Energy Efficiency Motivations and Actions of California Solar Homeowners

Ria Langheim, Georgina Arreola and Chad Reese,
California Center for Sustainable Energy

ABSTRACT

Individuals who invest in solar photovoltaic (PV) systems can realize many benefits from energy efficiency measures. When performed before the installation of a PV system, energy efficiency upgrades can reduce the size of the PV system needed to offset a home's electric energy use. In addition, the measures may also increase the comfort, value and safety of homes. This research employs a combination of survey and focus groups to examine the home energy efficiency activities and underlying motivations of California Solar Initiative (CSI) participants in the San Diego Gas & Electric (SDG&E) territory. The results reveal that both home energy efficiency upgrades and the installation of a PV system are motivated primarily by cost savings, along with secondary motivations such as concern for the environment. The majority of respondents installed home energy efficiency upgrades before the installation of the solar system. We found that upgrades tend to be performed either before or after the installation of their PV system, but not at both times. Solar adopters focus extensively on basic home upgrades, such as replacing lighting with more energy-efficient bulbs or purchasing more efficient appliances. The responses of participants revealed that the energy audits required by the CSI program did not result in an increase of energy efficiency upgrades before the installation of the PV system. The results are aimed at policy makers who are working to improve the connection between energy efficiency and solar in residential programs.

Introduction

The residential rooftop solar PV market in California has experienced rapid growth in recent years, increasing more than fivefold since 2010. As this market expands, a number of key questions surrounding the relationship between solar and energy efficiency remain unclear. How do solar customers perceive the value of energy efficiency? How does this change after solar is installed? Are customers installing solar in conjunction with or in lieu of energy efficiency? Understanding this relationship is critical given the state's efforts to expand the residential energy efficiency market and its aggressive Long Term Energy Efficiency Strategic Plan, which call for reducing energy consumption in residential buildings 40% by 2020. By examining these relationships in more detail, we may find that solar customers represent the ideal market segment for energy efficiency – they are homeowners, have demonstrated a willingness and ability to investment in their homes, are engaged in energy-related issues and have taken proactive steps to manage their energy usage and bills.

Multiple studies have examined the motivations and implementation behavior of homeowners and how to improve the adoption rate of home upgrade/energy efficiency measures (e.g. Pelenur and Cruickshank 2012; Gromet, Kunreuther, and Larrick 2013). While many home upgrade measures are considered low hanging fruit, the potential for energy savings is often not fully realized by homeowners, a phenomenon referred to as the "Energy Efficiency Gap." At the same time there is a growing body of research studying the synergies between installing energy

efficiency technologies and solar photovoltaic in residential homes to understand how these technologies can be effectively employed together (e.g. CALSEIA 2010; Prindle and Elridge 2007).

Homeowners who invest in solar can realize many benefits from energy efficiency measures. By reducing loads, a homeowner can reduce the size of the PV system needed to offset energy use. For this reason, implementing energy efficiency measures in conjunction with the installation of a PV system is promoted as best practice in the state's solar incentive programs and mandated in Senate Bill 1, the legislation that established the GoSolar! California effort (GoSolarCalifornia 2014). Moreover, energy efficiency measures also may increase the comfort, value and safety of homes by sealing leaks, adding insulation and improving indoor air quality.

The California Center for Sustainable Energy (CCSE) conducted this study to understand better the connections between residential energy efficiency and solar installations from a homeowner perspective. The results are aimed at policy makers who are working to improve the connection between home energy efficiency upgrades and solar in residential programs.

This research employs a combination of surveys and focus groups to examine the energy efficiency awareness, activities and motivations among residential solar adopters. The survey captured the degree to which CSI participants in the SDG&E territory have engaged in energy efficiency improvements as well as their motivations for both this investment and the solar project itself. The focus groups targeted selected survey respondents, exploring in more detail the awareness and motivations among PV owners to invest in home energy efficiency retrofits.

Survey of Solar Home Owners

In the first step of the study we conducted a survey with residential solar home owners who participated in the California Solar Initiative (CSI) to assess their demographics and prospective on energy efficiency, as well as the extent and timing of energy efficiency adoption.[1] The survey was administered online to participants in the SDG&E service territory who installed a solar PV system prior to June 2012.[2] Of the 9,783 eligible participants, CCSE had valid email addresses for 8,166. A total of 2,499 CSI participants completed the survey, for a response rate of approximately 30%. We excluded 145 surveys in our analysis,[3] resulting in a total CSI participant survey sample of 2,354 (the respondents).

The survey responses were combined with additional data points collected through the application process, including information on PV system size and location of the installation. Data from the registrar of voters also was appended to get a better understanding of participants' political affiliations, which was used for the focus group participant selection.

Home Tenure

The vast majority of the respondents reported having lived in their residence for an extended period. Eighteen percent lived in their homes for between 5-10 years, and 64% for

[1] Authorized under Senate Bill 1 (Murray, Chapter 132, Statutes of 2006) and launched in 2007 the program incentivized newly installed solar systems in California. Between 2007 and 2013, nearly all residential PV solar systems were incentivized under the CSI program, making program data very representative of the overall market. The CSI program is currently in its final stages with limited rebate funds available.

[2] CCSE administers the CSI rebate program for the SDG&E service territory and keeps a database of all projects.

[3] These surveys are from Orange County residents for which building characteristics data was unavailable.

more than 10 years. In addition, survey respondents plan to stay in their homes for the near future: 17% for at least 5-10 years and over 80% more than 10 years.

Demographics

Among residential solar system owners, income and education levels are markedly higher than the general population. The median income range is $125,000 to $149,000 – well above the median household income of the county ($63,373). In all, more than 65% of survey respondents reported a household income of $100,000 or more a year (Figure 1).

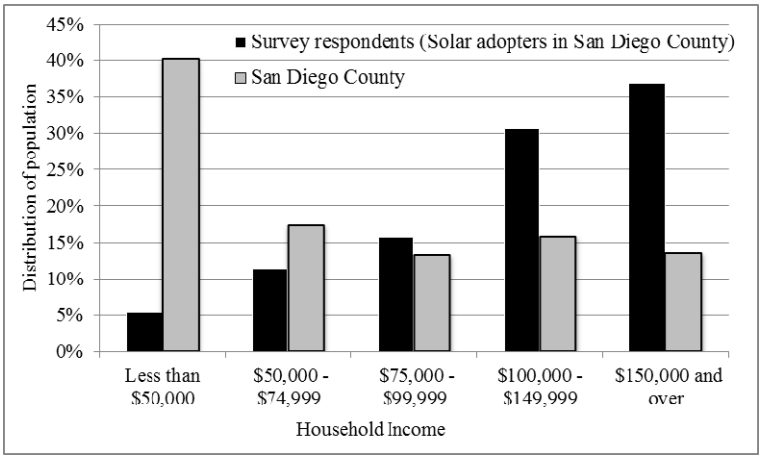

Figure 1. Income distribution among survey respondents and San Diego County population. Data for San Diego County is derived from 2008-2012 American Community Survey 5-Year Estimates.

Among solar system owners, 44% have advanced degrees, while 36% of system owners graduated from a four-year institution. San Diego solar home owners are 4 times more likely to have advanced degrees than the general San Diego population and nearly twice as likely to have bachelor's degrees (Figure 2).

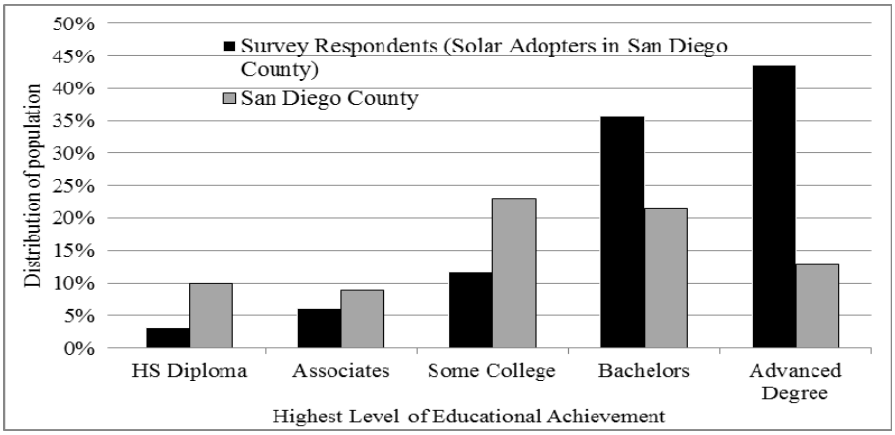

Figure 2. Educational attainment among survey respondents and San Diego County population. Data for San Diego County is derived from 2008-2012 American Community Survey 5-Year Estimates.

Motivations for Installing Solar

To understand what motivated the investment in solar PV we asked survey respondents to report the importance that various factors played in their decision. The results are summarized in Table 1. The data clearly shows that saving money on electricity costs was the most important motivation in the adoption of a solar PV system. This is not surprising given the high cost of electricity for residential customers in California, which can be more than $0.30/kWh.[4] Based on a review of application data, we found that a majority of survey respondents consumed well into the higher tiers of the rate structure during summer months. The motivation to reduce high tier consumption is reflected in the survey responses with a majority of solar home owners having sized their system to shave off the top tiers of consumption, thus reducing marginal pricing down to the lowest portions of the pricing structure. In our sample, 73% of respondents sized their system to offset 80% or more of their electricity load.

Respondents ranked reducing reliance on nonrenewable resources and federal/state incentives second and third respectively, followed by environmental considerations and increased property values.

Table 1. Motivations for installing solar*

Factors motivating adoption of solar	Mean Rank	Ranked most important	Ranked 2nd most important
Save money on electricity costs	5.4	74.1%	7.5%
Reduce reliance on nonrenewable energy sources	3.6	13%	24.7%
Federal incentives	3.5	5%	24.8%
State incentives	3.3	2%	14.8%
Increase environmental quality &lower pollution	3	9.1%	19.9%
Increased property value	2.9	1.4%	17.4%

*Respondents ranked a preset list of six motivations in order of most to least importance, if they were a part of the decision-making process (6 refers to most important).

When comparing motivations to adopt solar across demographics, such as educational attainment, distinct differences emerge (Figure 3). For example, respondents with advanced degrees are more motivated by environmental concerns and reducing reliance on fossil-fueled energy compared to other degree holders. In contrast, respondents with a high school, associate's degree or some college perceive the influence of solar on the value of the property higher than people with higher degrees. Understanding nuances in motivations across demographics may aid in tailoring effective energy efficiency messages across the spectrum of solar home owners.

[4] Most domestic residential usage in CA is charged on a volumetric tiered structure through which users pay different prices per unit of electricity based on the total volume of energy consumed in a given billing period. The size of individual tiers is based on the customer's baseline, which is determined by their climate zone and heating fuel.

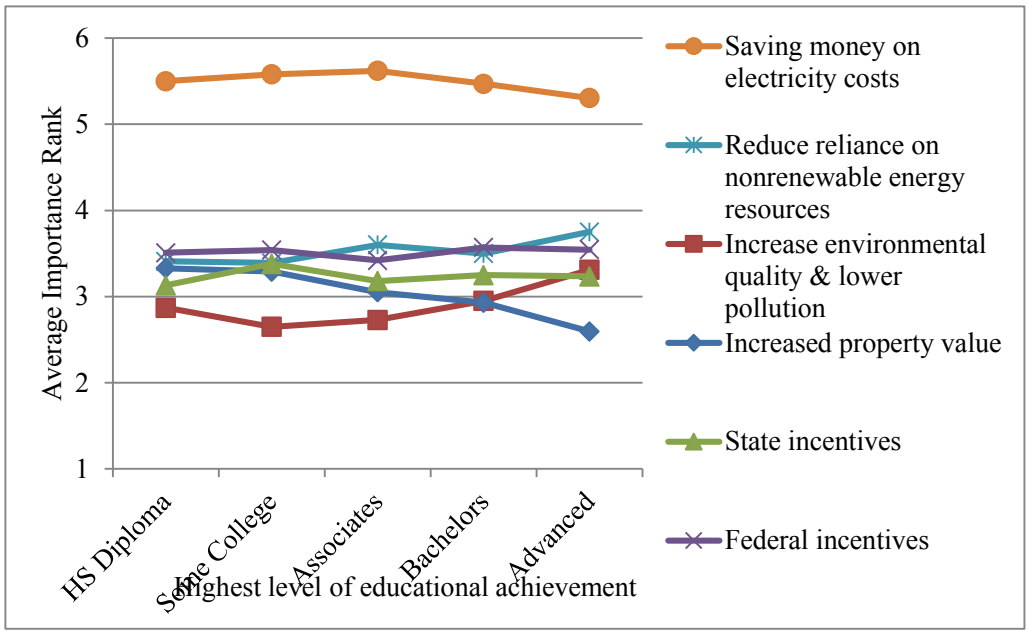

Figure 3. Motivations for installing solar by education segment.

Motivations for Investing in Home Energy Efficiency Upgrades

Similar to their motivations to go solar, survey respondents overwhelmingly reported that saving money was the most important motivating factor for installing energy-efficient technologies (Table 2). In general, financial and environmental motivations rank highest, while concerns such as creating a more comfortable and healthy indoor environment seem to be of lower importance. While concerns about home health, comfort or safety are perceived as less important compared to economic and environmental drivers, survey responses on health and comfort issues in the home indicate that these concerns have significant potential for home energy efficiency upgrades. Survey respondents reported the following issues/concerns with regard to health and comfort in the home.

- 52% report hot/cold zones in their homes
- 42% indicate that someone in the household suffers asthma or allergies
- 21% are concerned about mold in their homes

Respondents who reported hot/cold zones listed air sealing and insulation twice more often as priorities for future energy efficiency upgrades compared to respondents without hot/cold zones. Overall, respondents with any safety or comfort concerns indicated more often to prioritize mechanical system upgrades for future upgrades compared to respondents without these concerns. These data indicate that while health and comfort are not the primary drivers of energy efficiency upgrades, customers appear to understand that a connection exists and reveals what could be a significant opportunity to engage customers on nonfinancial motivation for deep home energy upgrades.

Table 2. Motivations and benefits for investing in energy efficiency*

Factors motivating energy efficiency upgrades	Mean Rank	Ranked most important	Ranked 2nd most important
Lower energy bills	9.4	71.8%	12.7%
Conserving energy and resources	7.9	17.8%	32.3%
State/federal incentives	7.3	3.8%	33.8%
Increased home value	6.4	1.4%	9.5%
Environment/less pollution	6.3	7.1%	13.2%
Comfortable indoor temperatures	5.6	2.7%	6.9%
Lower home maintenance costs & increase equipment life	5.4	1.4%	4.8%
Improved indoor air quality	4.0	0.2%	1.2%
Improved safety (against contaminants)	3.0	0.4%	1.3%
Recommendation from contractor	2.2	0.6%	0.6%

* Respondents ranked a preset list of 10 motivations in order of most to least importance, if they were a part of the decision-making process, (10 refers to most important).

Home Energy Efficiency Upgrade Behavior

In addition to exploring motivating factors, the survey also inquired about what type and during what time solar customers performed home energy efficiency upgrades. Survey respondents indicated whether they performed any energy efficiency upgrades prior to or in conjunction with and/or after to the installation of solar in their homes in the following categories.

- Basic: lighting, low-flow fixtures, Energy Star appliances/ceiling fans/attic fans
- Envelope: windows/doors/air sealing/insulation/cool roof
- Mechanical Systems: solar water heater/high-efficiency water heater/high-efficiency HVAC/ducts & seals/high-efficiency furnace

More than 87% of survey respondents had installed or upgraded one of these energy efficiency technologies in their homes. The majority of respondents had installed or upgraded measures before or in conjunction with the installation of the PV system (Table 3). This is an important finding indicating that solar home owners utilized available technologies to reduce the amount of energy consumed at a critical time – before the PV system is sized. Simple upgrades dominate the energy efficiency categories across the two time windows, which resembles the findings made by Hee, Wedding and Urlaub (2013) in a study about behavior of PV system owners in North Carolina.

Table 3. Depth of energy efficiency measures shown in relation to time of solar installation

	Preinstallation	Postinstallation
Simple	80%	37%
Envelope	54%	12%
Mechanical	40%	10%

The most commonly installed technologies are high-efficiency lighting, Energy Star appliances, ceiling fans, low flow shower heads and fixtures and efficient windows (Table 4). The least commonly adopted technologies are the cool roof, solar water heater, air sealing and duct/seal replacement. While duct sealing or replacement represents a significant energy savings opportunity (the average duct system in California homes leak 30% of the conditioned air according to the California Energy Commission [2010]) only 1 in 8 solar adopters made such upgrades before the installation of the PV system. In general, all types of energy efficiency technologies are more commonly installed prior to the PV system.

Table 4. Type of home energy efficiency upgrades shown in relation to time of solar installation

	Type of home energy efficiency upgrades	Preinstallation	Postinstallation
Simple	Lighting (i.e.CFLs, LEDs, motion sensors)	56%	28%
	Low-flow shower heads and fixtures	44%	5%
	Ceiling Fans	46%	5%
	Attic Fans	24%	3%
	Energy Efficient Appliances (must be ENERGY STAR®)	52%	12%
Envelope	Windows	44%	6%
	Doors	20%	4%
	Air Sealing	10%	2%
	Insulation (weather stripping/ sealing ducts)	27%	5%
	Cool roof	3%	0%
Mechanical	Duct/Seal/replacement	12%	2%
	Solar Water Heater	7%	1%
	Tankless/high-efficiency Water Heater	13%	3%
	High Efficiency Furnace	21%	4%
	High Efficiency Air Conditioner	20%	4%
	None	13%	52%

PV system owners appear to perform energy efficiency upgrades either before *or* after the installation of their system, but not at both times. This relationship is indicated by the very low correlation values of pre- and post-PV system upgrades in Table 5. This potentially indicates two distinct approached to energy efficiency: one, taken by a majority of customers, where solar is viewed as an extension or culmination of an energy efficiency process, and two, taken by a smaller subset of customers, where solar triggers an increased awareness of usage and subsequent actions on energy efficiency. Further research into energy efficiency behavior of solar home owners is necessary to test this hypothesis.

Table 5. Pearson's Correlation Analysis between pre- and post-PV installation upgrades Correlation coefficients close to 1 or -1 show a strong association between two variables

		Pre-PV Installation			Post-PV Installation		
		Simple	**Envelope**	**Mechanical**	**Simple**	**Envelope**	**Mechanical**
Pre-PV Installation	Simple	1					
	Envelope	0.38	1				
	Mechanical	0.29	0.35	1			
Post-PV Installation	Simple	**0.06**	**-0.05**	**-0.04**	1		
	Envelope	**0**	**0.02**	**0.02**	0.19	1	
	Mechanical	**0**	**0**	**-0.02**	0.16	0.23	1

Interestingly, those who invest in home energy efficiency upgrades after the installation of PV system upgrades do not appear to be influenced by the percentage of system offset. Respondents who offset large amounts of their total consumption (more than or equal to 80%) and those that offset smaller amounts (less than 80%) show little difference in postinstallation activities (Table 6). This convergence of behavior suggests that both groups perceive the value of performing energy efficiency measures similarly. This may have to do with the absolute level, rather than percentage, of consumption after the PV system installation. Additional data and analysis are needed to explore motivations for post-PV upgrades further.

Table 6. Adoption of energy efficiency measures after PV installation segmented by percentage of usage offset

PV Offset	**None**	**Basic**	**Envelope**	**Mechanical**	**% of total Respondents**
Less than 80%	54%	27%	7%	12%	26.7%
80% or more	54%	27%	9%	10%	73.3%

$\chi^2(1, N = 3) = 2.97, p = 0.396$

Energy Efficiency Audit

The survey also asked respondents about the required energy efficiency audit integrated into the CSI program in order to understand the influence of this process on energy efficiency behavior. Energy efficiency audits are a prerequisite for participation in the CSI program; however, they can range in sophistication from a short, web-based audit to a more complete home performance audit with building diagnostics. The solar contractor often determines the type of audit performed. The energy audit requirement is an important component of the solar rebate process, as audits have been shown to increase awareness and knowledge of energy efficiency technologies at a critical time in the PV installation process (Hee, Wedding and Urlaub 2013; Palmer et al. 2011). By reducing loads before PV installation, a homeowner can reduce the size of the system needed to offset energy use and reduce overall costs. Guerin et al.

(2000) found that energy audits lead to an increased adoption of energy efficiency technologies as well as reduction of energy consumption. However, the effect of CSI audits on PV owners' energy upgrade behavior has not been established in the literature to our knowledge.

About a third of the respondents (30%) indicated that an audit was performed, while 42% indicated that no performance audit was made and the other 28% were unsure. This is a noteworthy finding given that audits are required for participation in the CSI program and that copies of the completed audit documents are on file in each customer's application. To understand the extent to which audits influence customer behavior, we compared the number of energy efficiency upgrade measures taken by CSI participants that recalled the audit to the participants that could not recall one being performed or were unsure. As shown in Table 7, the differences in home energy upgrade measures between those who recall the audit and those who did not were insignificant, with the exception of mechanical system upgrades, which were higher among the audit group. Based on these data, recollection of the CSI audit did not seem to result in a shift towards pre-PV installation uptake of energy efficiency technologies.[5]

Table 7. Depth of energy efficiency measures shown in relation to time of solar installation and audit awareness

	Before/In Conjunction with PV		**After PV installation**	
	Audit	**No Audit**	**Audit**	**No Audit**
Simple	82%[1]	79%[1]	35%[4]	38%[4]
Envelope	56%[2]	53%[2]	11%[5]	12%[5]
Mechanical	44%[3]	38%[3]	10%[6]	10%[6]

1: $\chi^2(1, N = 1) = 3.30$, $p = .069$, **2**: $\chi^2 = 1.12$, $p = .29$, **3**: $\chi^2 = 9.55$, $p = .002$, **4**: $\chi^2 = 2.51$, $p = .11$, **5**: $\chi^2 = 0.3$, $p = .58$, **6**: $\chi^2 = 0.016$, $p = .899$

Focus Groups with Selected Solar Home Owners

In addition to surveying CSI participants, a subset of PV adopters were invited to participate in focus groups to explore in more detail their awareness and motivations of investing in whole-home energy efficiency retrofits.

Focus group participants were selected by performing a customer segmentation informed by an Opinion Dynamics Corporation (ODC 2009) study of investor-owned utility customers in California. We identified two segments established by the ODC analysis, the "Leading Achievers" and "Practical Spenders" market segments, which, based on demographics such as household income and education, likely represented a majority of CSI participants. We focused on these segments due to the high levels of home ownership, significant investments in energy-related projects (i.e., PV) and demographic composition of survey respondents.

The ODC report characterizes Leading Achievers as having a high percentage of home ownership, high income, high educational attainment and a more liberal political leaning. When investing in energy efficiency, they tend to be motivated more by environmental considerations and concerns for the welfare of future generations.

[5] This data analysis was not able to take into account how many home energy efficiency upgrades were performed before the solar participants had to engage in the audits. We are aware that those upgrades were not motivated by the CSI audit.

The Practical Spenders, on the other hand, are more politically conservative than the other segments and are primarily motivated to use energy efficiently in order to save money and reduce dependence on foreign energy sources. This group tends to be less motivated than the Leading Achievers by environmental considerations and concerns about the welfare of future generations. Practical Spenders tend to have slightly lower incomes than the Leading Achievers and lower levels of education. The demographic, political and motivation characteristics of both segment groups are shown in Table 8.

Table 8. Leading Achiever and Practical Spender segment characteristics

	Leading Achiever	**Practical Spender**
Income	$150k and Up	Under $150k
Education	Master's or above	Bachelor's or below
Political Leaning	Political leaning was not considered for this segment	Conservative precinct (50% Republican or more)
Motivation for PV	Environment #1	Energy independence #1 or 2

The focus groups were conducted in early December 2012 and consisted of CSI survey respondents that indicated a willingness to participate in further research. It is important to note that this approach presents the potential for self-selection bias, where those willing to participate in further research may not be representative of the survey population as a whole; however, further analysis revealed that those who had opted in were both demographically and geographically similar to the population as a whole.

There were 16 participants across the two groups (8 each for Leading Achievers and Practical Spenders), each receiving $50 for their participation in the 90-minute discussion facilitated at CCSE. The focus group facilitator led participants in an in-depth discussion about how they perceive the value of energy efficiency.

Focus Group Observations — Value of Energy Efficiency

A few distinct differences regarding motivations and awareness of the value of energy efficiency emerged in the discussions of the two focus groups. The Practical Spenders group linked energy efficiency to home maintenance. "Energy efficiency is part of taking care of your house, it's an ongoing process – so it needs doing all the time." This group also mentioned value seen in increasing comfort. Some participants made improvements like double-paned windows and realized the added benefits of a quieter home, as well as a cooler home in summer and a warmer home in winter.

Practical Spenders emphasized the importance of saving money; lowering or eliminating their electricity bill was clearly linked to the decision to install solar panels. Their solar installations were made with an eye toward the future as participants stated that they were keen to avoid SDG&E rate hikes and protect themselves during their retirement years. However, they had a tough time linking energy efficiency to any type of post-solar installation monetary gain.

In the Leading Achievers group discussion, a couple of participants stated that they made a concerted effort to complete energy efficiency upgrades before installing their solar panels. "It's seems like a prerequisite to me. We were encouraged [from the solar company and SDG&E] to do energy efficiency first. We had an audit before we put in solar." The Leading Achievers also discussed the value of protecting the environment, being green in general and

reducing their carbon footprint. “I want to reduce my carbon footprint – that was the goal in putting in solar.”

When the discussion turned to energy efficiency measures and value of audits, participants of both groups provided similar responses and insights. All of the participants mentioned or agreed in some way that they had completed an energy audit as part of their solar system project.[6] Many also presented details about energy efficiency measures they had completed over the past several years. From windows to insulation, participants had a variety of reasons for completing the measures: updating an older home, making their home more comfortable, noise abatement and energy savings. Several stated that they had incorporated energy efficiency upgrades and appliances into remodeling projects.

The discussion showed that participants in both groups did not think of the energy efficiency audit as a deliberate attempt to promote energy efficiency measures with their solar installation. Even though participants could recall the audits and understood the link between sizing the PV project and reducing consumption, only a few mentioned completing an energy efficiency upgrade project with the installation of the PV project. There was a lot of agreement among participants that completing a comprehensive energy efficiency project before installing solar panels enables installation of smaller systems. Participants did not complete energy efficiency measures as part of their solar project except for one participant who stated that his solar company recommended a new duct system before solar installation.

Participants in both groups with systems that offset nearly 100% of yearly load stated that completing additional energy efficiency measures now would not achieve significant additional cost savings due to the current laws governing payment for overproduction, which create a “disincentive” to produce more than they will use. Despite this, both groups discussed changing their energy consumption behavior to conserve energy after the installation of the PV system. Participants stated that they don’t want their consumption to exceed production of the PV system. One participant likened it to a game – he stated that he is constantly monitoring use and production. One participant stated that he hasn’t turned on his plasma television since he installed solar and another participant stated that he now goes around turning off lights.

Conclusions

The survey and focus groups provide instructive insight into the motivations and behavior of solar home owners with regard to home energy efficiency upgrades. Saving money is the prevalent driver in decisions to install a PV system and perform home energy efficiency upgrades. Even though many solar home owners reported several health-related concerns in their homes, indoor air quality and safety against contaminants was not an important decision factor for home energy efficiency upgrades. However, homeowners did appear to make a link between these concerns and future upgrades.

In our survey analysis and focus groups we found that the importance of decision factors for pursuing solar as well as energy efficiency upgrades differ by demographics such as educational attainment and income. Understanding nuances in motivations across demographic groups may aid in tailoring effective energy efficiency messages across the spectrum of solar home owners.

[6] This is not representative of the survey population that only had 30% audit recall. However, this could be due to the group dynamic and people changing their answer to fit in with their peers.

The majority of solar home owners understand the value of energy efficiency with installing solar. Focus group participants were very outspoken about its advantages and analysis into upgrade behavior shows that most participants take energy efficiency measures before installation of a solar system. Simple upgrades, such as lighting and Energy Star appliances, are most commonly installed among respondents. In contrast, duct/seal replacement, which could yield significant energy savings are only performed by a small fraction of solar adopters. Overall, solar adopters perform home energy efficiency upgrades either before or after the installation of their PV system, but not both at the same time. In the focus group discussions, some participants stated concern that additional home energy efficiency measures would make them net exporters due to their system sizing, resulting in financial loss. This fear of net excess generation reinforces the need to engage customers on comprehensive energy efficiency programs prior to the installation of a PV system.

While energy audits are a required item in the CSI program, only 30% of respondents recalled participation in one. Moreover, these audits did not seem to result in a shift from post- to pre-PV installation upgrade behavior. In the focus group discussions, participants did not connect energy audits to the PV system installation process. The findings suggest that participants are not sufficiently aware of these audits, which points to insufficient guidance by the program and contractors. It seems that the requirement was merely a formality in the application process.

Overall, while the PV system is largely viewed as the capstone event along the energy upgrade continuum, it is not clear that customers engage in this behavior due to knowledge about the synergies between solar and energy efficiency. The implications of this are potentially large given the scale of savings that could be left on the table when energy efficiency is not addressed comprehensively before the installation of the PV system. To address this issue, we recommend integrating future solar incentives into energy efficiency programs. Creating a separate and distinct program for PV was an effective strategy to grow the California market in 2007; however, at current levels of adoption, PV solar should be integrated into energy efficiency programs and be framed as a home energy upgrade technology. This reframing may help potential solar customers explore the full range of energy efficiency options available to them and facilitate more crossovers of energy efficiency contractors to solar and solar contractors to energy efficiency.

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