 Customers Receiving Only Energy Efficiency Recommendations: Recommendation and Response Frequencies

Table 9 presents the responses to audit tips by customers who only received EE tips. The least popular tips were:

- Installation of monitoring equipment (36% not interested)
- Recycling second refrigerator (refrigeration–other) (35% not interested)
- Installation of pool covers (34% not interested)
- Strategic placement of windows (32% not interested)
- Installation of an efficient freezer (refrigeration–equipment) (20% not interested)

The most popular tips were the same as for the group in Table 8.

Table 9: Customers Receiving Only EE Recommendations: Recommendation Frequency and Response

Recommendation		Customers Receiving Only EE Recommendations				
		Customer Response to Recommendations				
Category	Type	"Done"	"Will Do"	"Not Interested"	N (# of rec's.)	Received Recommend-ation (% of customers)
Appliances	Equipment	81.8%	14.1%	4.1%	11,652	17%
Behavior	Appliances	65.2%	19.8%	15.0%	40,403	59%
	Comprehensive	50.1%	39.5%	10.3%	9,806	14%
	HVAC	77.2%	18.3%	4.5%	36,789	54%
	Lighting	81.1%	17.3%	1.6%	19,281	28%
	Plug load	61.0%	31.6%	7.4%	36,274	53%
	Pool pump	68.7%	18.9%	12.4%	1,796	3%
	Refrigeration	60.3%	26.1%	13.6%	16,778	25%
	Water Heat	56.2%	36.0%	7.8%	19,568	29%
Controls	HVAC	84.2%	12.5%	3.3%	9,587	14%
	Lighting	79.6%	12.3%	8.1%	2,717	4%
Envelope	Equipment	60.7%	27.4%	11.9%	12,373	18%
	Other	69.2%	17.7%	13.1%	809	1%
HVAC	Equipment	68.3%	12.2%	19.4%	3,836	6%
	Maintenance	67.7%	26.5%	5.8%	8,108	12%
	Other	72.7%	20.1%	7.2%	28,874	42%
Lighting	Efficient Equipment	77.7%	18.2%	4.0%	12,065	18%
Monitoring Equipment		15.4%	48.9%	35.7%	2,824	4%
New Construction/Remodel		59.2%	8.7%	32.1%	483	1%
Plug Load	Equipment	56.6%	32.4%	11.0%	10,030	15%
Pool	cover	50.6%	15.4%	34.1%	267	0%
	VSD	63.5%	20.4%	16.2%	334	0%
Refrigeration	Equipment	71.2%	9.0%	19.8%	546	1%
	maintenance	52.7%	44.7%	2.6%	8,542	12%
	Other	54.1%	11.1%	34.8%	8,613	13%
Water Heat	Equipment	79.4%	14.1%	6.4%	4,134	6%
	Other	80.1%	15.1%	4.8%	10,027	15%
Total		**86.2%**	**45.6%**	**21.9%**		**100%**
n (column)		**58,951**	**31,215**	**15,003**	**68,411**	**68,411**

6.1.6 A Comparison of Household Characteristics: IDSM Willing Versus IDSM Unwilling

Table 10 presents a comparison of household characteristics between customers who indicated a willingness to adopt tips across the DSM categories versus customers who were unwilling to adopt tips across the DSM categories. These customers all received tips across two or more DSM categories. The first group, "IDSM willing", indicated they have done or would do at least one tip from at least two DSM categories. The second group "IDSM unwilling" indicated they were not interested in all tips across at least two of the DSM categories. This sample is smaller than characterized in the previous tables because household characteristic questions were only asked (or we only have data available for) of a subset of customers who received tips.

The column on the far left indicates whether the statistic shown in the row for IDSM willing is statistically significantly different from IDSM unwilling. An "X" shown in the far left column indicates there is a statistically significant difference at $p<.05$ in a two tail test.

- IDSM willing customers are more likely to live in single family homes, are owners, have AC, use electricity for space and water heat, or have a slightly larger household size due to the presence of more children.
    - 91 percent of IDSM willing customers live in single family homes compared with 86 percent of IDSM unwilling customers; this is a statistically significant difference.
    - 78.5 percent of IDSM willing are owners compared with 74.4 percent of IDSM unwilling (statistically significant).
    - 12.6 percent of IDSM willing customers heat with electricity compared with 8 percent of IDSM unwilling. The difference is made up with natural gas with there being no statistically significant difference in use of other fuels. Water heat is similar.
    - IDSM willing customers are more likely to have AC (85 percent versus 77 percent for IDSM unwilling).
    - No statistically significant difference in home size between IDSM willing and IDSM unwilling.
    - IDSM willing have 3.77 people per home versus 3.61, which, while small, is statistically significant.
    - The number of adults per home (IDSM willing at 2.48 versus IDSM unwilling at 2.43) is not statistically significant, but the number of children per home (1.29 versus 1.18) is statistically significant.

Table 10: Home and Household Characteristics: IDSM Willing Versus IDSM Unwilling

Home Characteristic		Customers Indicating "Will do" or "Done" to one or more recs from two or more DSM cats DG/DR/EE		Customers Indicating "Not Interested" to all recs from two or more DSM cats DG/DR/EE		Significantly different? (two sided, 95% CI)
Category	**Type**	**Statistic**	**N**	**Statistic**	**N**	
House Type	Multi-Family	9.0%	314	14.1%	174	X
	Single Family	91.0%	3,168	85.9%	1,058	X
Tenure	Own	78.5%	3,021	74.4%	1024	X
	Rent	21.5%	829	25.6%	353	X
Heating Fuel	Electricity	12.6%	487	8.0%	110	X
	Natural Gas	82.7%	3,184	88.2%	1,215	X
	None	0.1%	3	0.1%	1	
	Not Sure	4.1%	156	3.1%	43	
	Other	0.5%	20	0.6%	8	
Water Heater Fuel	Electricity	8.3%	320	6.0%	82	X
	Natural Gas	85.9%	3,306	88.3%	1,216	X
	None	5.2%	199	4.9%	67	
	Not Sure	0.2%	7	0.4%	5	
	Other	0.5%	18	0.5%	7	
Has AC	No	15.2%	585	23.1%	318	X
	Yes	84.8%	3,265	76.9%	1,059	X
Home Size	Mean	1,969	3,850	1939	1,377	X
Number of Occupants	Mean	3.77	3,850	3.61	1,377	X
Number of Adults	Mean	2.48	3,850	2.43	1,377	
Number of Children	Mean	1.29	3,850	1.18	1,377	X
Total		73.70%	3,850	26.30%	1,377	

6.2 Commercial Saturation Survey and Commercial Market Share Tracking (CSS/CMST)

We were provided access to the telephone survey data collected through the Commercial Saturation and Market Share Tracking Studies (CSS/CMST). These data provided information on customer size and participation history as well as various aspects of IDSM-related attitudes and awareness. Of course, this study focuses on the small commercial segment while the CSS/CMST covers all-sized commercial customers. To begin this exercise, we filtered the data

to include only customers defined as small or very small, which are those with less than 100 kW (among demand metered sites) or 300 MWh annual usage (for those without demand metering).

We used data regarding previous program participation and energy audits, along with attitudinal data, to categorize the small commercial customers into four bins with respect to their approach to IDSM: those that have adopted; those that indicate willingness to adopt; those that indicate at least some interest in adopting; and those that indicate no willingness to consider IDSM solutions.

Businesses are categorized as *adopting IDSM* if they

- Had an integrated audit and adopted one demand response or distributed generation recommendations at any time before or after the IDSM audit; or
- They participated in programs that included at least two of the following: energy efficiency program, demand response or distributed generation program.

Businesses are categorized as *willing to adopt IDSM* if they participated in the IDSM audit but have not yet adopted demand response or distributed generation measures.

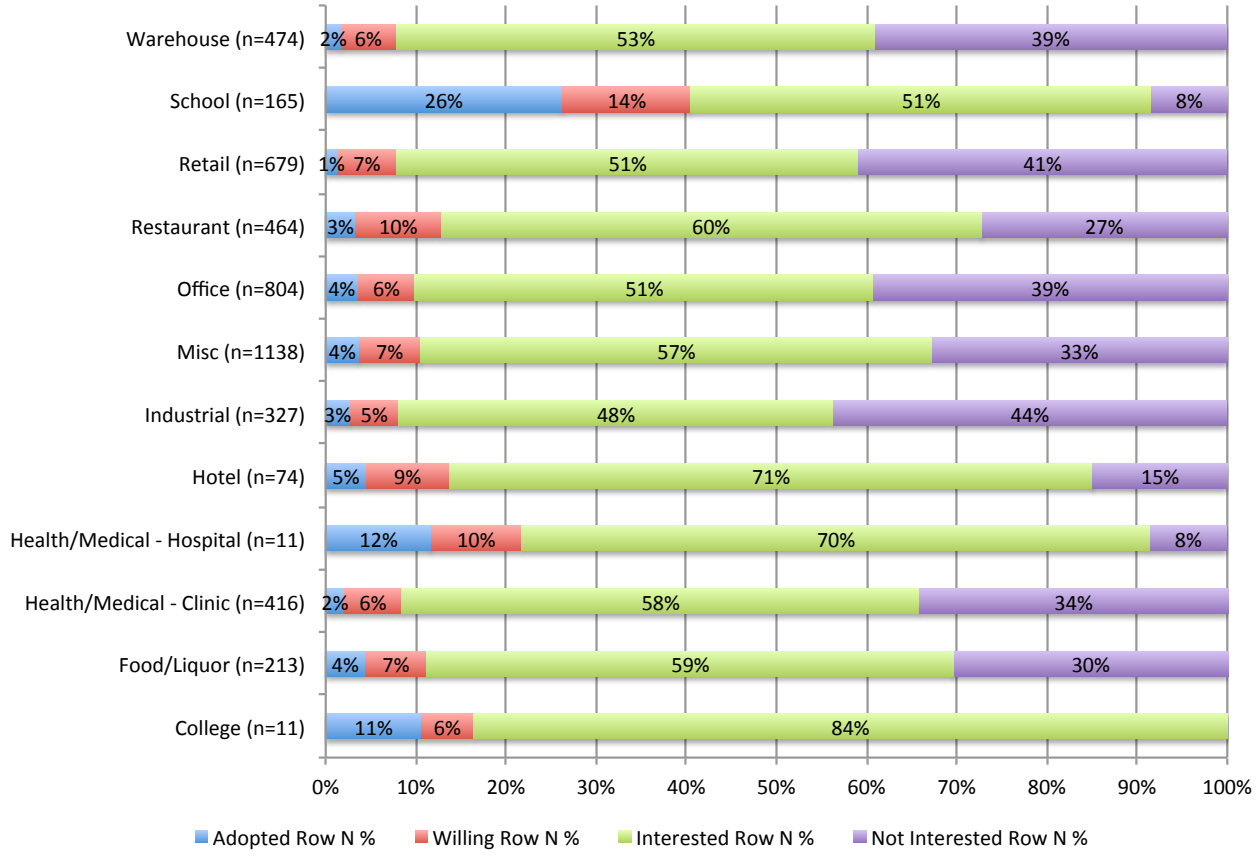
Businesses are categorized as *interested in IDSM* if they do not fall into either of the above categories, but noted during the survey one of the following:

- Environmental consciousness is very important or essential to their business;
- They have a long term energy plan; or
- They have a specific policy for energy efficient equipment procurement.

Businesses are categorized as *not interested in IDSM* if satisfy none of the criteria in the above three categories.

The relative frequency of each category is shown in Figure 5 below by business type.

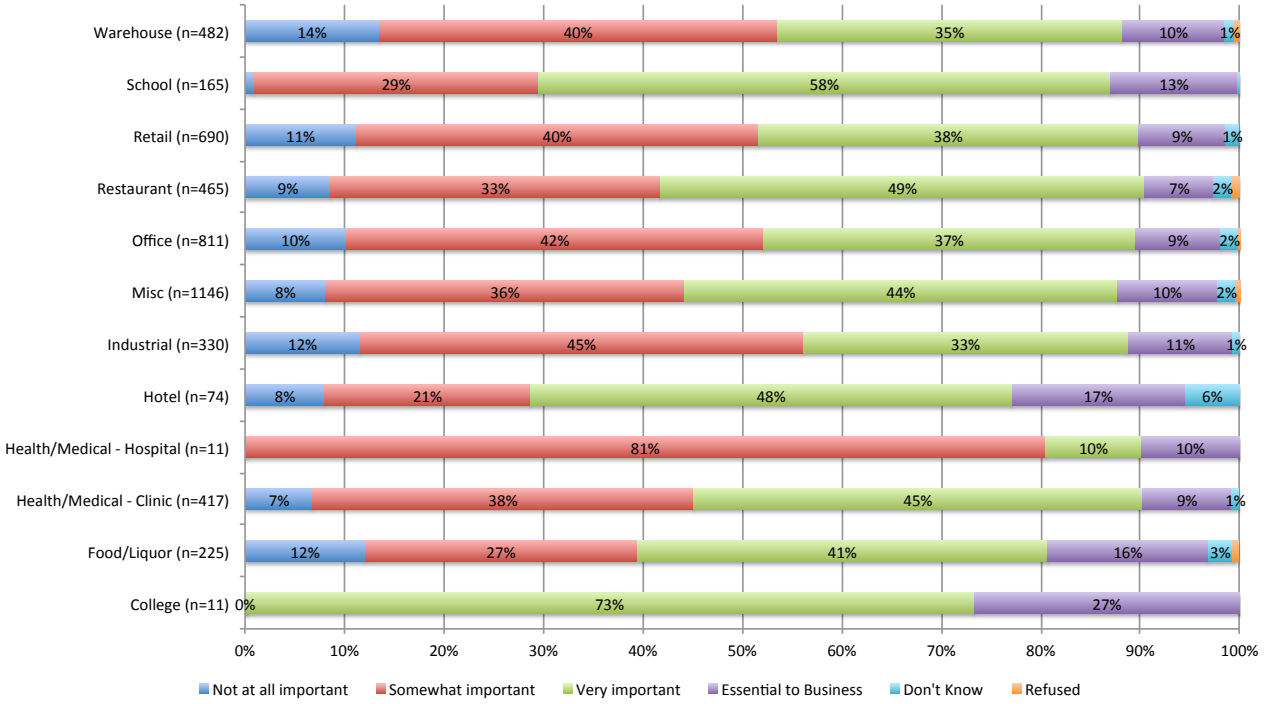
Figure 5: IDSM Adopter, Willing, Interested and Unwilling Category Frequencies, by Business Type



In general the propensity to be IDSM unwilling is greater than the combination of IDSM adopters and those classified as IDSM willing (under our definitions). With the exception of schools, hotels and healthcare facilities, between 30 and 44 percent of facilities across the remaining business types are IDSM unwilling to consider IDSM solutions.

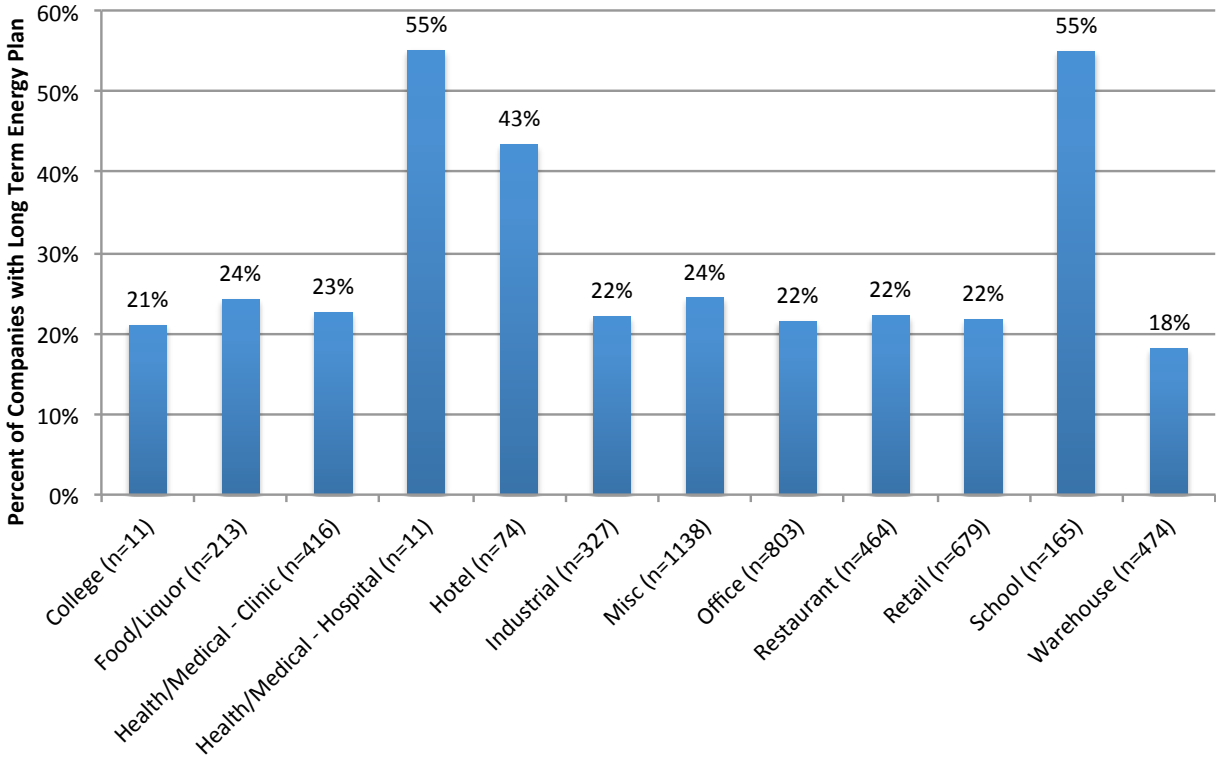
Figure 6 below summarizes responses to the survey question "How important is being environmentally conscious to your organization; would you say not at all important, somewhat important, very important or essential to your business?" Among ten of the twelve business types shown below, the propensity to consider environmental consciousness to be essential to business was between 9 and 17 percent, with the outliers at 7 percent (restaurants) and 27 percent (colleges). Among nine of the twelve business types, the propensity to report environmental issues to be "not at all important" is between 7 and 14 percent, while nearly none of the remaining business types do.

Figure 6: Reported Importance of Environmental Consciousness, by Business Type



As shown in Figure 7 below, across most business types in the small commercial segment about 22 to 25 percent of businesses have long-term energy plans. Schools, hotels and hospitals are the exception, where near or over half of establishments have long-term plans. Long-term energy plans support IDSM because intelligent planning takes into account all the DSM options, and the synergies between measures/strategy in performance and cost. The lowest rate of long-term energy plan incidence is among warehouses, where 18 percent have plans.

Figure 7: Percent of Establishments with a Long Term Energy Plan by Business Type



7. Findings and Conclusions

7.1 Summary of Customer IDSM Needs and Wants

In this study we found information sources in agreement with respect to the IDSM needs and wants among residential and small commercial customers. The predominant themes in the IDSM product and service marketing materials were reiterated during our in-depth interviews with both representatives of IDSM companies and IOU marketing staff. These sources indicate that customer needs and wants with respect to IDSM solutions are oriented toward the personal; monetary savings, long-term energy savings, convenience, ease-of-use and low risk with respect to return-on-investment top the list of priorities. There are also clear consumer preferences surrounding methods of conveying persuasive information to the mass market. Consumers and small business owners demand simple information and when initiating an IDSM inquiry themselves, consumers want answers quickly. Consumers are more likely to act if there is a clear benefit and only simple tasks required to obtain that benefit. Furthermore, customer behavior is more likely to be impacted by a high degree of personalization in messaging.

We also identified some emerging IDSM-related trends drawing from advancements in technology and communications. In particular, there is growing interest in the access to and use of real-time energy consumption data, and a growing number of products and services built around web-connected building monitoring and controls.

7.1.1 Customer Preferences Versus IDSM Characteristics

The underlying and core value of IDSM solutions is in allowing for customer optimization over all available energy management opportunities, something that demands an understanding of the ways performance and costs change with various bundles of DSM options. This takes a concerted effort to achieve in a world that naturally gravitates towards single-DSM options and even measure specialization within a DSM strategy area. This tendency is observed from both a market demand and supply perspective, with consumers and suppliers alike focused on a rather narrow field of energy management expertise. For example, solar installers are not representing their own interests well if they take steps to enforce the principles of the loading order; the bottom line for HVAC contractors is not related to their understanding of whole building energy performance or their ability to educate customers about the importance of time-of-use, let alone building awareness of available DR programs. The natural inclination of the market is not to be integrated—instead it tends towards fragmentation or compartmentalization into areas of interest or long-developed expertise. The skills required to offer renewables, EE and DR are highly specialized and complex. There has been a lot of time spent honing these skills, so it will take a lot of time and concerted effort to develop market capabilities to build supply and demand for IDSM solutions. It will require a lot of consumer and contractor education, but perhaps more importantly, clear and persuasive motivation.

We did find some exceptions to this natural tendency toward a narrow DSM strategy focus—such as in the building monitoring and control technology and in building architecture and design for major remodels or new construction. However, even in these areas there are missing elements that fall short of a fully integrated approach. Issues surrounding time-of-use and load-shifting/demand response are not well represented in the efficient new construction market. Some types of building monitoring and control software have the capability to consider DG, EE and DR, but mass-market versions accessible by residential and small commercial customers rely largely on user choice and behavior to achieve energy management gains of any sort. In order to pull this naturally segmented market together into an IDSM market, the best option may be to rely on government and public policy to create enough of a motivation to generate a significant market response. The IOUs are on the frontlines in the deployment of policy-driven IDSM efforts, and take primary responsibility for educating customers about DSM options and synergies across measures and strategies.

During the in-depth interviews conducted for this study, we talked to the IOUs and other market actors about IDSM marketing and education, to gather their current understanding of customer preferences and requirements with respect to IDSM information. We also reviewed marketing materials used by IDSM product and service companies, and conducted research into basic principles of consumer marketing. All of these sources align with one another indicating the following key customer preferences for IDSM messaging:

- Keep it simple—simple messages resonate better.
- Ensure the message conveys a clear benefit.
- Personalize—messages that reflect an accurate and detailed understanding of the recipient receive substantially more attention and regard.
- Make action items easy and clear.

These customer preferences and the concepts and issues that comprise IDSM are nearly at odds with one another.

- IDSM is broad in scope and deeply complex; it is multi-dimensional in both costs and benefits by alternative measure bundles and building particulars.
- IDSM requires understanding options that comprise deep retrofits and have longer paybacks—rendering benefits less clear to customers with short investment horizons, a measurable component of the mass market.
- While IDSM demands a high level of personalization, since multi-DSM synergies vary according to building particulars, this level of personalization is not feasible nor cost effective in messaging mass markets.
- Finally, while some programs such as Energy Upgrade California are working toward making comprehensive retrofits a one-stop-shop, navigating the implementation of IDSM solutions is an even more complex task than navigating the complexity of single solutions (e.g., solar or energy efficiency). Traditional EE, DR and DG are each highly complex individually and are not easy sells, as evidenced by substantial remaining market potential after many years of programs and market intervention efforts.

It would thus seem there is an underlying incompatibility of customer preferences and IDSM messaging goals. However, the IOUs have adopted a potentially successful strategy in what they term "Continuous Engagement". If successful, this approach meets the needs and wants of the mass market, while working consistently toward providing an IDSM education to customers to enable them to create an integrated energy plan and strategy. Furthermore, it establishes the IOUs as information and support resources, where customers can find references and information easily. A similar approach to DSM in the large commercial and industrial sector—termed Continuous Energy Improvement—can be found across many regions, utilities and agencies, including California, the Northwest Energy Efficiency Alliance, and Efficiency Vermont. Continuous Energy Improvement establishes a working relationship with customers to promote energy conservation and management solutions.

7.1.2 Bridging the Gap: Continuous Engagement

Today one of the central goals of the utility IDSM offerings to the small commercial and residential sectors is to engage customers in an ongoing way so they are continuously interacting with IOU resources and information. The goal is not a single-moment market intervention to achieve a specific retrofit or measure adoption, but to engage customers over time as supporters and partners in their energy management, ensuring that customers find the best opportunities for IDSM improvements through both behavior and measure adoptions.

Continuous engagement has other energy conservation benefits. It provides the utility a reliable and effective channel to reach customers with information in real time. This can be a useful tool for demand curtailment as well as for the dissemination of new information for managing energy. Moreover, it provides a platform for customers to become educated.

7.1.3 Need States

As the IOUs strive to leverage the short span of attention that residential and small commercial customers typically have for IDSM-related material. They have learned that customer receptivity to IDSM information is highly dependent on customer "need states". In fact, interviewees report the single biggest determinant of receptivity to information is the customers need state—a term that refers to events or triggers that change an individual's receptivity and desire for IDSM information. These points in time are also sometimes referred to as "market entry points". Successfully targeting and messaging customers that are in a highly receptive need state—or market entry point—will drive the impact of IDSM information.

We asked the IOUs whether they were currently targeting customers in particular need states as part of their IDSM marketing strategy. We learned that interventions targeted to customers in specific need states—or at well-defined market entry points—are relatively expensive. The data required to support such an effort often needs to be purchased from a third party provider and demands the IOUs have a good understanding of the value of that data in promoting IDSM solutions—an understanding that does not exist today. IOU interviewees tell

us that it is important to understand the relative frequency of need states that lead to IDSM uptake, and to be able to use that information and available data resources to cost effectively those customers with IDSM messages.

7.1.4 Technology: EMS, Smart Thermostats and HAN/In-Home Displays

One of the primary drivers in the IDSM market arises from technology developments that leverage advanced connectivity and communications, including the EMS, smart thermostats and HAN/in-home displays. Markets for these products are growing and evolving rapidly but face some very real hurdles.

There remains strong IDSM potential in building monitoring and controls in both the commercial and residential sector, though it is difficult to know how the markets and products will evolve and whether they will capture the full energy management potential. The Achilles heel in both sectors with respect to capturing energy savings is in the inherent reliance on how the products are used by the consumer, especially given that they are more likely to be motivated by things other than energy efficiency (e.g., increasing comfort or convenience).

Vendors of commercial and residential monitoring and controls equipment are facing business challenges related to low 'barriers-to-entry' for the industry. Well-established companies compete with a host of new competitors offering a wide variety of unique and innovative products. This dynamic has created not only business uncertainty for vendors, but a confusing array of products for buyers to consider, and greater purchase risk associated with the proprietary nature of these systems and longevity of the vendor. These issues are compounded by a lack of communications protocol standards that limits interoperability.

Still, there are reasons to be optimistic about the commercial EMS market. Hardware and software advances have made products oriented to smaller commercial customers cost effective, opening up a large new customer base. Navigant Research reports, "The market for BEMS for utility customers is nascent, with most of the leading activity being driven by utilities in the United States and Canada. Pike Research estimates that global spending will reach $41 million in 2012, growing at a robust compound annual growth rate of 29 percent through 2020, when the market will reach $319 million worldwide."[36]

The status of the monitoring and controls market in the residential sector is not as bright as for commercial, but may change. The products and services on the market today have failed to gain traction after encountering a number of counter-forces: lack of a clear need, i.e. indifference to potential savings, high first costs and the complexity of equipment, compatibility issues and unsettled standards for interoperability, and a confusing array of products and vendors (similar to the nonresidential issue discussed above). Navigant Research is still somewhat optimistic, stating that "a continued desire among consumers to

[36] Building Energy Management Systems for Utility Customers, Navigant Research, Q4 2012, http://www.navigantresearch.com/research/building-energy-management-systems-for-utility-customers

reduce bills, regulatory mandates for greater efficiency, wider use of variable pricing schemes, and a strong green sentiment will combine to help drive adoption forward." Navigant concludes that the market's driving forces will ultimately yield some growth, particularly where policy mandates are strongest. In particular, it predicts the global market will grow from $300.7 million in 2012 to $1.8 billion in 2022.[37]

7.1.5 Policy: Building Codes and TOU Rates

Among the leading market drivers for IDSM are changes in public policy that affect energy costs and building codes. California has set aggressive goals for building new Zero Net Energy (ZNE) homes and commercial buildings. In a ZNE building, the annual energy consumption is equal to its annual production of renewable energy. The ZNE approach mandates integrated solutions and so has been one of the major drivers of IDSM solutions and integrated new construction design in the market. The ZNE building design is a particularly strong driver for EE and DG. It is also a driver for DR, but much less so. This is troublesome because greater saturation of DG increases the value of effective DR, which can offset the variability in renewable production. Furthermore, with more EE present, DR can require greater numbers of participants since per unit consumption on peak will be generally lower.

The mandatory transition to time-of-use rates in the commercial sector is a major development for DR and is also viewed by IOU staff as an important IDSM driver and marketing opportunity. All commercial accounts will default or have the option to go with time-of-use rates over the next couple of years. This statewide transition of small commercial customers to peak day pricing has created a platform for the IOU to approach these customers about their rates and ways to save energy and money. This is particularly useful for the small commercial segment because historically it has been a relatively non-engaged segment, facing greater rates of split incentives, cash flow restrictions and short planning horizons.

7.1.6 Challenges of the Solar PV Market

In California, half of all solar capacity installed to-date was added in 2013, including 607,689 California homes that installed a PV system. The relationship of Solar PV to utilities and regulatory systems is evolving and rapidly taking shape, as are embedded issues related to EE, DR, storage and the smart grid. The pace of change creates a challenging environment to create and implement policies supporting optimized integration.

The importance of the loading order (i.e. minimized DG system size) and the critical role of load shifting and DR in the successful integration of renewables is not at the front and center of the agenda of the private sector companies distributing PV panels to the residential and small commercial sectors. This is particularly limiting with regard to the institution of policies

[37] Home Energy Management, Navigant Research, Q4 2013, http://www.navigantresearch.com/research/home-energy-management

and processes to minimize system sizing and implement cost-effective energy efficiency opportunities at each site prior to DG system installation.

The solar industry has taken off more rapidly than markets for either DR or EE for a number of reasons. Renewables have a number of distinct advantages in their ability to appeal to customers relative to EE and DR. First, solar has the benefit of being tangible and not suffering from the elusive and difficult-to-measure nature of EE and DR (i.e. the elusive 'negawatt'). Its physical nature and prominent display on buildings provides a cultural and social value to the owner. Tax incentives, no-money-down options, guaranteed production levels and aggressive marketing tactics also contribute to the growing success of the solar industry.

7.2 Recommendations

Based on the findings discussed above, we recommend the IOUs and the CPUC consider the following to help better understand and promote IDSM in the small commercial and residential sectors:

- We recommend that the IOUs and the CPUC consider utilizing existing and/or future research to support efforts to establish continuous engagement with customers via online tools and complementary outreach efforts. More specifically, consideration should be given to analyzing tracking data and gathering feedback from customers regarding:

    - The frequency and motivations behind their use of IOU online tools, with a focus on identifying drivers for repeated exposures;
    - The success and accuracy of personalized features—including whether business types and household features reflected in the tools are accurate, what types of information are most important to the perceived degree of personalization, and the role of personalization in driving repeated use of the tools;
    - The role of energy consumption feedback on a customer's degree of continuous engagement. This could include presence of in-home displays, Home Energy Reports, and other AMI-enabled and/or Green Button applications.
    - Whether information is clear and successful in communicating IDSM solutions, with a focus on measuring the educational success of the tools, particularly for frequent users;
    - What the primary motivations are for creating tool-based long-term energy plans and updating them; and
    - Feedback regarding the usability of the tools for customers seeking both basic and detailed IDSM information.

- We recommend the IOUs and the CPUC consider investigating the power of various events or circumstances in predicting highly receptive IDSM need states. The data available to support targeted marketing to customers experiencing those events or circumstances should be considered in parallel, and may largely drive the focus of this

research area. We recommend considering research into the following events that may correlate with more receptive need states:

- Recent changes in household occupancy, such as marriage/co-habitation, a new baby, or a son/daughter leaving home;
- Customers entering the housing market;
- Refinancing of customers' homes;
- Applications for home equity loans by customers;
- Planning a roof replacement;
- Addressing old or failing HVAC equipment;
- Customers considering installation of Solar PV;
- Starting or expansion of customers' businesses;
- Application for business loan or line of credit;
- Subscribing to architecture and design journals or magazines;

- We recommend the IOUs continue to leverage the opportunity presented by the transition of small commercial customers to TOU rates to raise IDSM knowledge and awareness. This transition offers both a rare instance of IOU focus on this relatively hard-to-reach customer segment, as well as a 'teachable moment' where customers may be more receptive to energy management information than during times where energy procurement is 'business-as-usual'.
- We recommend the IOUs and the CPUC consider rate-based and integrated programmatic changes. Due to the compartmentalization and narrowly defined fields of DSM specialization, success in creating IDSM awareness and promoting the uptake of IDSM solutions may require a combination of policy and programmatic support. Recent updates to Title 24 building codes and ZNE initiatives are both very positive developments for promoting IDSM. These changes present an opportunity to leverage new levels of attention on the importance of energy management and IDSM solutions, but to be successful they will also require strong programmatic support. We recommend the IOUs leverage changes in Title 24 building codes as a platform for IDSM education, as well as to facilitate greater levels of code compliance and intelligent IDSM uptake. Given the history of low levels of code compliance, there could even be a justification for direct program support to bring customers up to code, especially as the code becomes more stringent. Otherwise significant IDSM opportunities may remain untapped. We recommend the IOUs and the CPUC create and enhance programs to support successful implementation of these policies:
  - New construction programs offering design assistance, as well as workforce education and training efforts will help to ensure the codes are implemented intelligently and consistently with their intention.
  - We recommend the IOUs and CPUC consider placing greater attention and increased program resources on ensuring code compliance. We recommend consideration be

given to setting compliance goals and investigate programmatic options that financially incentivize measured improvements in compliance rates.

- Consider enhancing the DR and load shifting elements of ZNE goals in the small commercial and residential sectors. The design and construction of ZNE buildings offers opportunities for DR education and deployment, along with EE and DG.
- Consider adding a DR element to California's Quality Installation and Quality Maintenance programs. Residential air conditioning makes up a substantial portion of summer peak usage, and with control features such as pre-cooling and small temperatures changes, DR may offer measurable peak curtailment potential in the future.
- If not already in place, consider bolstering DR and/or load shifting incentives for solar PV owners by instituting a TOU rate that more closely reflects true time-specific costs of net consumption.

8. Appendix A: Interview Guides

This appendix contains the following interview guides:

1. Products and Services
2. Supporting Organizations and Institutions
3. IOU Marketing Staff Interview Guide
4. IOU Data Staff Interview Guide

8.1 Interview guide for IDSM Market Assessment: *Products and Services*

Introduction

Hello, this is _____ calling from Evergreen Economics. We have been hired by the California Independently Owned Utilities to assess the market possibilities for the integration of products, services and technologies that relate to what we call "Integrated demand side management." IF NEEDED*: This can involve any combination of energy efficiency, demand response, and distributed generation.* Our objective is to understand characteristics of customers and opportunities with higher potential for integrated solutions uptake. We are hoping to speak with you or a coworker about [PRODUCT] for 15-20 minutes now or in the future.

Q1. Are you the best person to speak with? *If not, ask to speak to the best person (most familiar with the market, product, etc.)*
Q2. Would you be able to help us with our efforts? *If no, thank and terminate.*
Q3. Does now work or would you like to schedule something within the next week or two?

Company/role

Q1. What does your company do?
Q2. What are your rolls and responsibilities at the company?

Product and Marketing

Q3. Please tell me a little bit about [PRODUCT]. What needs in the market does it fulfill?
Q4. How long has your company been selling [PRODUCT]?
Q5. Who is the target customer for [PRODUCT]? Commercial, small business, residential?
Q6. Why do you think customers purchase [PRODUCT]? What factors are involved in their decision making process?

Q7. From a customer point of view, what barriers exist to purchase [PRODUCT]?
Q8. What distinguishes your [PRODUCT] from that of competitors?
Q9. What channels do you reach your customers through?
Q10. What are the main messages you communicate your customers?
Q11. Are there certain traits that you see in your customers? Does this differ between those who end up making a purchase vs. those who don't? *Probe on location, politics, environment, home type, home size, refinancing, remodeling, have solar*.

Integration

Q12. Are there other items or services that customers are purchasing or looking into when they are looking to buy [PRODUCT]?
Q13. When customers purchase [PRODUCT] are they doing any major renovations? If so, what kind?
Q14. [IF APPLICABLE]: What kind of training do customers get on how to use [PRODUCT]?
Q15. What kind of partnerships do you have with other products or companies, if any?
Q16. IF DEMAND RESPONSE=1: Are there ways, if any, that your product interacts with energy efficiency or distributed generation tools or products?
Q17. IF ENERGY EFFICIENCY=1: Are there ways, if any, that your product interacts with demand response or distributed generation tools or products?
Q18. IF DISTRIBUTED GENERATION=1: Are there ways, if any, that your product interacts with energy efficiency or demand response?
Q19. IF CONSULTING=1: What types of customers are interested in integrated projects (elements of energy efficiency, demand response, and distributed generation)?
Q20. IF CONSULTING=1: In your experience, which types of customers seem more open to purchasing bundled products?

Future Market

Q21. What do you see for the future of [PRODUCT]? *Probe on areas of future growth, stagnation, etc.*
Q22. Do you see your product fitting into either the small commercial or residential markets? If so, how and when? How does it plan to sustain that fit? What barriers exist to these markets currently?
Q23. If 22=no: How will it fit in in the future?

Closing Remarks

Q24. Thank you so much for taking the time to speak with me today. Is there anything you think I didn't cover that I should have?

8.2 Interview guide for IDSM Market Assessment: *Supporting Organizations and Institutions*

Note to interviewer: This guide is divided into two sets of questions, one for media specific groups, and another for associations or trade organizations.

Introduction

Hello, this is _____ calling from Evergreen Economics. We have been hired by the California Independently Owned Utilities to assess the market possibilities for the integration of products, services and technologies that relate to what we call "Integrated demand side management." IF NEEDED*: This can involve any combination of energy efficiency, demand response, and distributed generation.* Our objective is to understand characteristics of customers and opportunities with higher potential for integrated solutions uptake. We are hoping to speak with you or a colleague about [ORGANIZATION/INSTITUTION] for 15-20 minutes now or in the future.

Q1. Are you the best person to speak with? *If not, ask to speak to the best person (most familiar with the market, product, etc.)*
Q2. Would you be able to help us with our efforts? *If no, thank and terminate.*
Q3. Does now work or would you like to schedule something within the next week or two?

Organization/role

Q4. What does [ORGANIZATION/INSTITUTION] do?
Q5. What are your rolls and responsibilities at [ORGANIZATION/INSTITUTION]?
Q6. How long has [ORGANIZATION/INSTITUTION] been in existence?
Q7. How many members/employees/board members are part of [ORGANIZATION/INSTITUTION]?

IF ASSOCIATION=1 else skip to Media Specific Questions Battery

Product and Marketing

Q8. Please tell me a little bit about the technology or service that brings your members together. What needs in the market does it fulfill?
Q9. What barriers do your members face in bringing their product/service to market?
Q10. Who is the target customer for [PRODUCT/SERVICE]? Commercial, small business, residential?
Q11. Why do customers purchase [PRODUCT/SERVICE]? What factors are involved in their decision making process?
Q12. From a customer point of view, what barriers exist to purchase [PRODUCT]?
Q13. What channels do members reach their customers through?

Q14. What are the main messages you communicate your customers?
Q15. Are there certain traits that you see in your customers? Does this differ between those who end up making a purchase vs. those who don't? *Probe on location, politics, environment, home type, home size, refinancing, remodeling, have solar*.

Integration

Q16. Are there other items or services that customers are purchasing or looking into when they are looking to buy [PRODUCT/SERVICE]?
Q17. When customers purchase [PRODUCT/SERVICE] are they doing any major renovations? If so, what kind?
Q18. [IF APPLICABLE]: What kind of training do customers get on how to use [PRODUCT/SERVICE]?
Q19. What kind of partnerships do you have with other products, companies or associations, if any?
Q20. IF DEMAND RESPONSE=1: Are there ways, if any, that your product interacts with energy efficiency or distributed generation tools or products?
Q21. IF ENERGY EFFICIENCY=1: Are there ways, if any, that your product interacts with demand response or distributed generation tools or products?
Q22. IF DISTRIBUTED GENERATION=1: Are there ways, if any, that your product interacts with energy efficiency or demand response?
Q23. What types of customers are interested in integrated projects (elements of energy efficiency, demand response, and distributed generation)?

IF MEDIA=1, ask Media Specific Questions Battery, else, skip to Future Market Battery

Media Specific Questions

Q24. We are interested particularly in your broad view of the market. We are specifically interested in small business and residential applications for integration of energy efficiency, demand response, and distributed generation. Please keep this in mind as I ask you the following questions.
What types of technologies and topics do you cover?

Q25. What do you perceive as being customer (*by customer we are specifically looking for information on small commercial and residential customers*) wants and needs with regards to energy efficiency, demand response, and distributed generation?
Q26. Do you think customers see these three things differently, as unique strategies? Or as part of an entire toolkit to increase energy efficiency or reduce costs?

Q27. Do you see or perceive customer interest in integrated solutions, which include a combination of energy efficiency, demand response, or distributed generation?
Q28. What about from an industry perspective? Where do you see interest in integrated solutions across companies or even within companies?
Q29. What types of markets or customers do you see integrated applications working for?
Q30. What barriers exist to customers or companies doing more integrated projects?

Future Market

Q31. IF ASSOCIATION: What do you see for the future of [PRODUCT/SERVICE]? *Probe on areas of future growth, stagnation, etc.*
IF MEDIA: What are your future predictions for a more integrated market?
Q32. IF ASSOCIATION: Do you see your [PRODUCT/SERVICE] fitting into either the small commercial or residential markets? If so, how and when? What barriers exist to these markets currently?
IF MEDIA: Do you see integrated products fitting into small commercial or residential markets? If so, how and when?

Closing Remarks

Q33. Thank you so much for taking the time to speak with me today. Is there anything you think I didn't cover that I should have?

8.3 IOU Marketing Staff Interview Guide

MEMORANDUM

February 21, 2014

To: IOU Marketing Staff, familiar with integrated marketing efforts and the residential and small commercial markets

From: IDSM Market Characterization Statewide Study Management Team, and Steve Grover and Christie Torok, Evergreen Economics

Re: IDSM Market Characterization Study, Residential and Small Commercial Markets, Information packet and interview discussion guide

This memo pertains to a request for your input on a current Integrated Demand Side Management (IDSM) Market Characterization Study. This study is an IOU-led study with a budget of $80,000; it is managed by Lonnie Mansi of San Diego Gas & Electric (SDG&E) and implemented by Steve Grover and Christie Torok of Evergreen Economics.

The focus of the study is residential and small commercial customer needs and wants related to IDSM solutions.

Based on the recommendations of the IDSM program management staff, and with the support of IOU EM&V staff and study staff, you have been selected as among the best IOU personnel to interview for this effort. We seek your input to inform the study's core research questions and to provide guidance in refining and prioritizing those questions.

This memo provides a briefing on the study scope, approach and current status, and outlines the specific topics we would like to discuss during the interview. This information is presented below and is organized into four sections as follows:

1. **Background and Study Research Objectives** – Provides a brief overview of the study goals and rationale.
2. **Summary of Approach** – Provides a brief description of the primary research activities that are being conducted for this study.
3. **Project Schedule and Interview Timeline** – Provides a summary of progress to date, and the time frame that we would like to schedule a one-hour discussion with you.

4. **Interview guide** – This section summarizes the issues and questions that we would seek your input on during the interview.

Background and Study Research Objectives

The delivery of integrated solutions is relatively new in California. As such, there is likely opportunity to optimize resources through an improved understanding of the markets and customer preferences regarding integrated solutions. The objective of this assessment is to understand customer characteristics and opportunities with higher potential for integrated solution uptake. For example, a small retail customer using rented space may be interested in a small lighting retrofit but may not find discussion of demand response or distributed generation opportunities compelling. On the other hand, a customer having an air conditioner serviced may find information about AC Cycling programs offered by the technician to be relevant and useful. While blanket messaging and awareness-raising is one mode of promotion that will be pursued, a well-informed, targeted effort is another important plane of promotion. The results of this study will be used to drive a more targeted marketing effort.

Summary of Approach

The study approach consists of four distinct data collection and analysis tasks:

1. **Literature review** – We will review existing evaluation studies available on CALMAC and pull out findings that are particularly relevant to IDSM. This includes examining survey results that relate to customer decision-making and possible barriers to IDSM.
2. **Product and marketing review** – We will review websites and marketing materials to identify trends in IDSM technologies, services and information offered in the market. Particular attention will be paid to the associated marketing messages to determine the likely customer targets and the factors that are being emphasized to promote IDSM.
3. **Data analysis** – We will review existing databases from the IOUs that relate to IDSM and lend insight to customer preferences with respect to IDSM solutions.
4. **In-depth interviews** – We will conduct in-depth interviews with those market actors that are identified as being the best sources of information about the customer groups being targeted by IDSM. These interviews will include program managers, marketing and sales staff, and industry members that are currently advertising IDSM solutions as identified in #2.

Note that we are **not conducting customer phone surveys** as part of this research effort.

Project Schedule and Interview Timeline

- Initiate evaluation contract: November 2013
- Literature and Product/Marketing Review: November 2013 through January 2014
- Interview program managers and key market actors: January through February 2014
- Request and review IOU tracking data February through March 2014

- Prepare evaluation report: February through March 2014

At this time, we have completed the majority of the literature review as well as the product and marketing review, and are now turning our attention to the in-depth interviews and data analysis tasks.

Our target window for scheduling a one-hour discussion with you is on or before ***February 18, 2014.***

In-Depth Discussion Guide for Gathering Study Input and Feedback

The following is a summary of the key issues and questions we would like to discuss in the interview. These fall into two general categories: input to the study objectives and approach, and IDSM market perceptions and experience.

Study Input and Feedback

- When planning best strategies to promote IDSM in residential and small commercial markets, what information is most helpful to you? What additional information would you like to have to support your efforts?
- In the next phase of our study we will be interviewing people who work in the IDSM area, such as energy consultants and contractors, or product developers. Do you have any suggestions for us as we select these industry contacts for interviews?

IDSM Market Perceptions and Experience

- Please briefly describe your current engagements and activities that relate to the promotion of IDSM (residential and small commercial). What factors contributed to your current approach?
    - What activities and marketing strategies have been most effective in promoting IDSM to the residential and small commercial markets?
    - Would you share your perceptions of the current residential and small commercial markets as they relate to the delivery of IDSM solutions? For example, are there particular technology/program combinations that you see more often than others? Why do you think customers prefer to pair certain programs/technologies with each other? What elements of your programs/offerings lend themselves to easier integration?
    - What trends or shifts in the market have most significantly affected customer uptake of IDSM? What role has technology played in these changes? Is there a particular customer base that adopts IDSM solutions more readily? Are their drivers and motivations entirely unique, or can you identify drivers and motivations that could be applied to lower adopting customers? What are those

drivers or motivations? What other customers might respond to them, and how?

- Is the market changing rapidly? Would a detailed analysis of the drivers behind historical IDSM uptake be relevant to your IDSM efforts?
- In designing outreach and services, is there a market segmentation scheme that you currently use to focus or customize strategies to different areas of the market?
    - If yes, please describe the strengths and weaknesses in your current scheme. What additional information or research would help you strengthen your current approach?
- Are there new services or marketing strategies under consideration for delivery and promotion of IDSM?
    - What, if any, market research could be done to assist in planning for these changes?

8.4 IOU Data Staff Interview Guide

MEMORANDUM

February 3, 2014

To: IOU Data Management Expert**,** Online Integrated Audit Tracking Data and IDSM PPM data

From: IDSM Market Characterization Statewide Study Management Team, and Steve Grover and Christie Torok, Evergreen Economics

Re: IDSM Market Characterization Study, Residential and Small Commercial Markets, Information packet and data resources interview guide

This memo pertains to a request for your input on a current Integrated Demand Side Management (IDSM) Market Characterization Study. This study is an IOU-led study with a budget of $80,000; it is managed by Lonnie Mansi of San Diego Gas & Electric (SDG&E) and implemented by Steve Grover and Christie Torok of Evergreen Economics.

The focus of the study is residential and small commercial customer needs and wants related to IDSM solutions.

Based on the recommendations of the IDSM program management staff, and with the support of IOU EM&V staff and study staff, you have been selected as among the best IOU personnel to interview for this effort. We seek your input to inform our approach and planning for the data analysis activities as described below.

This memo provides a briefing on the study scope, approach and current status, and outlines the specific topics we would like to discuss during the interview. This information is presented below and is organized into four sections:

1. **Background and Study Research Objectives** – Provides a brief overview of the study goals and rationale.
2. **Summary of Approach** – Provides a brief description of the primary research activities that are being conducted for this study.
3. **Project Schedule and Interview Timeline** – Provides a summary of progress to date, and the time frame in which we would like to schedule a one-hour discussion with you.
4. **Interview guide** – This section summarizes the issues and questions that we would seek your input on during the interview.

Background and Study Research Objectives

The delivery of integrated solutions is relatively new in California. As such, there is likely opportunity to optimize resources through an improved understanding of the markets and customer preferences regarding integrated solutions. The objective of this assessment is to understand customer characteristics and opportunities with higher potential for integrated solution uptake. For example, a small retail customer using rented space may be interested in a small lighting retrofit but may not find discussion of demand response or distributed generation opportunities compelling. On the other hand, a customer having an air conditioner serviced may find information about AC Cycling programs offered by the technician to be relevant and useful. While blanket messaging and awareness raising is one mode of promotion that will be pursued, a well-informed, targeted effort is another important plane of promotion. The results of this study will be used to drive a more targeted marketing effort.

Summary of Approach

The study approach consists of four distinct data collection and analysis tasks:

5. **Literature review** – We will review existing evaluation studies available on CALMAC and pull out findings that are particularly relevant to IDSM. This includes examining survey results that relate to customer decision-making and possible barriers to IDSM.
6. **Product and marketing review** – We will review websites and marketing materials to identify trends in IDSM technologies, services and information offered in the market. Particular attention will be paid to the associated marketing messages to determine the likely customer targets and the factors that are being emphasized to promote IDSM.
7. **Data analysis** – We will review existing databases from the IOUs that relate to IDSM and lend insight to customer preferences with respect to IDSM solutions.
8. **In-depth interviews** – We will conduct in-depth interviews with those market actors that are identified as being the best sources of information about the customer groups being targeted by IDSM. These interviews will include program managers, marketing and sales staff, and industry members that are currently advertising IDSM solutions as identified in #2.

Note that we are **not conducting customer phone surveys** as part of this research effort.

Project Schedule and Interview Timeline

- Initiate evaluation contract: November 2013
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- Prepare evaluation report: February through March 2014

At this time, we have completed the majority of the literature review as well as the product and marketing review, and are now turning our attention to the in-depth interviews and data analysis tasks.

Our target window for scheduling a one-hour discussion with you is on or before February 18, 2014.

Interview Guide: Data Gathering Objectives and Data Availability

The following is a summary of the types of data that could be valuable in gaining additional insight into the underlying composition of customers that adopt IDSM solutions.

We seek your input on the feasibility of obtaining each data resource, the best approach for obtaining available data, and whether similar or related information may be available even if these data are not.

1) Online Integrated Audit Tracking Data

- **Data indicating which DSM tools or components were visited and which were completed -** Examples include the rate "what if" analysis, the solar PV tool, and the EE audit.
- **Data entered by the customer into the tool during the audit process -** For example, customer reported equipment holdings and efficiency levels.
- **Technical or descriptive information generated by the audit tool -** For example, disaggregated usage information and potential for savings.
- **Data on page click-throughs -** That is, records indicating which pages were visited by the customer during the audit and in what order.
- **Indicators of partially completed DSM tools/audit-components.**

- **Recommendations provided by the audit tool to the customer as a result of the audit -** For example, recommendations for measure replacement or installation, referrals to DR or CSI programs.
- **Audit ID and Customer IDs -** We do *not* require customer name or contact information for this study. However, we ask that customers completing the integrated audit more than once be flagged with the same customer ID.
- **Geographic Indicators -** In lieu of address, indicators of geographic location of customer such as the Census Block Group, Census Tract or Zip Code of customer.
- **Interconnect date for accounts that are net metered.**
- **Annual Energy Consumption Data -** Annual kWh, kW and Therms.
- **Customer class (residential versus commercial)**
- **NAICS code for nonresidential participants**
- **Rate Code associated with account (or largest account at the site audited)**
- **Date of audit**

2) EE/PV/DR program participation records for customers participating in the online audit and/or in more than one DSM area, in particular:

- Program Name;
- Date of participation and duration of participation for DR;
- Details of any incentivized measures or projects installed through EE or DG programs; and
- Identifier that will match incentive and DR tracking records to integrated audit tracking.

We would also like to explore the possibility of analyzing data for <u>all</u> customers that participated in more than one DSM area, not just those that completed the online audit.

We hope that some of these data have already been assembled in support of the end-of-cycle reporting of Program Performance Metrics (listed below) for IDSM. What data were assembled for the PPM reporting effort? Do these data include the details listed above, for the integrated audit and multiple DSM tracking?

IDSM Program Performance Metrics, End-of-Cycle Program Reporting*
Number and percentage of integrated audits provided to each customer class and NAICS code.
Number and percent of integrated audit participants (identify NRA participants) in all customer classes (Residential, Commercial, Industrial, Agriculture) that implement recommended DSM measures / participate in other DSM programs (EE, DR, DG – Track which categories implemented / participated in) or other recommended technical process and practice improvements. (If possible, identify whether participants received incentives or not.)*
Program participant awareness of IDSM practices in each of the market sector subprograms.

*Source PG&E 2013-2014 Energy Efficiency Portfolio Program Implementation Plan, Statewide Program, Integrated Demand Side Management, PGE2108, April 23, 2013

9. Appendix B: Technologies Database

This appendix contains the technology database that accompanied the Literature, Commerce and Product Review.

9.1 IDSM Product and Service Cost and Savings Information

Table 11: Cost Information From Research and Interviews

IDSM Enabling Services (n=6)	
Building Design/Construction (n=3)	• No information
Green and Sustainable Business Consultants (n=3)	• No information
IDSM Enabling Technologies (n=44)	
Energy Management Systems (EMS/HAN) (n=21)	• Starter Kit: $179-$299, Accessories: $19.99 - $199.99, Service Plan: $0-$9.99/month • $4.99 per year
Energy Storage (n=7)	• $2,000 to $2,500 per kW
In-home display (n=3)	• No information
Load Pattern Analysis (n=1)	• $20 per report
Smart appliances (n=1)	• $900 to $1,900
Thermostats (n=11)	• $200 • $249 • $250 • $344 • $275
Integrated Technologies (n=17)	
Ground Source/Geothermal Heat Pump (n=2)	• Cost for 1 million BTUs (4.0 COP, $.12/kwh) = $8.79, Installation Costs: $20,000-$47,000 depending on model
Integrated Distributed Generation: Hybrid HVAC (n=5)	• $1,695 • $2,500 to $3,000 for installation • $24,000 for installation
Integrated Distributed Generation: Solar-Thermal hybrid PV system (n=2)	• $7.25 to $7.50 per watt

Solar Cooker (n=2)	• $29 • $33
Waste Heat Recovery and Cogeneration: Heat Recovery Ventilator (n=3)	• $25,000 to $150,000
Waste Heat Recovery and Cogeneration: Micro CHP (n=2)	• No information
Waste Heat Recovery and Cogeneration: Working Fluid for Org Rankine Systems (n=1)	• No information
Total (n=67)	

Table 12: Savings Information From Research and Interviews

IDSM Enabling Services (n=6)	
Building Design/Construction (n=3)	• $9.2 million saved in kWh bills for first 1,000 SheaXero homes.
Green and Sustainable Business Consultants (n=3)	• No information
IDSM Enabling Technologies (n=44)	
Energy Management Systems (EMS/HAN) (n=21)	• $1 per day • 10% to 40% on electric bills per year • 14% kWh consumption savings, 25% peak demand reduction • 15% to 30% of energy consumption • 20% or more on energy costs each month • 40% reduction in electric bill • Demand control: 10-30%, lowering utility bill by 5-10%, 20-40% lower rates with dynamic pricing • Up to 7% of utility bill
Energy Storage (n=7)	• 12 kW of source equivalent peak demand reduction for a minimum of 6 hours daily, shifting 72 kW-hours of on-peak energy to off-peak hours • 30% to 70% fossil fuel energy savings

In-home display (n=3)	• No information
Load Pattern Analysis (n=1)	• No information
Smart appliances (n=1)	• No information
Thermostats (n=11)	• $10 to $50 per month
Integrated Technologies (n=17)	
Ground Source/Geothermal Heat Pump (n=2)	• 25% to 50% less energy costs than other HVAC systems • Up to 70% on heating, 50% on cooling, and 30% to 50% on hot water • AC kWh savings of 30% to 50%, 70% for air source heat pump • AC kWh savings of 30% to 70%, 50% for air source heat pump
Integrated Distributed Generation: Hybrid HVAC (n=5)	• More than 80% on heating and cooling costs • 36% to 100% of cooling costs
Integrated Distributed Generation: Solar-Thermal hybrid PV system (n=2)	• No information
Solar Cooker (n=2)	• No information
Waste Heat Recovery and Cogeneration: Heat Recovery Ventilator (n=3)	• 1 million kWh with total investment volume of $65,225
Waste Heat Recovery and Cogeneration: Micro CHP (n=2)	• No information
Waste Heat Recovery and Cogeneration: Working Fluid for Org Rankine Systems (n=1)	• No information
Total (n=67)	

9.2 IDSM Product Database

IDSM_Product_Service_Database.xlsx