

# Who Wants Efficiency? Americans' Attitudes and Actions around Energy Use

*William LeBlanc, Rachel Cooper and Aleana Reeves, E Source*

## ABSTRACT

American energy use characteristics don't fit neatly into a box; diversity is the new norm. The paper dives into details of residential consumer energy use, attitudes, and program participation, as well as identifying the customers who are most, and least, likely to participate in energy efficiency actions. This information can assist planners, implementers, and marketers understand where energy use trends are going, how to target their marketing dollars to the right customers and technologies, and how to segment customers to gain market traction.

The analysis is based upon a recent survey of 32,471 heads-of-household across the U.S., looking at: Participation in utility-sponsored programs, attitudes toward efficiency and utilities, equipment and plug load saturation, and desire for emerging products such as electric vehicles and smart meter information. The large data set allows for the creation of new segmentation models, and discovery, through regression analysis, what levers raise program participation. Associated demographic and psychographic data further enriches the ability to identify high potential targets for demand-side management (DSM) programs.

The analysis shows several interesting trends. First, people love their gadgets. Whether old or young, rich or less-rich, or rural or urban, residential customers have their homes and pockets filled with electronics which have increased electricity use. There are signs, however, that the number of these gadgets per household is leveling off. Second, a very large new appliance, in the form of an electric vehicle, could dramatically alter the landscape of electricity use. There is a very strong preference for the convenience of a plug-in hybrid (gas/electric) vehicle vs. an all-electric plug in. Third, programmable thermostats still lack in both market penetration, and in getting their owners to program them. Fourth, through data analysis and targeting, marketers can find customer groups that have a much higher probability of participating in a wide variety of energy efficiency programs, which in turn can accelerate adoption of programs and technologies as well as lower marketing costs.

## Drivers of Energy Efficiency Actions

Given the very aggressive goals utilities and states are setting for energy savings, finding the customers who are most likely to participate in efficiency programs is an important task for success. Data analysis identifies numerous dimensions that can help target specific program offerings to the best customers. Marketing costs can be substantially reduced, cost effectiveness therefore rises, and more savings can be created for limited budgets.

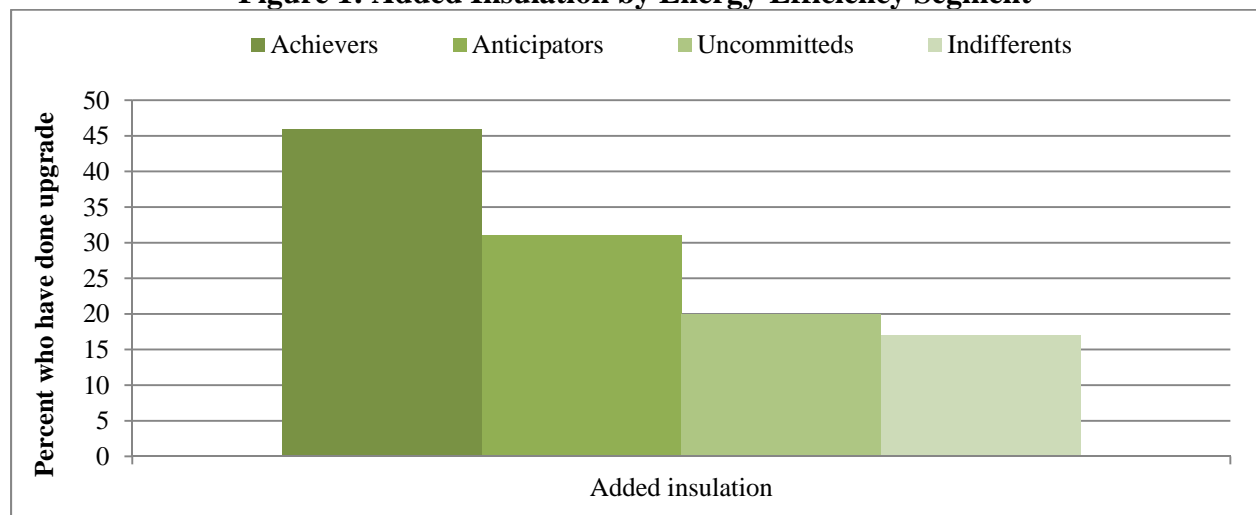
Many segmentation approaches that have been developed focus on a customer's "greenness", and then assume that green customers are the best targets for energy efficiency. However, the data shows a different story; green customers constitute only one profile of many customer types that have high potential for energy efficiency (Cooper, 2012). Another segmentation shortfall is that research approaches have often used customer-reported likelihood, or stated future plans, to participate in efficiency programs, which is considered unreliable to accurately predict actual sign-ups (Morwitz, 1997). To that end, E Source developed a

segmentation schema that focuses on customers who report, through the survey, actual participation in a wide variety of efficiency and conservation activities (Cooper). From these data, one can discover the attributes of these high achievers, and then find other customers that have similar characteristics and are most likely to participate. Following are the four segments developed specifically for energy efficiency program targeting (Cooper):

- **EE Achievers™:** The EE Achievers segment, constituting 13% of the residential population, includes those customers who are most engaged in DSM programs, particularly those based on energy efficiency. They have demonstrated a willingness to participate in multiple energy actions, which could include recent rebate activity, weatherization, audits, and multiple compact fluorescent lamp (CFL) purchases.
- **EE Anticipators™:** The EE Anticipators segment (22% of customers) is dominated by customers who are very inclined to participate in efficiency programs but have not yet done so in an extensive manner. They have some of the same characteristics demographically and attitudinally as the EE Achievers, and they have participated in one program or made multiple CFL purchases.
- **EE Uncommitteds™:** Although the EE Uncommitteds segment, at 23% of residential customers, shows high interest in saving money through saving energy, they are not ready to commit to participating in utility programs at this time. EE Uncommitteds appear to have significant barriers to participation and could be a good segment for low-cost, no-cost approaches to energy savings.
- **EE Indifferents™:** The EE Indifferents, representing 43% of the population, is the least promising group of customers from an energy-efficiency marketing standpoint. They are doing very few, if any, efficiency actions. They also are the least enthusiastic about stating interest in saving money through energy savings.

Below is one example of how the segments can be used to identify targets for insulation/weatherization (see Figure 1) upgrades and services. For this approach, the probability of uptake for Achievers is more than twice that of Uncommitteds or Indifferents.

**Figure 1: Added Insulation by Energy-Efficiency Segment**



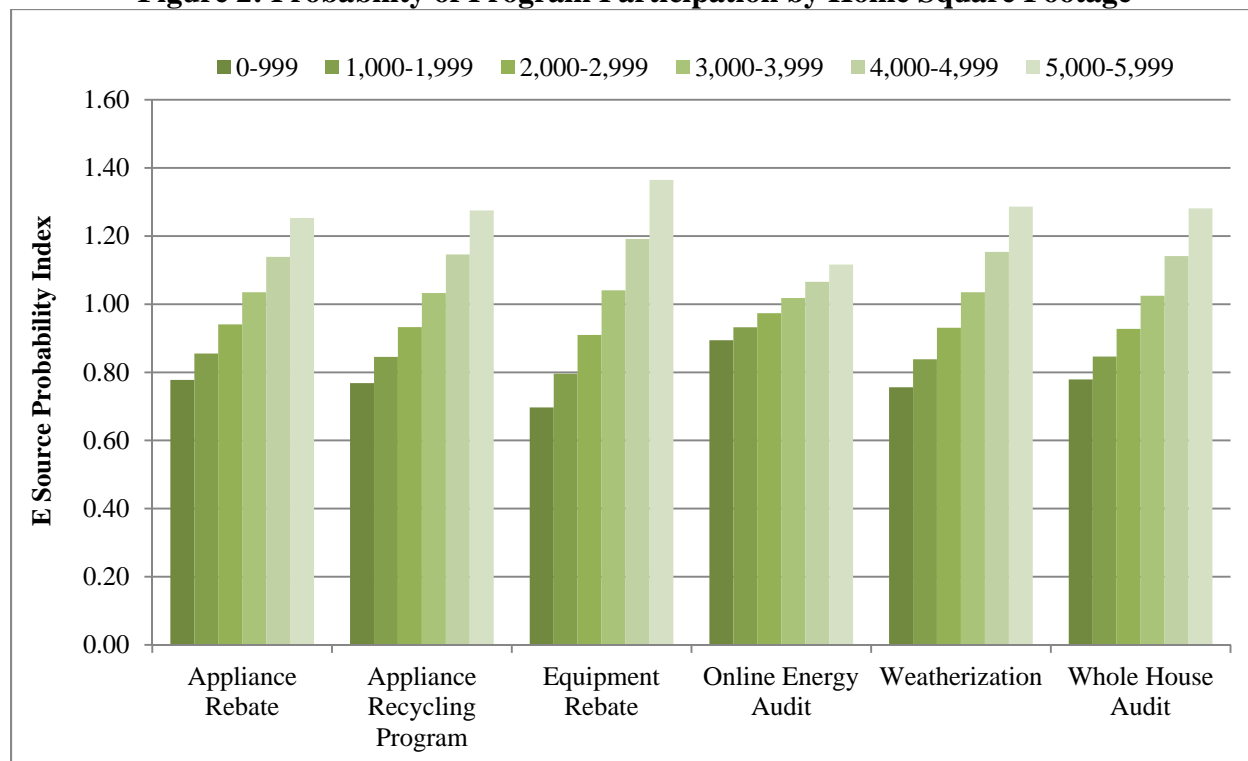
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## Targeting Through Probabilities of Participation in Energy Efficiency Programs

Once the highest potential customers are identified in the residential population, there are many different methods to actually target these customers in practice. One targeting analysis focused on participation in five common energy efficiency programs: in-house audits, online audits, appliance rebate programs (kitchen and clothes appliances), equipment rebate programs (heating, AC, and water heating), and appliance recycling (refrigerators). Probability Indices were created, which is defined as the probability of a certain segment to participate divided by the average probability to participate. The index is normalized at 100; a score of 125, for example, denotes that a segment has a 25% higher probability of participating than the average customer.

**Probabilities by home characteristics.** Analysis was done on energy efficiency program participation versus house size, house type, and house age. House size was a fairly strong driver for all programs. The larger the home, the more likely they were to participate in all 6 energy efficiency programs (see Figure 2). House type was a fairly large driver for equipment rebates, appliance rebates, and appliance recycling programs, with the highest probability in single family houses, dropping with duplexes, again dropping with 3 or more units, and the lowest being mobile homes. The age of the home is not a strong driver for any of the programs. Older homes have slightly higher probability of participation in weatherization, and newer homes are more likely to complete online audits. Targeting larger single family homes is probably the most direct method to find the highest probability participants.

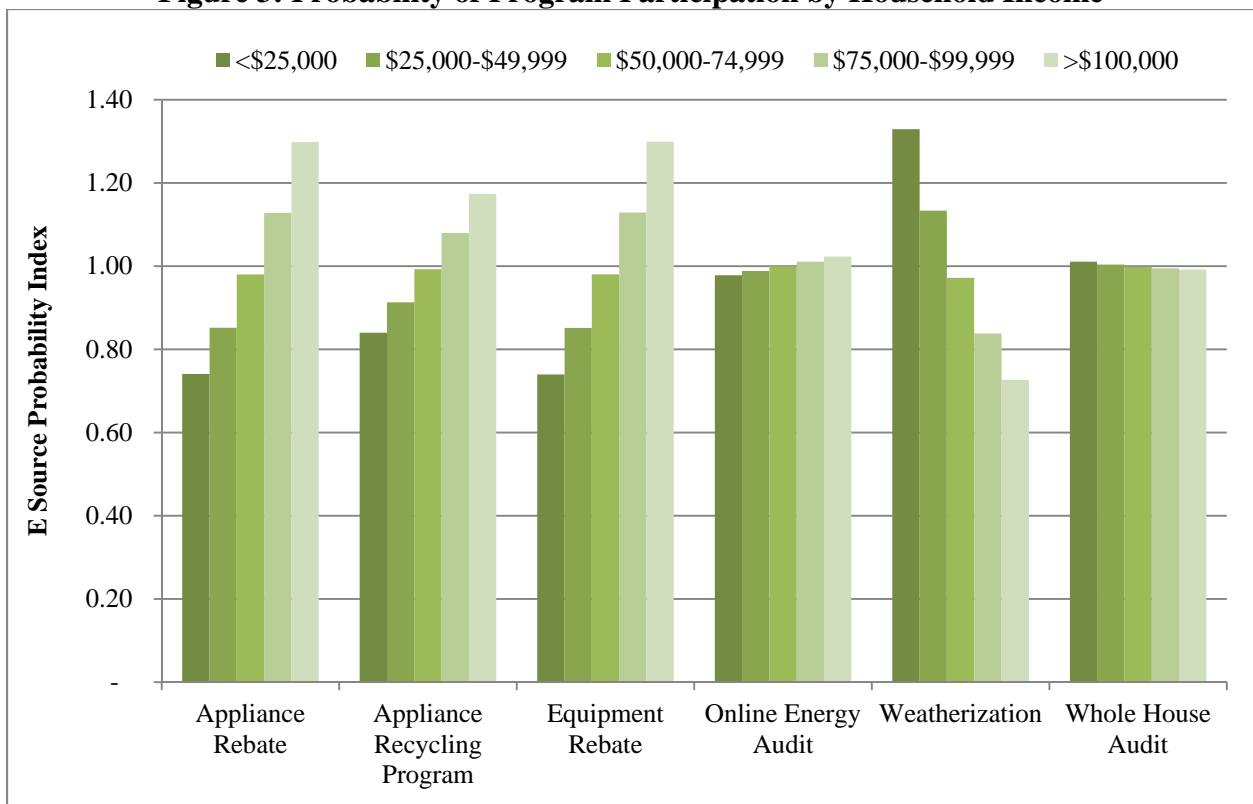
**Figure 2: Probability of Program Participation by Home Square Footage**



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**Probabilities by household characteristics.** In addition to the residential structure characteristics, analysis was also completed on various household variations, including own vs. rent, size of household, age of head of household, income, and education. Income is a significant driver when discerning participation in efficiency programs, except for online and in home audits (see Figure 3). For equipment and appliance rebates and appliance recycling, higher income drives higher participation. When it comes to weatherization, however, the equation flips, and the lower the income, the higher the participation. The authors assume that this is due to low income weatherization programs that have accelerated over the past two years due to Federal funding. Higher education is a moderate driver for participation in all programs, except for weatherization where the probabilities are flat. Home ownership is also a positive driver for participation in all programs, with appliance and equipment rebates, and a whole house audit as most pronounced.

**Figure 3: Probability of Program Participation by Household Income**



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### Targeting through PRIZM

Another method that can be used to target the highest potential residential customers for energy efficiency is to use an established market segmentation schema that is in place for multiple markets. One such geodemographic segmentation system is offered by Nielsen and is called PRIZM, and includes 66 residential segments. By cross-referencing the PRIZM segments with these high energy efficiency achievers, one can specifically identify, by address, those customers with a higher likelihood of participation. For example, one of the PRIZM segments with a high score within the EE Achievers is the Movers & Shakers, who are 80% more likely to

participate in efficiency programs than the average customer, and nearly 4 times as likely to participate as the lowest of the 66 segments. Some characteristics of the Movers & Shakers include: wealthy suburban homeowners without children in the home; high education levels; ages 35-54; lifestyle traits include the tendency to buy from J. Crew, attend NHL games, watch Saturday Night Live, and drive a Range Rover (Nielsen, 2012).

### **Dealing with the Laggards**

The analysis points out who the highest probability households are for efficiency, but how do we bring the rest of the population up the curve? This depends on their relative readiness to invest time, effort, and money into energy efficiency. The E Source segments provide a useful framework to analyze how to best deal with the laggards:

- **EE Anticipators:** The EE Anticipators are very close to being committed to efficiency, and are the most likely to bump into the Achievers segment over time. These customers have a variety of barriers that are likely to relate to taking immediate action. From a marketing standpoint, there is not a great need to change these customers' attitudes or make them aware of programs, as they already have awareness of programs and approaches. Instead, they need to be provided with options that make their decision simpler, such as providing on-bill financing, hand-holding for the contractor selection process, and testimonials from other satisfied customers.
- **EE Uncommitteds:** The Uncommitteds are likely to need additional information about the benefits of energy efficiency. They appear to be willing to try efficiency programs, but probably need to start small with no and low cost options. These may include CFL installations, easy weatherization, simple behavior actions, and even do-it-yourself options. Once they experience the benefits, they are more likely to move up the ladder to more active segments.
- **EE Indifferents<sup>TM</sup>:** The EE Indifferents represent the most difficult segment from a marketing perspective, and their participation would be expensive to capture. They are unlikely to have the knowledge and resources to engage in significant efficiency upgrades. However, this group should be engaged with early-stage communications about the benefits of efficiency, the ability to control energy bills, and the fact that many people are already investing in efficiency upgrades and taking conservation actions. In time, these laggards will move up the efficiency curve.

### **TVs, EVs, and HVACs: Who Has What?**

The market research study of 32,000-plus households also provides a rich view of energy use in the home. This information can be used to identify areas of need for efficiency and behavior change, to understand saturation and trends, and to better understand the energy use patterns and desires of residential end-users. We have selected five energy-use categories to share; these were chosen by the authors as areas of interest due to their quickly changing profiles in homes (lighting, plug loads), their latent savings potential (programmable thermostats, second refrigerators), and potential impacts on energy growth (electric vehicles).

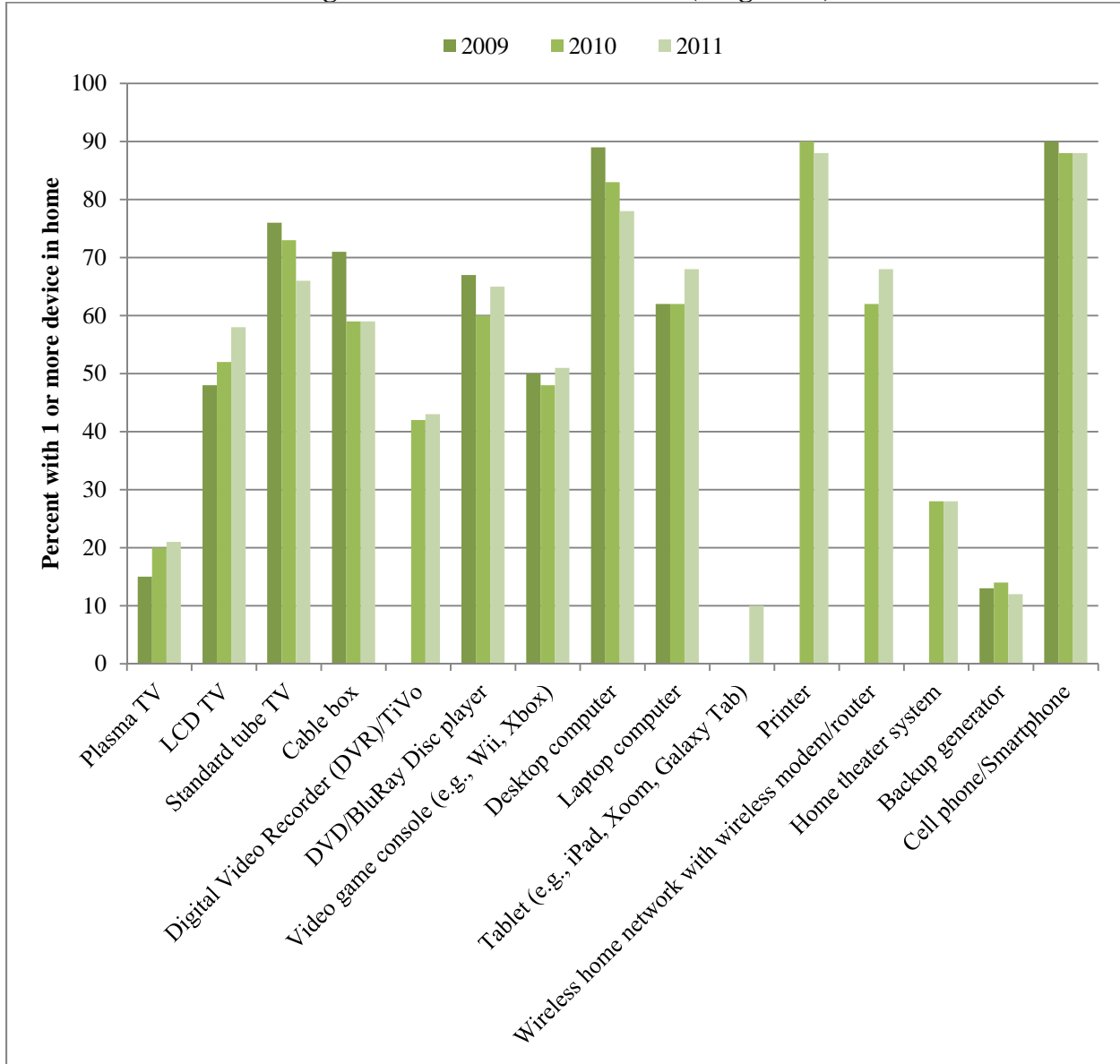
## Electronics Saturation (Plug Loads)

One of the areas of rapid growth in electricity use over the past decade is in electronics, primarily entertainment and computing technologies. This growth can be masked by improvements in electric efficiency in other major appliances such as refrigerators and air conditioners, if one looks only at total home electricity use. Certainly one of the remarkable stories of rapid adoption of a new technology is in flat screen high definition TVs. The data shows that there is a 58% saturation of LCD TVs, plus another 21% for plasma TVs, for a combined number of 79% (see Figure 4). This is a rapid ascension from 63% in 2009 and 72% in 2010. The good news is that these TVs have become more energy efficient over the past several years, and are more efficient than their old standard tube TV counterpart of the same screen size. For example, with screen sizes of 41-50 inches, the draw of a LCD or Plasma HDTV averages about 110 watts, with standby power use at less than 1 watt if in energy saving mode. Tube TVs of 31-40 inches draw a typical 162 watts, for comparison purposes (Criscione 2011).

The data shows that a leveling off may be occurring among other electronic loads in the household. Penetration of entertainment electronics such as DVR, cable boxes, and DVD players has been relatively flat for the past 3 years. Likewise, cell phone penetration is stable, although the move to smart phones means greater energy usage per unit. Laptop computer saturation has risen slightly, but that is offset by a decline in desktop units.

A new device in the survey this year is the tablet PC, such as an Apple iPad. This product is off to a fast start, with a market penetration of 10% this year. However, looking at household income shows that the saturation of tablet PCs rises substantially as income goes up, with those making over \$100,000/year having approximately a 20% market penetration and those under \$50,000 per year having about a 5% market penetration. If the prices of these products drop over time, we can expect additional saturation of this growing plug load. However, we cannot yet tell whether tablets are replacing other computing technologies, or just adding to the mix.

**Figure 4: Electronic Saturation (Plug Load)**



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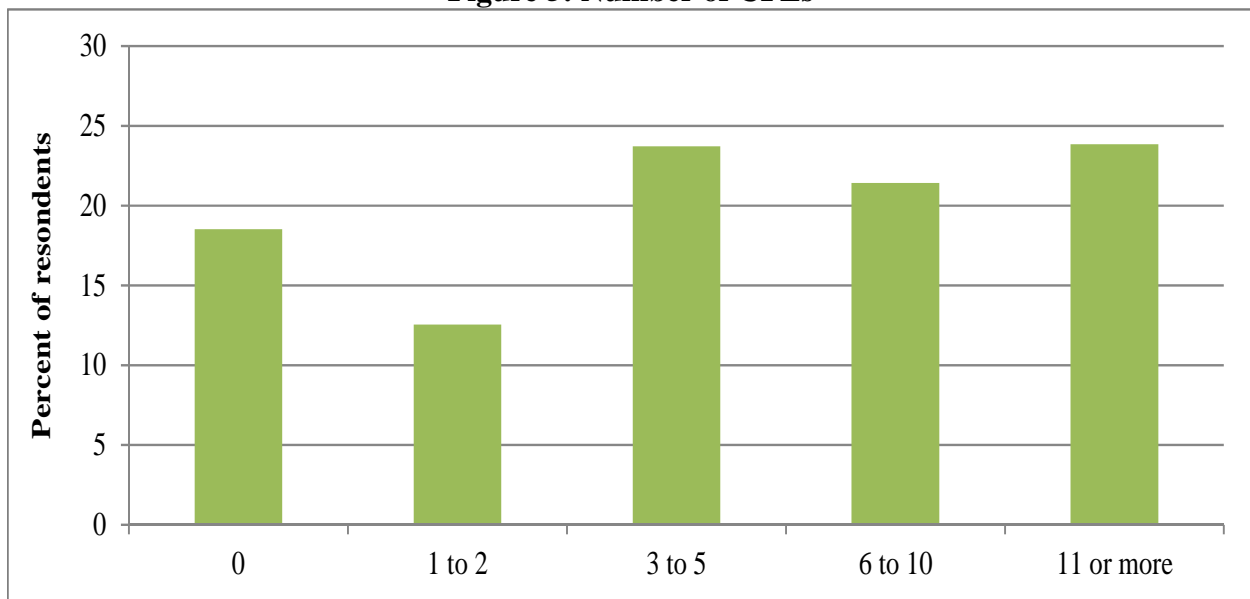
### Lighting Saturation

Compact fluorescent lamps (CFLs) continue to provide high potential energy savings in residential markets. Many utility efficiency portfolios depend heavily on CFLs for their residential DSM results (Bickel 2010), so understanding the market for additional CFLs is critical to meeting savings goals. U.S. shipments of CFLs grew rapidly from 2003 to 2007, then declined in 2008 and 2009, with multiple causes cited by Energy Star including a flagging economy, less emphasis on CFL sales by retail giant Wal-Mart, and the fact that CFLs simply last a long time and don't require rapid replacement (Bickel).

The Nielsen data shows that nationally, only 19% of homes still lack any CFLs. This rises to 26% for multifamily dwellings, however (Cooper). Still, only an estimated 16% of light sockets in the U.S. have CFLs, leaving a huge potential for savings (Bickel). Who are the best targets for CFLs? Since so many homes have at least one CFL (see Figure 5), the key initiative now is to get more sockets filled with efficient lighting, while ensuring that the lamps go into applications that have the highest hours of use. “Fishing where the fish are” becomes the key. There is a large variation in CFL adoption based upon home size, as one might expect. In homes larger than 3000 ft<sup>2</sup>, 36% have more than 10 CFLs. In homes smaller than 1000 ft<sup>2</sup>, only 11% have more than 10 CFLs (Cooper). Another key driver is prior efficiency activity; households who have completed energy upgrades in the past are almost twice as likely to have over 10 CFLs as those who have not completed upgrades. Some household attributes do not seem to influence CFL adoption to a great extent, however. Age is not a big factor, for example. In addition, how big of a burden the energy bill is, as measured as energy as a percent of overall monthly income, also is a minimal factor.

So the bottom line on targeting is evident in the regression analysis completed: key drivers are larger home size, owner occupied homes, and higher income households.

**Figure 5: Number of CFLs**



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## Refrigerators and Stand Alone Freezers

Second refrigerators have often been a target for energy savings through utility appliance recycling programs for many years. The prevalence of second refrigerators is still high, but varies a great deal by household characteristics and even by geography. Nationally, about 20% of households have two refrigerators (see Figure 6), and 2% have 3 or more. States with the highest prevalence of second refrigerators are Nebraska, New Jersey, Kansas, North Dakota, and Wisconsin, with more than one-quarter of residents with 2 or more units (see Table 1). The size of the home appears to be the biggest indicator of having multiple refrigerators, while the age of the home seems to have little influence. The length of time in the same residence is also a large



influence, possibly indicating that people simply keep their old unit when a new one is installed. This provides an opportunity for utility programs to intervene during the purchase process, and emphasize second refrigerator turn-in and recycling at the point of sale, as opposed to waiting to a later date.

Freezers are quite prevalent throughout the U.S., and can use - much or more energy than a refrigerator. Nationally, 38% of households have at least one stand-alone freezer (see Figure 6). But regional differences are quite pronounced. North Dakota has the highest penetration with 64% with at least one stand-alone, and 14% have 2 or more freezers (see Table 2). Montana and Idaho round out the top 3 “freezer states”. The Pacific Census region has the lowest prevalence of all census regions, with 25% saturation, followed by New England at 27%. The smaller households, measured by square footage or household members, tend to have far fewer freezers than either mid-sized or larger households. An interesting finding is that people who have lived in their home a longer time have more freezers as well. Fifty percent of those that have lived in their home for 10 years or more have freezers, while only about 21% of those in their home for 2 or fewer years have freezers. This seems to infer that freezers are “acquired” along the way, as opposed to a necessity when people move in.

**Table 1: States with Highest Second Refrigerator Saturation**

State	Percent with two or more refrigerators
Nebraska	28%
New Jersey	28%
Kansas	26%
North Dakota	26%
Wisconsin	26%

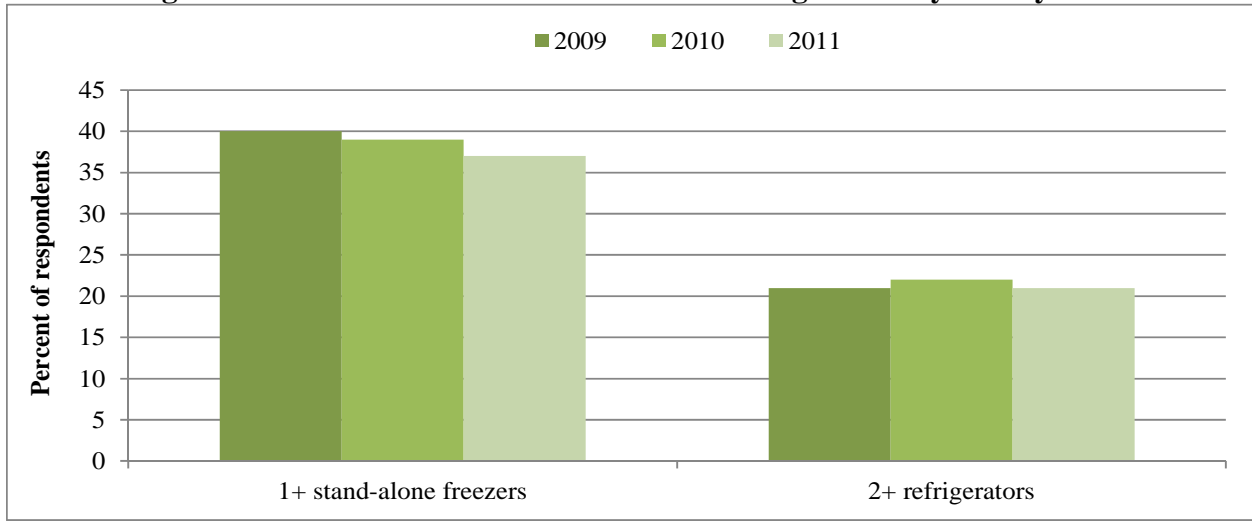
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**Table 2: States with Highest Freezer Saturation**

State	Percent with one or more freezers
North Dakota	64%
Montana	61%
Idaho	59%
State	Percent with two or more freezers
North Dakota	14%
Alaska	13%
Wyoming	11%
Montana	11%

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**Figure 1: Number of Stand-alone Freezers/Refrigerators by Survey Year**



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### Programmable Thermostat Actions

Programmable thermostats have been around for decades, yet many households still don't have them, and for those who do, a remarkable number still fail to program them to help lower energy costs. Forty one percent of households have a programmable thermostat, up from 38% in 2009 (see Figure 2). They are certainly more prevalent in newer homes, with 52% saturation in homes built after 2005, and 35% in homes built before 1960. In addition, 51% of owner occupied homes have programmable thermostats, whereas only 24% of rentals have them. Given that thermostats are relatively low cost yet can provide substantial savings for renters, this may be an area that is ripe for new assistance programs.

**Figure 2: Number of Programmable Thermostats by Survey Year**



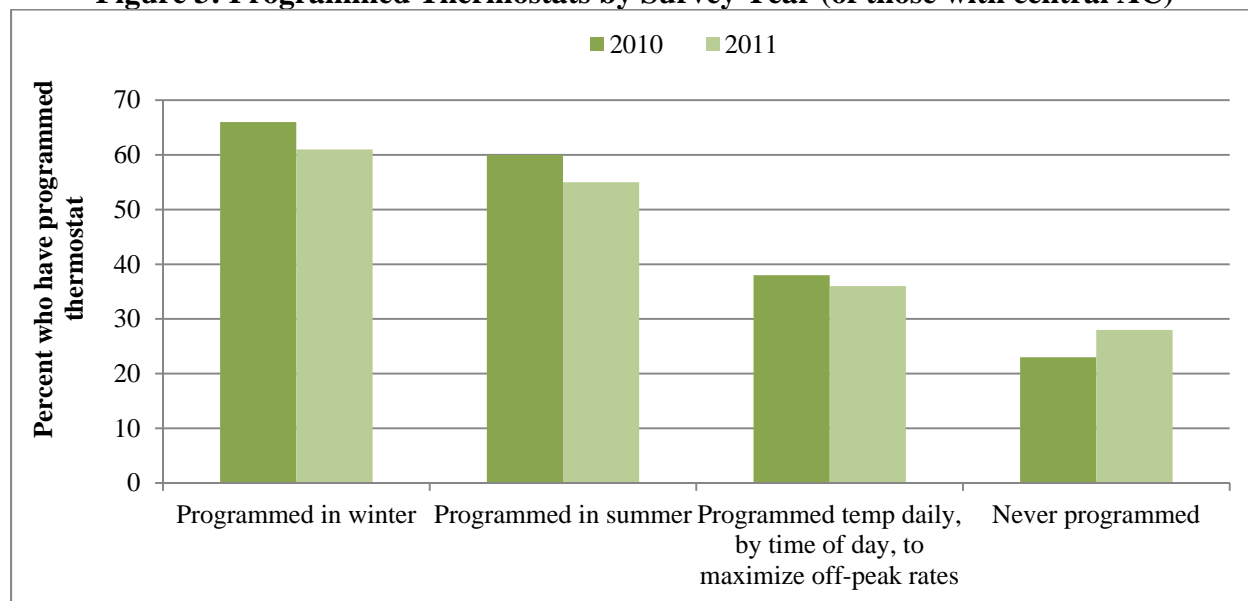
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Following on the own versus rent discussion above, even when a renter has a programmable thermostat, only about half (48%) program it for heating setbacks compared with 64% of owner occupied homes. As income rises, so does the chance that the thermostat gets

programmed in the summer and winter. Household size, education, and years living in the same home only have moderate effects on programming. Utilities will need to develop some innovative approaches to helping customers program their thermostats properly, and to capture the potential in the rental segment of the population.

When diving into more details by looking only at those who have programmable thermostats and have central AC, we can discover some habits surrounding programming itself. First, nearly 40% of customers with central AC have never programmed their programmable thermostat in the winter, and nearly 45% failed to do this for the cooling season (see Figure 3). Interestingly, while the proportion of those with programmable thermostats is increasing over time, the percent who actually program them is declining.

**Figure 3: Programmed Thermostats by Survey Year (of those with central AC)**



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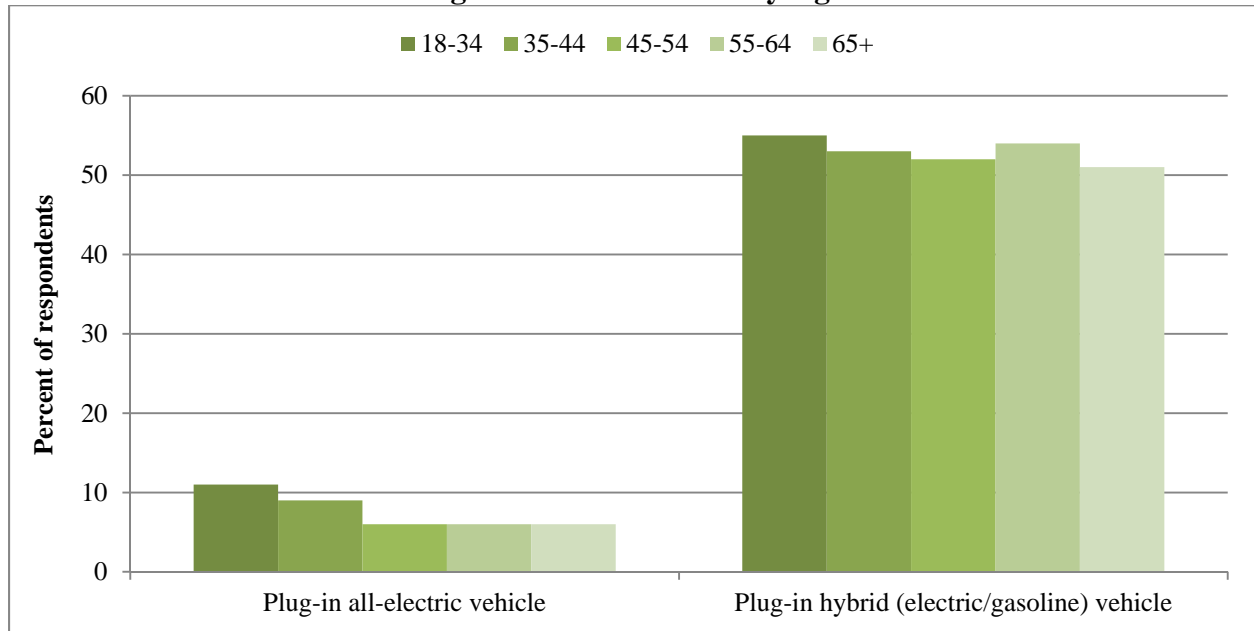
## Electric Vehicles

Different forms of electric vehicles promise to transform the landscape of personal transportation, potentially shifting fuel from oil/gasoline to electric power. In order to look at a respondents' view of electric vehicles, questions were asked about their preference for a pure plug-in electric car with no gasoline engine (such as the 2012 Nissan Leaf), versus a plug-in electric hybrid car with a backup gasoline engine (such as the 2012 Chevy Volt). By far, respondents prefer the hybrid, with 53% of respondents in 2011 saying this would be their preferred vehicle compared with 8% of respondents preferring the all-electric option (see Figure 9). The data shows that the plug-in hybrid is preferred fairly evenly across all age groups, but electric only vehicles are more preferred by younger drivers (see Figure 9). In addition, those that describe themselves as having a liberal mindset are nearly twice as likely to want an all-electric vehicle as conservatives and moderates, but for a plug-in hybrid, the preference levels are virtually the same.

If these numbers hold out as cars are sold, this has large implications for the utility business model surrounding EVs. If all-electrics are prevalent, then charging stations, especially

quick charge options, become paramount. If plug-in hybrids are dominant, then charging stations become a convenience issue, as opposed to a necessity.

**Figure 9: Preferred EV by Age**



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## Conclusion

Given the very aggressive energy savings goals set out in many jurisdictions, implementers and marketers need all the tools available to help identify the best targets for efficiency. Through analysis of a very rich data set of over 32,000 households, new trends can be identified, new segmentation approaches can be developed, and residential customer energy-use can be better understood.

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