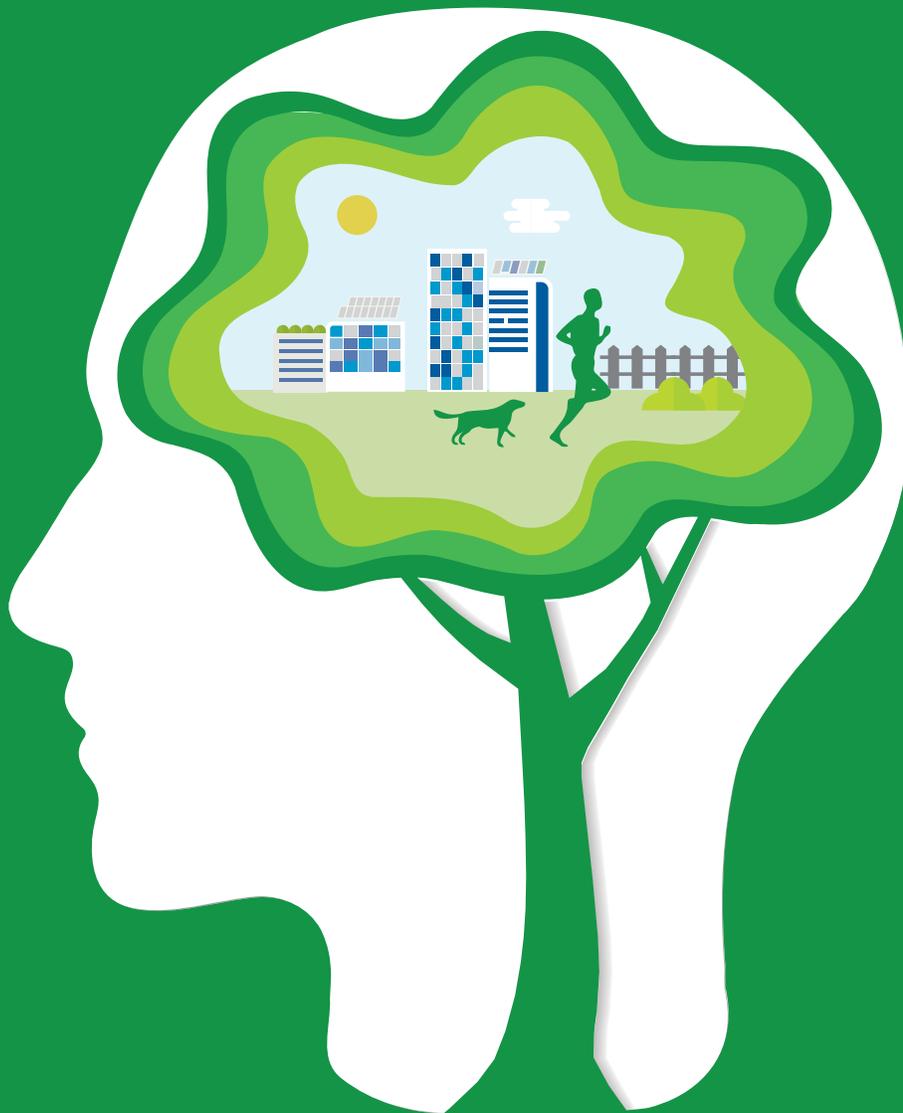


JANUARY 2018

# Consumer Adopter Survey



NC SUSTAINABLE  
ENERGY ASSOCIATION

JANUARY 2018

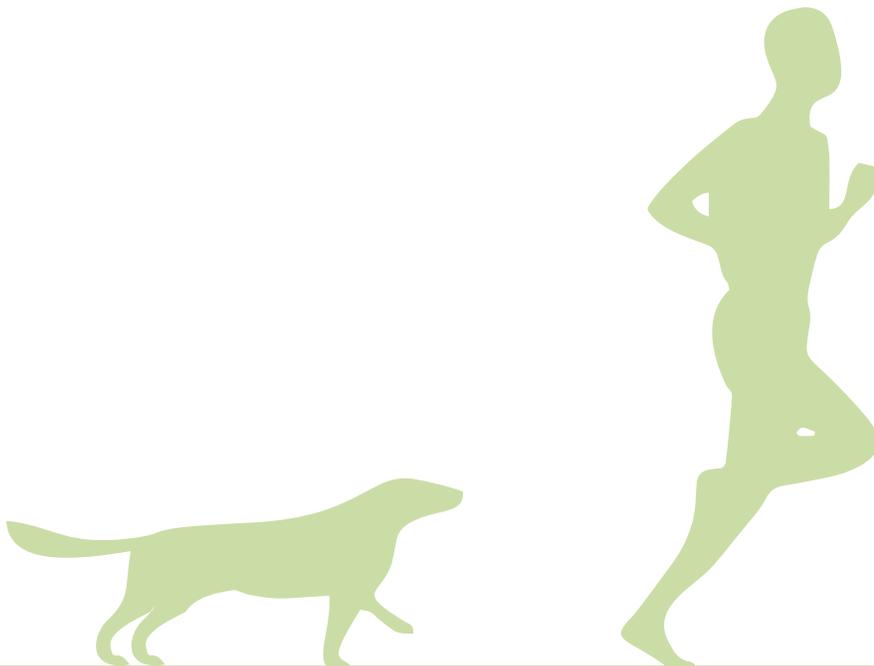
# Consumer Adopter Survey

**Authors:**

Adam Wiechman, Summer 2017 Intern  
Daniel Parker, Market Research Analyst  
Robin Aldina, Manager of Energy Research

**Design:**

Samantha Radford, Web and Creative Specialist



*The NC Sustainable Energy Association (NCSEA) is a 501(c)(3) nonprofit membership organization of individuals, businesses, government, and nonprofits interested in North Carolina's sustainable energy future. Our mission is to drive policy and market development to create clean energy jobs, economic opportunities and affordable energy that benefits all of North Carolina.*

4800 Six Forks Road | Suite 300 | Raleigh, NC 27609

# Table of Contents

---

<b>Introduction and Background</b> .....	<b>4</b>
<b>Methodology</b> .....	<b>6</b>
Survey Population.....	6
Survey Design.....	6
Survey Facilitation.....	6
Limitations.....	7
<b>Results</b> .....	<b>8</b>
General Results.....	8
Solar PV Specific Updates.....	14
Geothermal GSHP Specific Updates.....	19
Electric Vehicles: A New Field of Study.....	22
<b>Conclusion</b> .....	<b>26</b>
<b>Endnotes</b> .....	<b>28</b>

# Introduction and Background

---

Clean energy is a vital component of North Carolina's diversifying energy mix and its growing economy. According to a 2017 study by RTI International, the state has seen a total economic impact of \$17.9 billion from clean energy which has supported 113,998 full-time jobs and generated \$906.3 million in tax revenue from 2007-2016.<sup>1</sup> In particular, North Carolina now has more than 3,500 megawatts (MW) of installed solar photovoltaic (PV) capacity, ranking the state second in the nation for installed solar.<sup>2</sup> While solar and other clean energy technologies continue to improve and increase market penetration, the industry as a whole still faces considerable obstacles to comprehensive adoption.

Much of North Carolina's success with clean energy has come from utility-scale solar PV installations. Other technologies, especially within the residential and commercial/industrial sectors, have tremendous opportunities for growth to match the progress of utility-scale PV in the state. This report, and the survey on which it was based, focuses on the perceptions and experiences of independent consumers of clean energy technologies. Responses are in reference to residential and small commercial solar PV, solar thermal, energy storage, geothermal ground source heat pumps (GSHPs), or non-commercial electric vehicles (EVs). Small-scale solar PV is the most widely installed of these technologies in North Carolina with approximately 4,700 projects in the state sized under 25 kilowatts (kW). In contrast, there were only about 1,200 geothermal GSHPs<sup>3</sup> in North Carolina from 2011 to 2016 and only 6,251 EVs sold in the state.<sup>4</sup> Data collected through this survey reflects this distribution of technologies with the majority of opinions, motivations, and expectations expressed by solar PV owners.

The insights and experiences of these consumers provide important information about how to overcome the obstacles that have thus far limited growth of these technologies compared with utility-scale solar PV. As with any other product, continued adoption of clean energy is tied to the decisions of consumers electing alternatives to conventional energy production and consumption. Thus, customer-focused market intelligence can provide valuable direction for industry strategy as well as state and local-level policy development. The survey discussed in this report seeks to understand the demographics of current North Carolina clean energy customers as well as their motivations for and experiences with clean energy purchases.

Public opinion studies suggest that Americans hold a favorable view of renewable energy. A 2015 survey performed by Solar City, a national solar PV developer, highlighted an overwhelming preference for renewable energy sources, like solar and wind, over conventional energy sources like natural gas, nuclear, and coal.<sup>5</sup> The study, however, also found that most Americans still care more about the bottom line than positive social or environmental benefits, with 73% of the public opposed to investments that produced a lower return, suggesting that return on investment remains a crucial factor in decision-making.<sup>6</sup>

The limiting nature of financial security in environmentally beneficent investments has been observed in North Carolina customers before. In 2013, the UNC Kenan-Flagler Business School and NC Sustainable Energy Association (NCSEA) published a report on the motivations and experiences of customers in the solar PV and geothermal industries based on the results of a similar survey. This survey found that the most cited reason for solar PV adoption was the financial support provided by the federal and state tax credits and that the most cited reason for geothermal adoption was lower energy costs. Besides financial concerns, concerns for environmental impact and “doing the right thing” were regularly cited by solar PV customers as important. Geothermal customers, on the other hand, did not cite those reasons as often.

In regard to demographics, the report noted that white, high-income, middle-aged, home-owning, and educated were common traits observed among the customers who responded. This suggests a considerable consolidation in the clean energy market with one of the primary reasons being the financial capacity to overcome the upfront costs. To address this, the report recommended multiple solutions including market mechanisms to assist customers in affording the upfront costs of clean energy technology.<sup>7</sup>

The findings in this report represent an attempt to update the results of the 2013 UNC-NCSEA survey and expand the range of technologies surveyed to better understand the current motivations, characteristics, and experiences of retail clean energy customers. It is important to analyze motivations while considering demographics, especially if the clean energy market wishes to expand its reach from its traditional base. In order to do so, it may need to consider catering to motivations or needs that are not being met by the current market landscape. As Sigrin et al. note in 2015, “to continue growing, [the solar market] must expand into new populations.”<sup>8</sup> For instance, lower income households may be more dependent on financial support, and young adults, who may be more environmentally concerned but less likely to be homeowners, may require alternative procurement options than the conventional market practices.<sup>3,9,10</sup>

# Methodology

---

## Survey Population

The target population for the survey is North Carolina clean energy technology end-use customers, particularly non-utility scale customers. Clean energy technologies, for the purposes of this survey are classified by five technologies: solar PV, energy storage, electric vehicles (EVs), solar thermal, and geothermal ground source heat pump (GSHP) systems.

## Survey Design

The survey was created through SurveyMonkey, an online survey design, distribution, and analysis platform, and was designed to mirror the 2013 UNC-NCSEA survey of solar PV and geothermal customers. A single survey was designed for all participants to complete, consisting of a contact information and general questions section, separate sections for each specific technology, and a demographics section. The general questions section asks if the customer's system was installed in a home or business and for an estimation of the change in a customer's utility bill. The concluding demographics section asks for building-specific details such as the number of occupants, how long the customer has occupied the building, and the square footage of the building in which the technology was installed. In addition, this section asks the customer for age, level of education, race/ethnicity, household income, and intent for additional clean energy purchases.

Each of the specific technology sections were developed through feedback from companies in the appropriate industry. Across all technologies, questions were asked regarding the date/time of purchase, system capacity, sources of information for the purchase, estimated out-of-pocket cost, estimated payback period, motivating factors for the purchase, energy efficiency measures adopted before and after installation, important financing sources, and satisfaction levels regarding performance, financing options, and installation. In addition to these common questions, questions specific to the technology were included in some of the categories such as make and model of EVs and placement of solar PV systems (ground or rooftop).

## Survey Facilitation

The survey was distributed online in two phases in 2017. The first phase consisted of an email letter to NCSEA stakeholders who participated in a net-metering docket at the North Carolina Utilities Commission (E-100, sub 83). The first email was sent on March 27 with reminder emails sent on April 4 and April 11. This phase collected 171 responses.

The second phase involved indirect customer engagement through NCSEA members involved in clean energy development. Companies that sell and install technologies to the survey population described above were contacted via email and phone to distribute the survey to their customer bases. Companies were first contacted on June 14 and survey collection ended on July 21.

Companies communicated with their customers differently as some sent letters, while others sent out messages using the company email listserv, social media postings, and other online newsletters. This phase collected 192 responses, bringing the total to 363.

## Limitations

There are a few limitations to the survey that must be considered when interpreting the conclusions. First, respondents occasionally did not fill out every specific question in their corresponding technology section. Nevertheless, the number of responses per question by section usually only varied by 2-5 responses. In addition, demographically, the survey did not ask about whether the respondent was retired. As the majority of respondents were older in age, that distinction could have been important when analyzing annual household incomes because some retired-age respondents, who may have earned more when they were working, placed themselves in the lower income brackets when filling out the demographics section. Lastly, and most importantly, the survey population is of clean energy customers who have already purchased their system, not customers who are either deliberating whether to purchase their system or have decided not to. This fact prevents the survey from broad conclusions about customer decision-making with clean energy because the survey ignores key demotivators. For instance, one may be able to conclude that environmental concern greatly promotes solar PV purchases given the resounding feedback of current customers, but one cannot say that access to charging stations is not important for vehicle customers because the survey population does not include people who may have been deterred from purchase by the lack of charging stations.

# Results

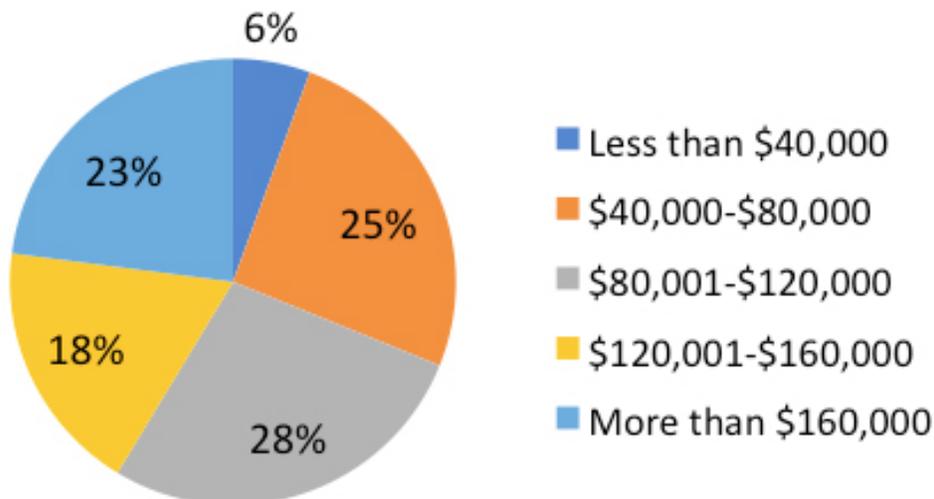
## General Results

### Demographics

Several conventional understandings of the clean energy market remain true in regard to race, education, and age. Of the respondents, 94.5% identified as white and 3% identified as Asian, leaving the remaining options with a representation of less than 1% each. The vast majority were well-educated as 88% indicated that they had earned at least a bachelor's degree and 55% earned a graduate degree. With regards to age, clean energy customers were largely middle-aged (52%) or of recently retired age (25%). Less than 5% were between the ages of 25 and 34. Home ownership was a common characteristic with around 75% of respondents having occupied their home for over 5 years.

The incomes of clean energy customers, however, appear to be more evenly distributed. While few respondents had an annual household income below \$40,000, the other four income brackets surveyed had a range of 18-28% representation in the survey sample, shown in Figure 1.1. The 2013 survey found a median income of \$100,000-\$150,000, which is similar to this survey's income distribution.

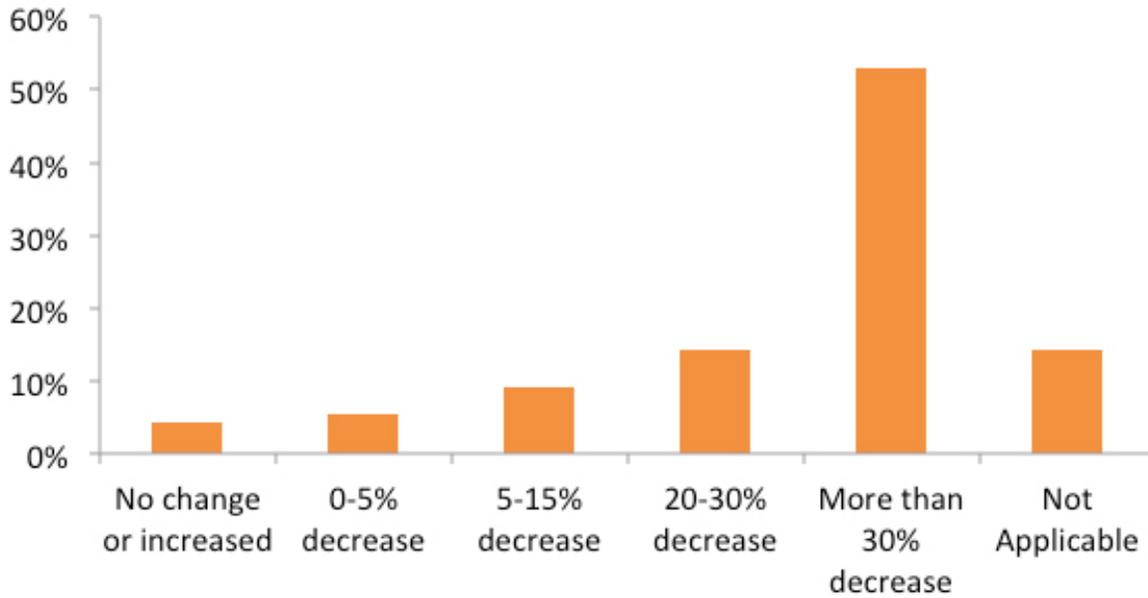
**Figure 1.1: Distribution of annual household incomes among surveyed clean energy customers.**



### Utility Bill Savings

Clean energy technology customers are experiencing significantly cheaper monthly utility bills as a result of their clean purchases. A considerable majority of surveyed customers claimed decreases in their monthly utility bills (82%) with around half experiencing decreases of over 30%. Only 4% of respondents reported either no change or an increase in their monthly utility bills. Figure 1.2 shows the distribution of those responses.

**Figure 1.2: Distribution of monthly utility bills after installation of clean energy purchase.**

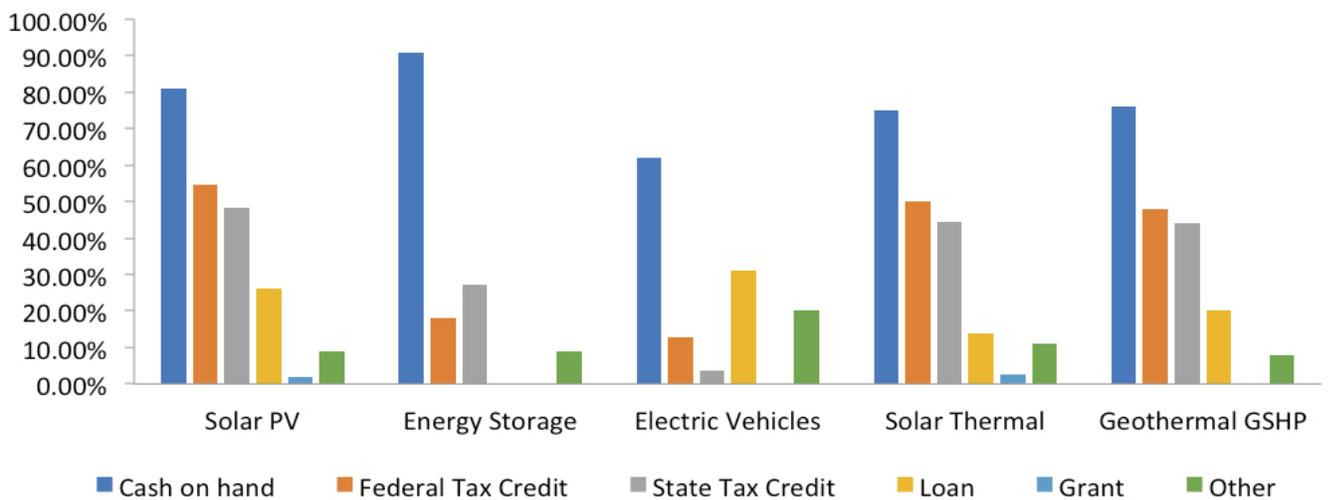


**Financing**

The majority of clean energy customers use cash on hand to finance their clean tech purchases, ranging from 62% of EV customers to 81% of PV customers, but many still use additional financial support for their purchase. Specifically, when considering technology purchases other than electric vehicles, around half of clean energy customers claim to have taken advantage of federal and/or state tax credits. Loan programs, though, are not used by most clean energy customers. The usage distribution of these financing options, separated by technology, can be found in Figure 1.3.

**Figure 1.3: Usage distribution of financing options for clean energy technologies.**

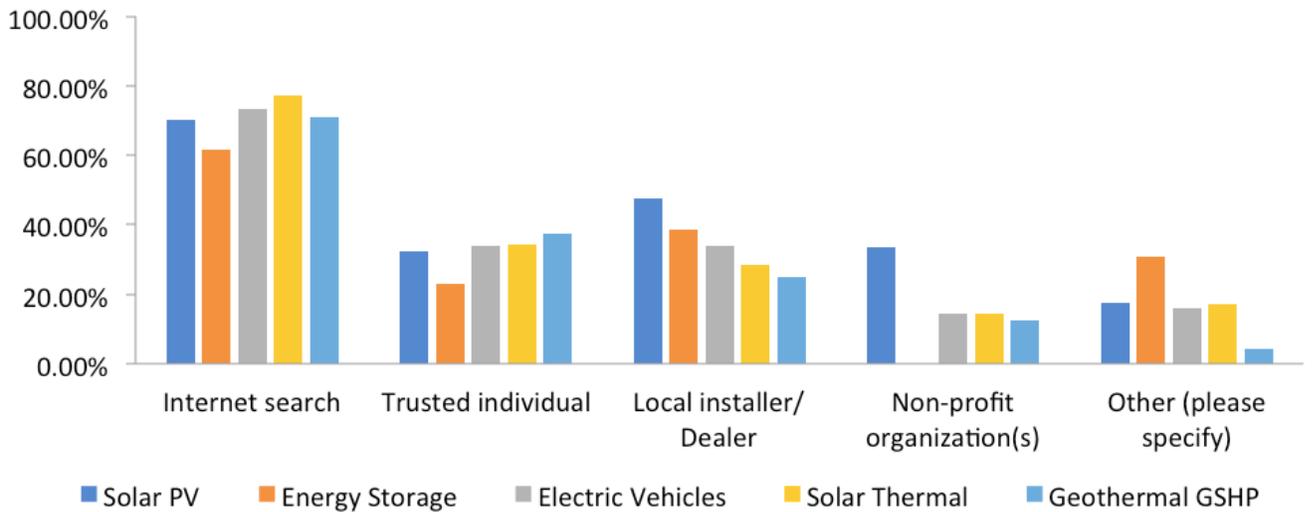
*The responses were generated from a “select all that apply” question.*



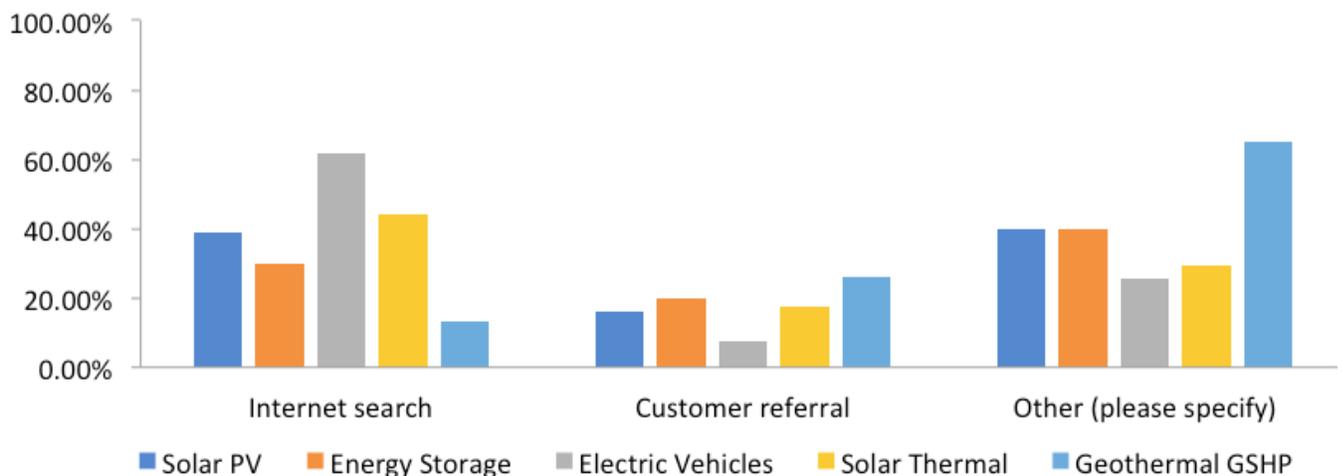
### Information Sources

Clean energy customers use a variety of sources to inform their purchases. Overall, the internet appears to be the most widely used source for both deciding whether to adopt a technology and choosing an installer/dealer for all the noted technologies with the exception of geothermal systems. In addition to the internet, customers also acknowledged the influence of trusted individuals, local companies, and non-profit organizations when deciding whether to adopt a certain clean energy technology. Figures 1.4 and 1.5 depict the usage distribution of the various information sources among the surveyed technologies. The significant number of respondents that selected the “Other” option highlights the diversity of ways customers can inform their purchase.

**Figure 1.4: Usage distribution of customer sources for deciding whether to adopt a given clean energy technology.** Only options with over 10% selection from the corresponding survey question are displayed.



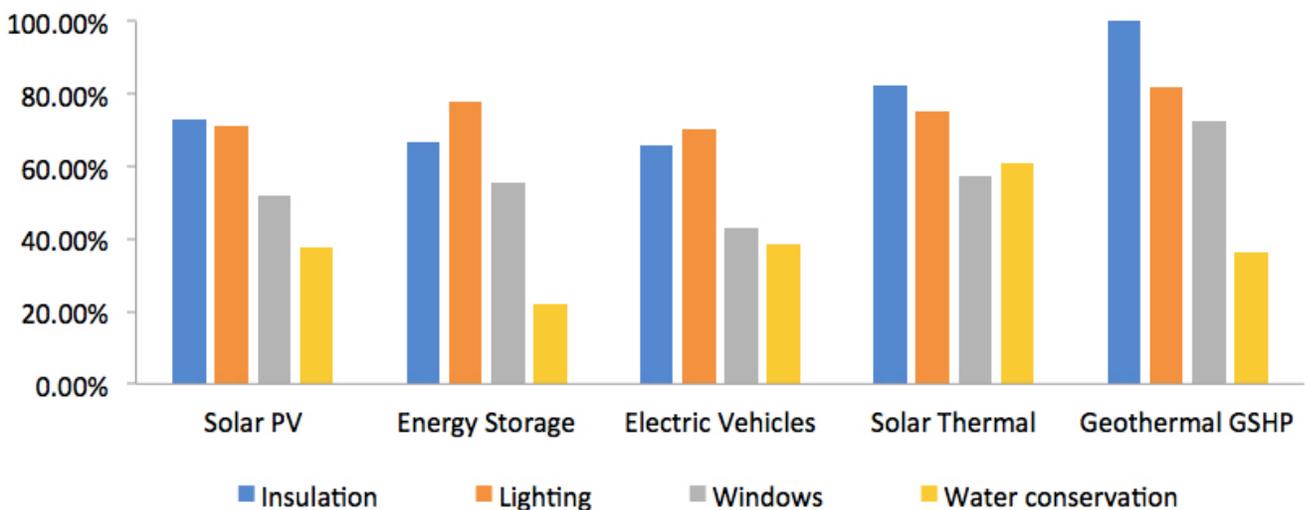
**Figure 1.5: Usage distribution of customer sources for hearing of local installers or dealers.** Only options with over 10% selection from the corresponding survey question are displayed.



## Energy Efficiency

Clean energy customers enact multiple energy efficiency measures before installing their new energy technology. These include insulation, lighting, window, and water conservation improvements as shown in Figure 1.6. Lighting was the most cited improvement after installation, but this percentage was still much lower than the percentage of customers who improved their lighting before installing other clean technology measures.

**Figure 1.6: Distribution of energy efficiency measures enacted before installation of given clean energy technologies.** Efficiency measures with an adoption percentage below 25% are not displayed.



## Motivations

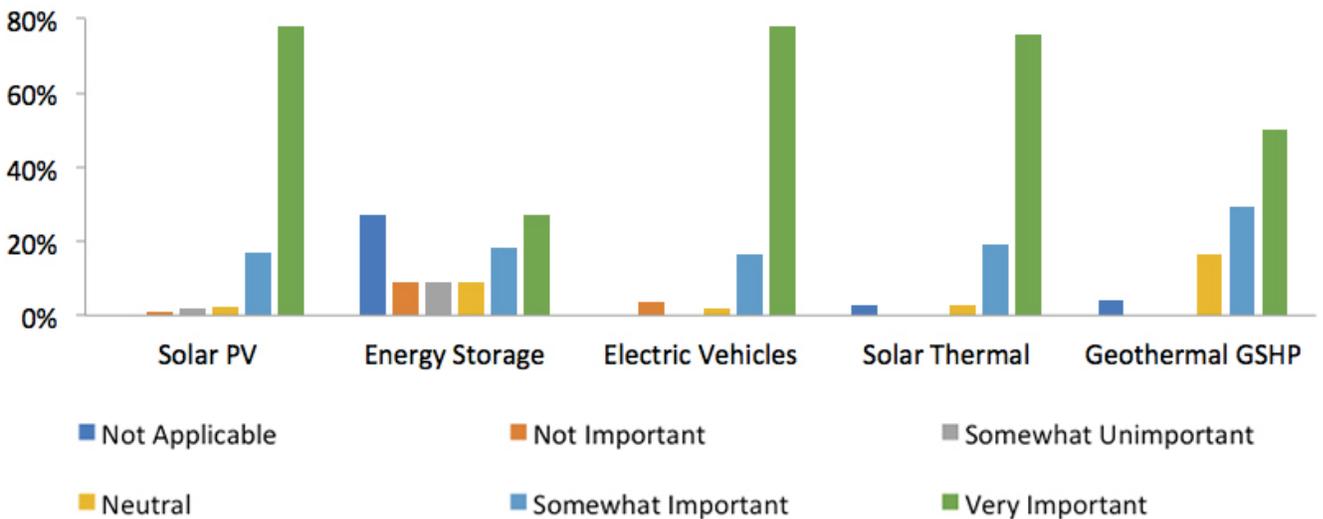
Multiple factors can compel a customer to adopt clean energy, but the survey brought to light a few overall trends. Environmental concern appears to be the primary motivation for clean energy purchases in every technology except GSHP. Environmental impacts received a “very important” ranking from over 75% of solar PV, electric vehicle, and solar thermal customers, and less than 5% of each of those customer groups classified environmental impacts as “not important.” No other concern surveyed received similarly overwhelming “very important” rankings, as shown in Figures 1.7 - 1.10. However, as the figure shows, geothermal customers are a notable exception, and they will be further discussed later in the report.

Another important motivation that emerged from the survey was concern about the cost of electricity and particularly concern about future bills. While the importance of future bills is not as pronounced as the overwhelming environmental concern, the majority of clean energy customers classified electricity costs as at least “somewhat important,” as shown in Figures 1.7 - 1.10.

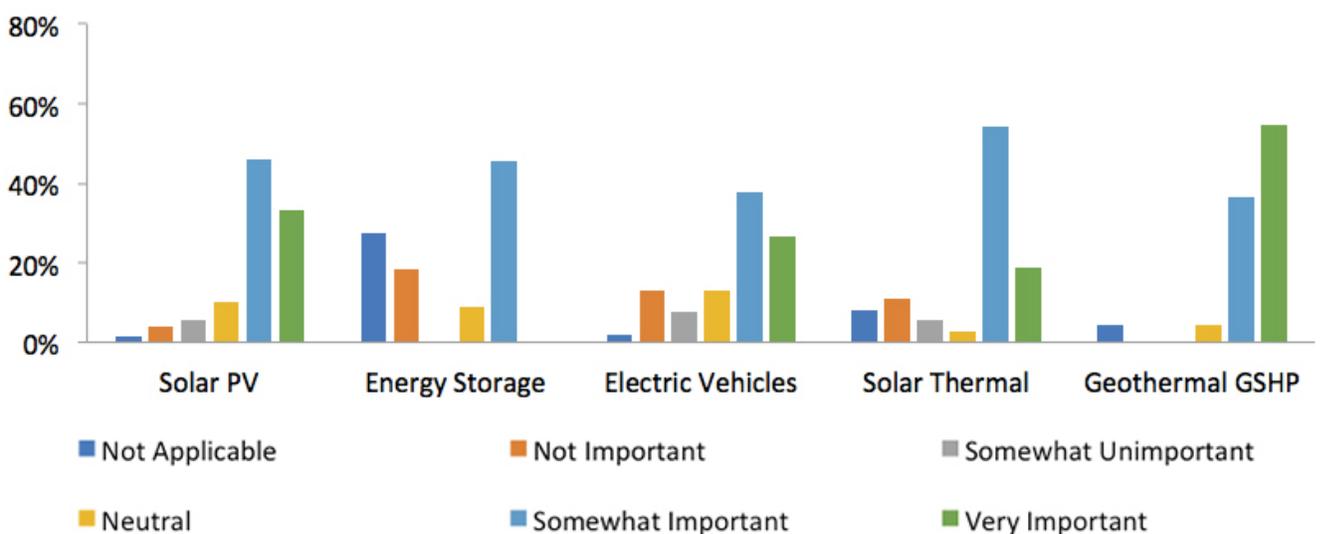
With the exception of electric vehicle customers, financial incentives appear to function as an important enabling mechanism for clean energy customers to act on their primary motivations (reduce their environmental impacts, cut electricity costs, etc.). Solar PV, solar thermal, and geothermal GSHP customers did not rank financial incentives as highly as environmental concern for primary motivations. The three technologies, however, certainly did not discount the incentives as only 5% or less of each technology’s customers found them to be “not important,” shown in Figures 1.7 - 1.10.

Energy storage, for the sake of survey analysis, was not factored into overall conclusions as the technology-specific questions received between 10-12 responses. This was not an adequate sample size to form conclusions about purchase motivations but the are still displayed in Figures 1.7 - 1.10

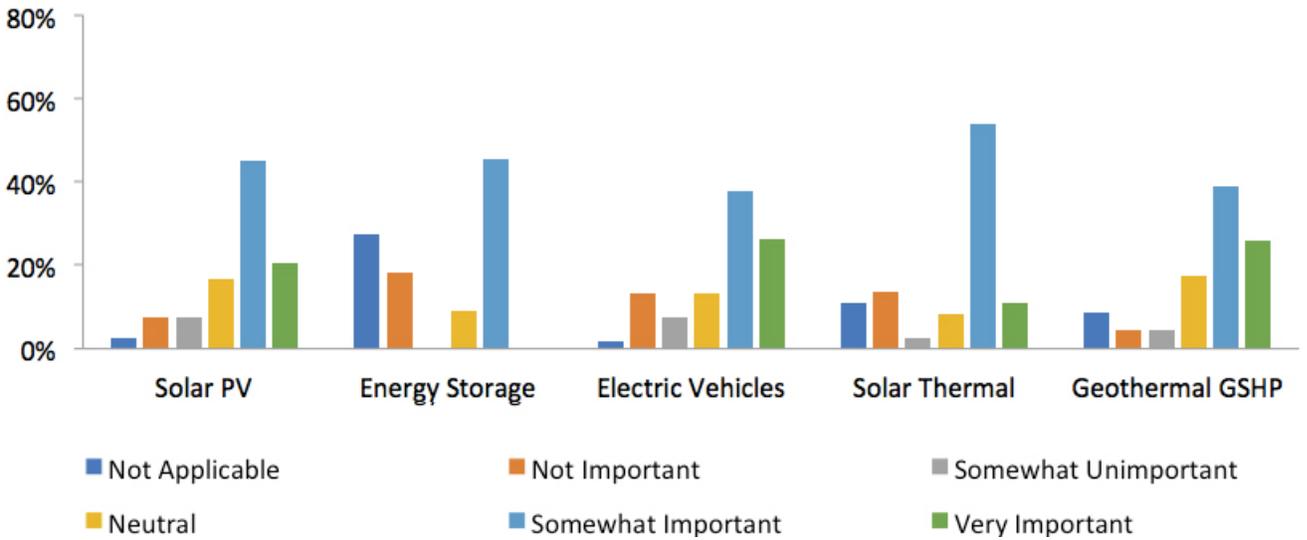
**Figure 1.7: Distribution of customer motivations for environmental concerns.**



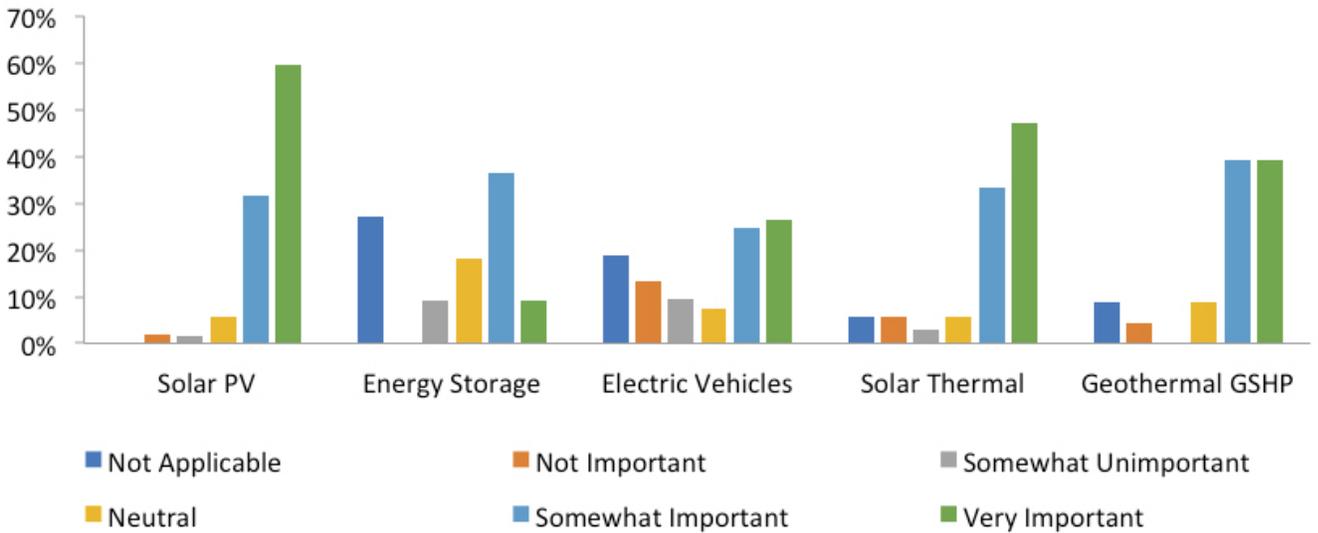
**Figure 1.8: Distribution of customer motivations for future electricity costs.**



**Figure 1.9: Distribution of customer motivations for current electricity costs.**



**Figure 1.10: Distribution of customer motivations for financial incentives.**



**Satisfaction**

Clean energy customers across all technologies are quite satisfied with the performance of their system and the installation process. When asked to rate their satisfaction with multiple aspects of clean energy purchases, all technologies yielded positive responses (over 75% at least “somewhat satisfied” and over 60% “very satisfied” when applicable) with regards to the installation process, including securing permits, choosing an installer, connection to utility provider, and the installation company.

The vast majority of customers (85%) were at least “somewhat satisfied” with the performance of their system, and for every technology except solar thermal, at least 75% of customers were “very satisfied.” About two thirds of solar thermal customers (64%) were “very satisfied” but a few respondents listed problems with leakages and panel issues. While maintenance of the system received generally positive feedback (over 70% at least “somewhat satisfied”), a few customers, particularly some who made geothermal and solar thermal purchases, highlighted specific problems in the open-response option either pertaining to company responsiveness or technology issues.

Clean energy customers are satisfied with available tax credits. Clean energy customers who used the federal or state tax credits were at least “somewhat satisfied” with accessing the federal tax credit over 80% and the state tax credit over 70% of the time. In comparison, they were “very satisfied” with accessing federal and state tax credits over 60% and over 50% of the time, respectively. There was not a significant number of mentions of the tax credit in the open-response option of the survey, so it is unclear what the source of any dissatisfaction could be.

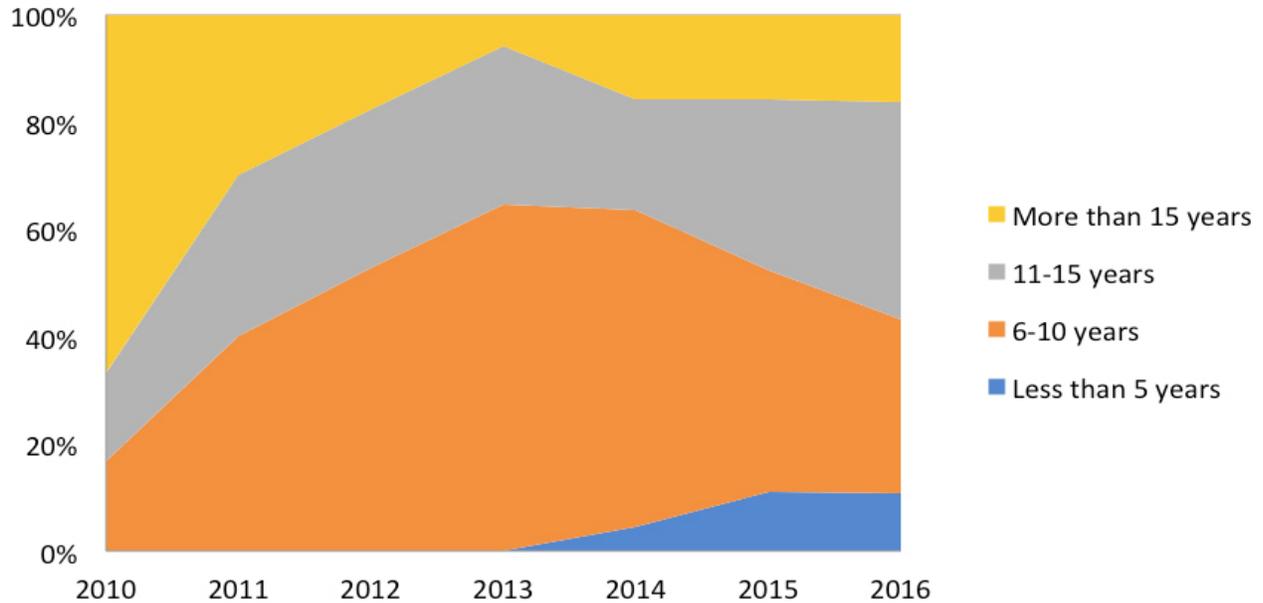
### **Solar PV Specific Updates**

The survey received 228 solar PV customer responses. Of the respondents, the majority of customers had systems installed after January 2014, providing a crucial update to the 2013 UNC-NCSEA Survey. Almost all of the PV systems (93%) are rooftop-mounted and around half have a capacity of 3-6 kW while around 30% have a capacity of 6-10 kW. Beyond the general results discussed in the above section, this report identifies key findings to supplement and update the 2013 survey.

### **Payback Period**

Over the past few years, PV customers appear to be expecting increasingly longer payback periods for their newly installed systems. The progression of payback period expectations over the past six years is shown in Figure 2.1. From 2010-2013, the percentage of PV customers with systems installed during that time who expected a payback period of 6-10 years increased, reaching a maximum of 65%. That percentage decreased for systems installed between 2014 and 2016 as more PV customers expected a payback period of 11-15 years. By 2016, more PV customers with systems installed in that year expected a payback period of 11-15 years (40.5%) than 6-10 years (32%). This finding is peculiar given that the vast majority of PV customers are claiming lower monthly utility bills. A potential explanation could be the expiration of the state renewable energy tax credit at the end of 2015, but more research is needed to make that conclusion.

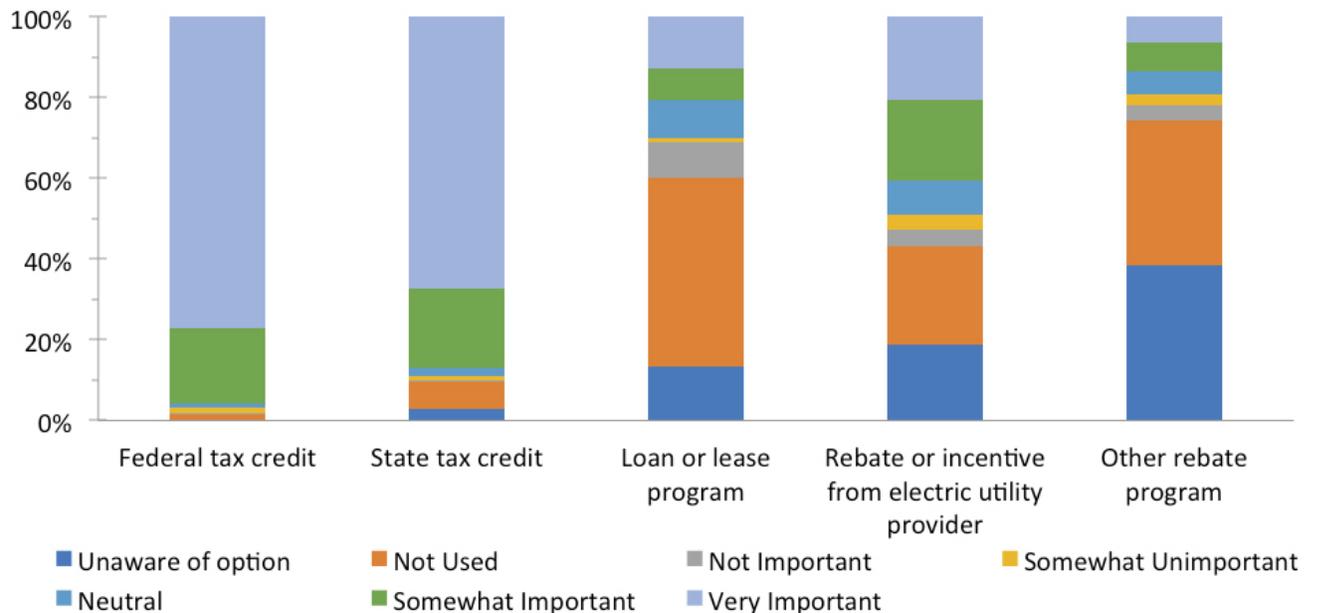
**Figure 2.1: Progression of payback period expectations for PV customers by system's installation date.**



### Financing

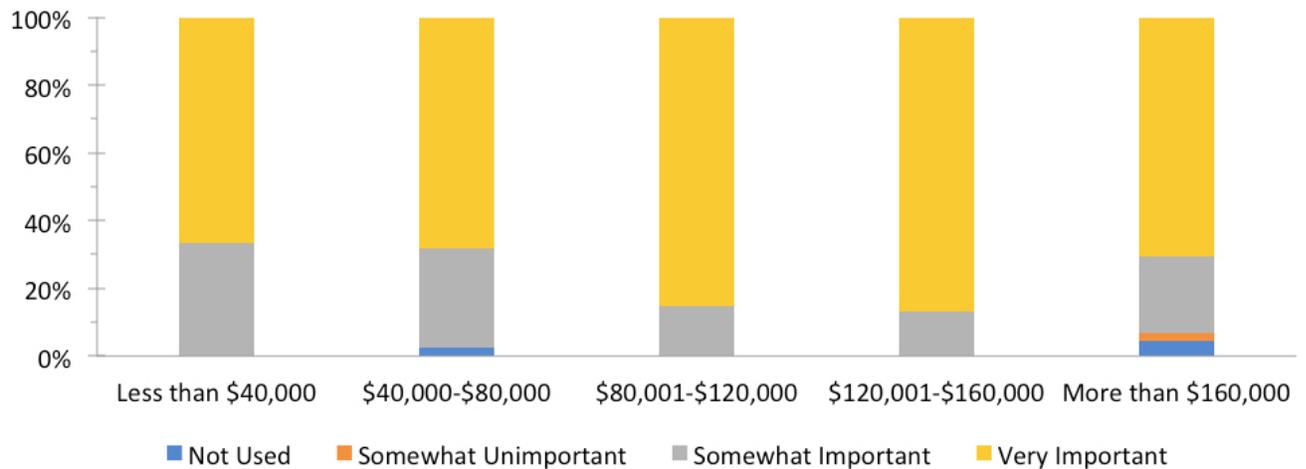
Similar to the 2013 survey, PV customers greatly value financial incentives, primarily federal and state tax credits, when purchasing their system. As Figure 2.2 shows, the federal and state tax credits received strong ranking in importance from the PV respondents with 96% and 87% of respondents, respectively, ranking them at least “somewhat important” and 77% and 67% of respondents, respectively, ranking them as “very important.”

**Figure 2.2: Importance of financial options for PV customers.**



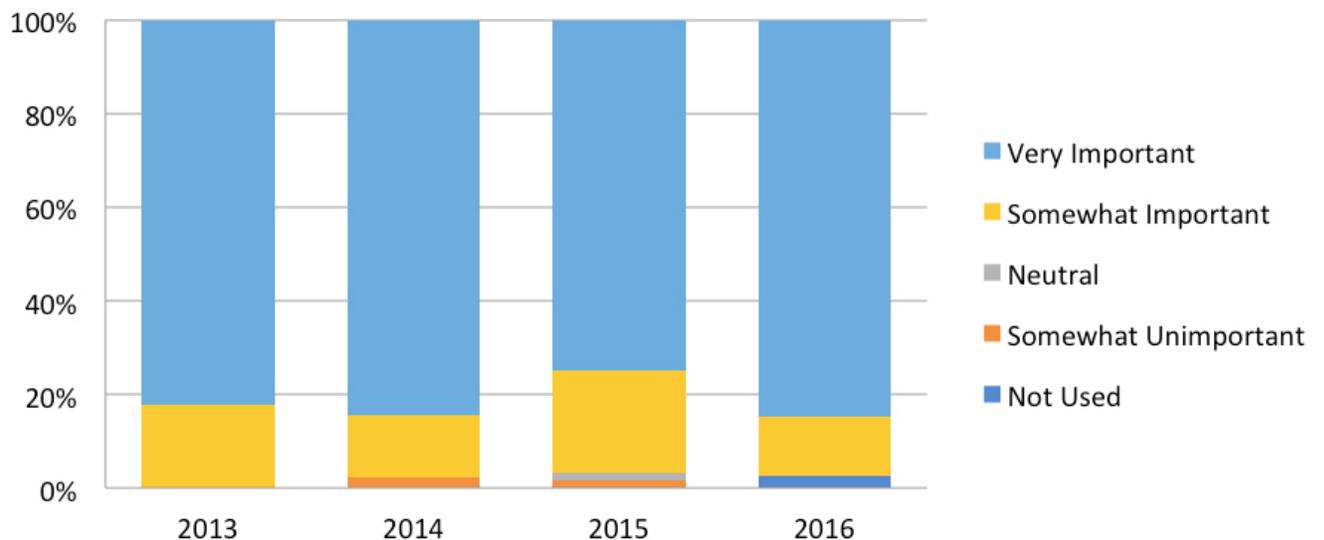
In fact, the importance of the federal tax credit was relatively consistent across both income level and date of installation since the percentage of respondents who ranked the federal tax credit as “very important” ranged from 67-87%. According to Figure 2.3, tax credits seem to be the most important in the upper-middle class bracket, suggesting that lower income populations may desire the financial support but are unable to utilize it with lower tax liability.

**Figure 2.3: Importance of the federal tax credit for PV customers according to annual household income.**



In addition, the importance of the federal tax credit was consistent for the past 4 years. Since 2013, the percentage of customers with newly installed PV systems that ranked the federal tax credit as “very important” has ranged from 75%-84%, with its lowest point in 2015 and its highest point in 2016 as shown in Figure 2.4.

**Figure 2.4: Importance of the federal tax credit for PV customers since 2013.**

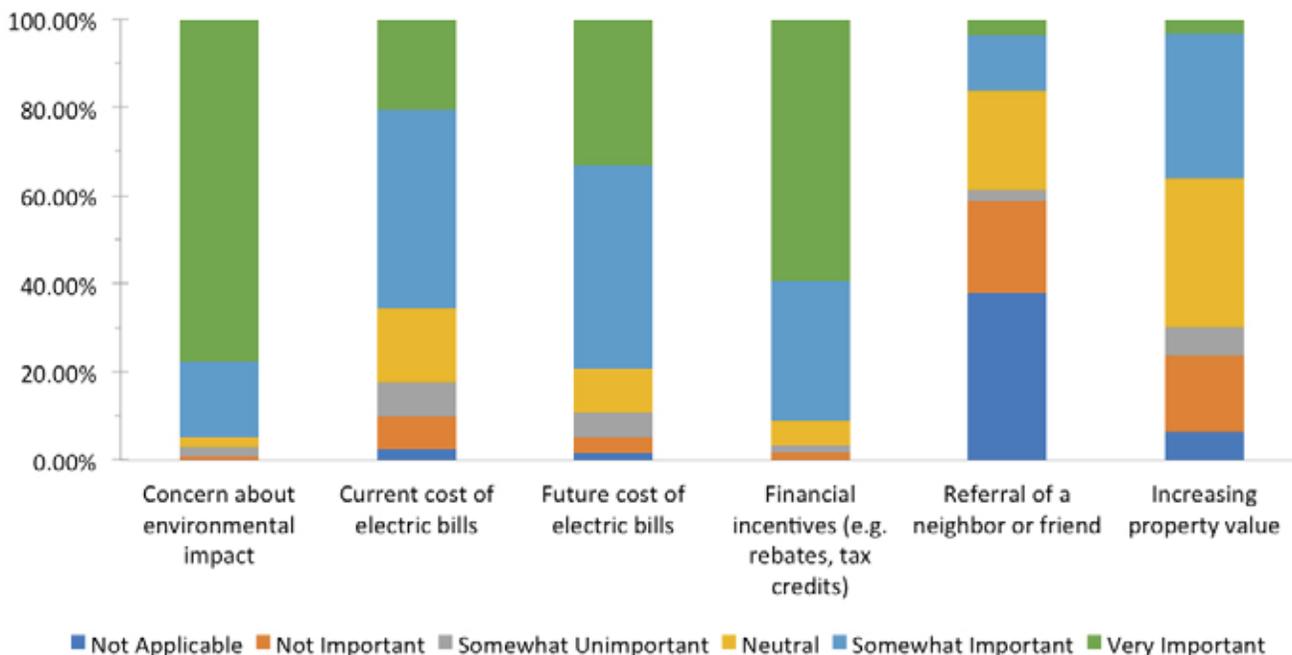


Results of this year’s survey seem to indicate a reduction in interest in loan and lease programs when purchasing PV systems. Specifically, Figure 2.2 shows that most respondents have little interest in loan or leasing programs, whereas the 2013 survey showed 76% classified the “availability of a loan” as “somewhat important” and 46% classified it as “very important.”<sup>4</sup> This change in interest may have been a result of the question not clearly differentiating between loan programs and leasing programs. Given that up until the recent passage of House Bill 589, there were no available leasing programs for solar PV systems in the state, it is no surprise that 47% classified them as “not used,” 9% as “not important,” 9% as “neutral” and 13% as “unaware of option.” The availability of this additional financing option will likely lead to different indication for this question in subsequent surveys.

### Motivations

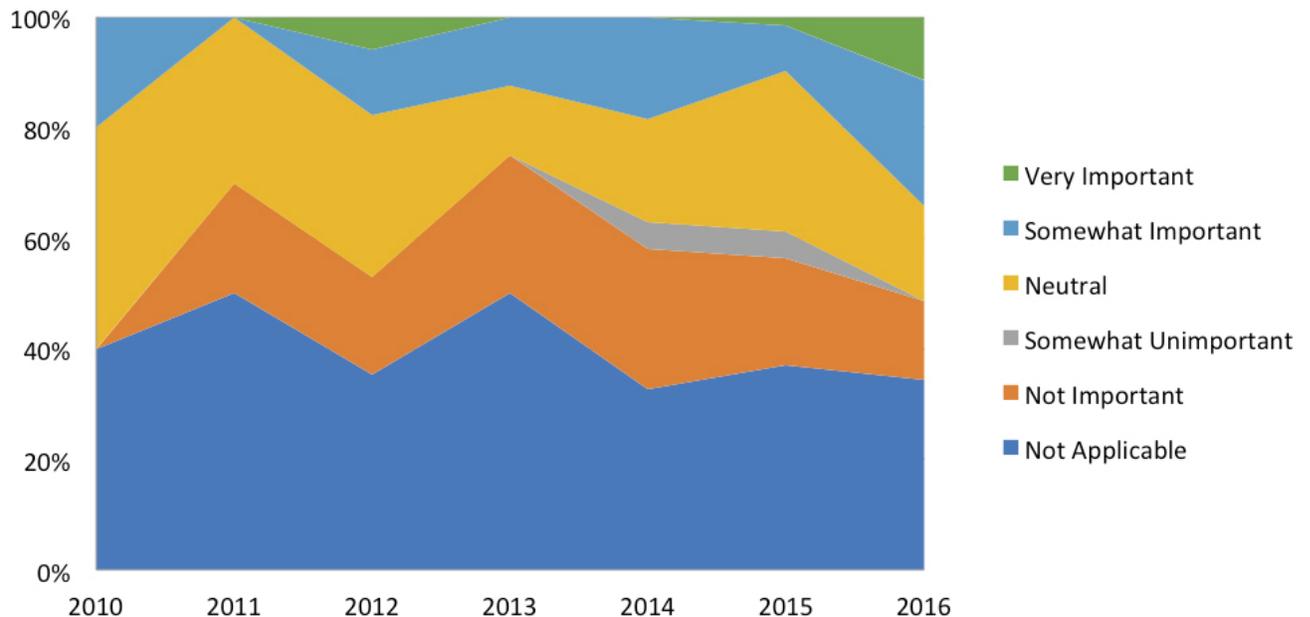
The primary motivations of PV customers remain consistent with the 2013 survey. The most important motivation was concern about the environment, as 95% of respondents cited it as at least “somewhat important” (92% in 2013 survey) and 78% cited it as “very important.” Similarly, 91% of PV customers found financial incentives to be at least “somewhat important,” which closely mirrors the 93% found in the 2013 survey. The complete distribution of the motivation importance rankings for this is shown in Figure 2.5.

**Figure 2.5: Importance of PV customers’ motivations for adoption.**



Nevertheless, this survey did reveal changes in the importance of current electricity costs and neighbor referral for PV customers from the 2013 findings. As Figure 2.5 shows, 68% of PV customers found current electricity costs to be at least “somewhat important,” a drop from the 81% in the 2013 survey. In other words, Figure 2.5 shows that the motivational focus for PV purchases has shifted more towards future costs of electric bills than current costs. Neighbor referral, however, has increased in importance from the 2013 survey. Then, only 11% of respondents valued neighbor referral as at least “somewhat important” (2% as “very important”). Now, that percentage has risen by 5%. Moreover, when analyzing the survey responses over the past six years there appears to be a significant increase in the role of neighbors in 2016, as 34% of respondents ranked neighbor referral as at least “somewhat important” and 11% of respondents ranked it as “very important,” which is five times more than the 2013 survey. That analysis over time is shown in Figure 2.6.

**Figure 2.6: Importance of neighbor referral for PV customers over the past six years.**



### Satisfaction

Similar to the 2013 survey, PV customers are quite satisfied with the performance of their system and the installation process. When asked to rank their experience with several aspects of their purchase, over 70% of respondents claimed they were “very satisfied” with choosing an installer, securing project permits, and the company that installed their system. On top of that, 75% of respondents claimed they were “very satisfied” with the performance of their system.

PV customers who pursued tax credits were generally satisfied with accessing them, but not equally among the federal and state options. Over 75% of respondents were “very satisfied” with accessing the federal tax credit while only 55% of respondents were “very satisfied” with accessing the state tax credit, likely due to the expiration of the North Carolina Renewable Energy Tax Credit.

A notable update to the 2013 survey is that customers are now more satisfied with their utility bill savings. Of the respondents surveyed, 89% claimed to be at least “somewhat satisfied” and 69% claimed to be “very satisfied” with their utility bill savings. This a significant shift in the degree of satisfaction from the 2013 responses where 34.8% were “very satisfied” and 79% were at least “somewhat satisfied.”

### Energy Storage Interest

While the majority of PV customers have considered energy storage (65%), they have chosen not to install it. Almost a third (29%) did not even consider adding energy storage. The most commonly cited reason for deciding not to install energy storage systems was cost. In addition, some customers pointed to the fact that they are already being compensated for their surplus energy produced through net metering programs which negates any incentive they might have to store their excess electricity. If net metering programs in the state are changed in ways that make it less attractive to consumers, investigating the change in attitude about the importance of energy storage system costs would be worthwhile.

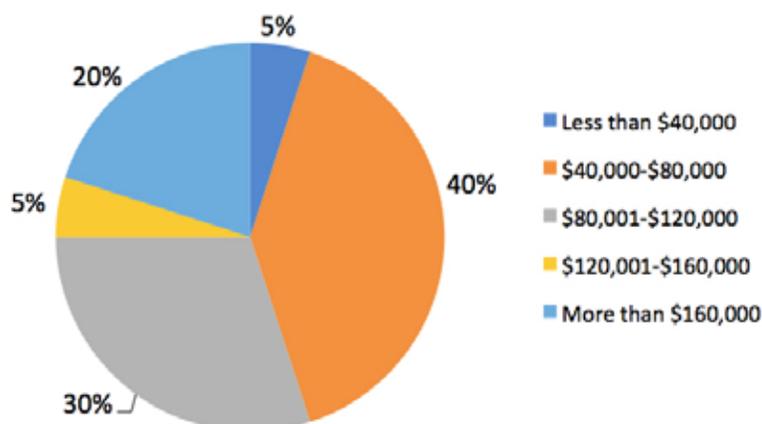
### Geothermal GSHP Specific Updates

The survey received 27 geothermal GSHP customer responses with installation dates since January 2010. Most (81%) of the systems are closed loop while 8% are open loop and configurations include horizontal (23%), vertical (38.5%), and lake/pond (4%). 58% had a capacity of 3-5 tons and 37.5% had a capacity of 1-3 tons. Beyond the general results discussed in the above section, this report identifies key findings to supplement and update the 2013 survey.

### Demographics

Of all the technologies surveyed, geothermal GSHP customers had the highest concentration of customers from the middle class with 70% of respondents claiming an annual household income between \$40,000-\$120,000 and 40% specifically in the \$40,000-\$80,000 range. The full distribution of annual household incomes for geothermal customers surveyed is shown in Figure 3.1.

**Figure 3.1: Distribution of annual household incomes for surveyed geothermal customers.**

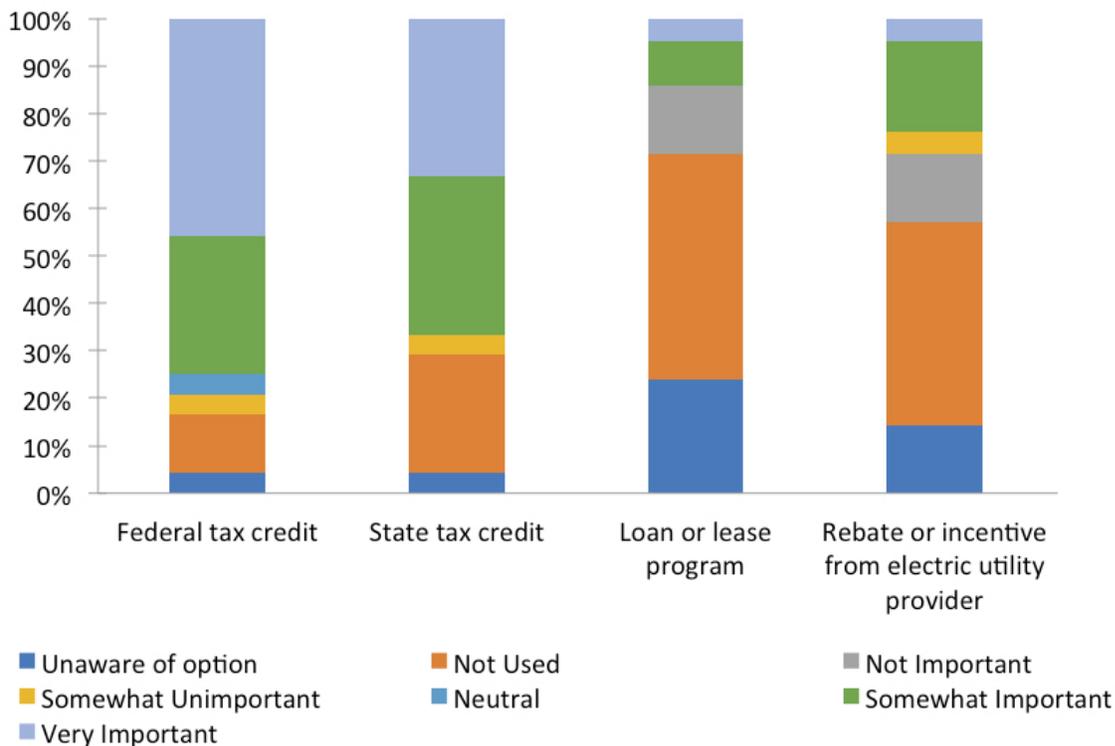


## Financing

Geothermal customers, as discussed in the general section, were consistent with other clean energy technologies surveyed in how they financed their system, with the majority of customers relying on cash on hand (76%). In addition, they greatly valued financial incentives; specifically, federal and state tax credits. As Figure 3.2 shows, 75% of respondents found the federal tax credit to at least be “somewhat important” (46% “very important”), and 66% found the state tax credit to at least be “somewhat important” (33% “very important”). The survey found the federal tax credit to be the primary form of financial incentive used by geothermal customers as 100% of the respondents who found financial incentives to be “very important” in the motivations question specifically ranked the federal tax credit as “very important.” Since the federal and state tax credits for geothermal ground source heat pumps expired at the end of 2016 and 2015, respectively, future customers might have to rely more heavily on loan or lease programs and rebates or incentives from their electricity provider in order to finance future purchases.<sup>11,12</sup>

With regards to loan and lease programs, though, the survey, as with solar PV, found less interest than the 2013 survey. As Figure 3.2 shows, 48% of respondents described loan or lease programs as “not used,” 14% as “not important,” and 24% as “unaware.” Responses from the 2013 survey, on the other hand, described the “availability of loan” as “very important” 58% of the time and at least “somewhat important” 74% of the time.

**Figure 3.2: Importance of financing options for geothermal customers surveyed.**

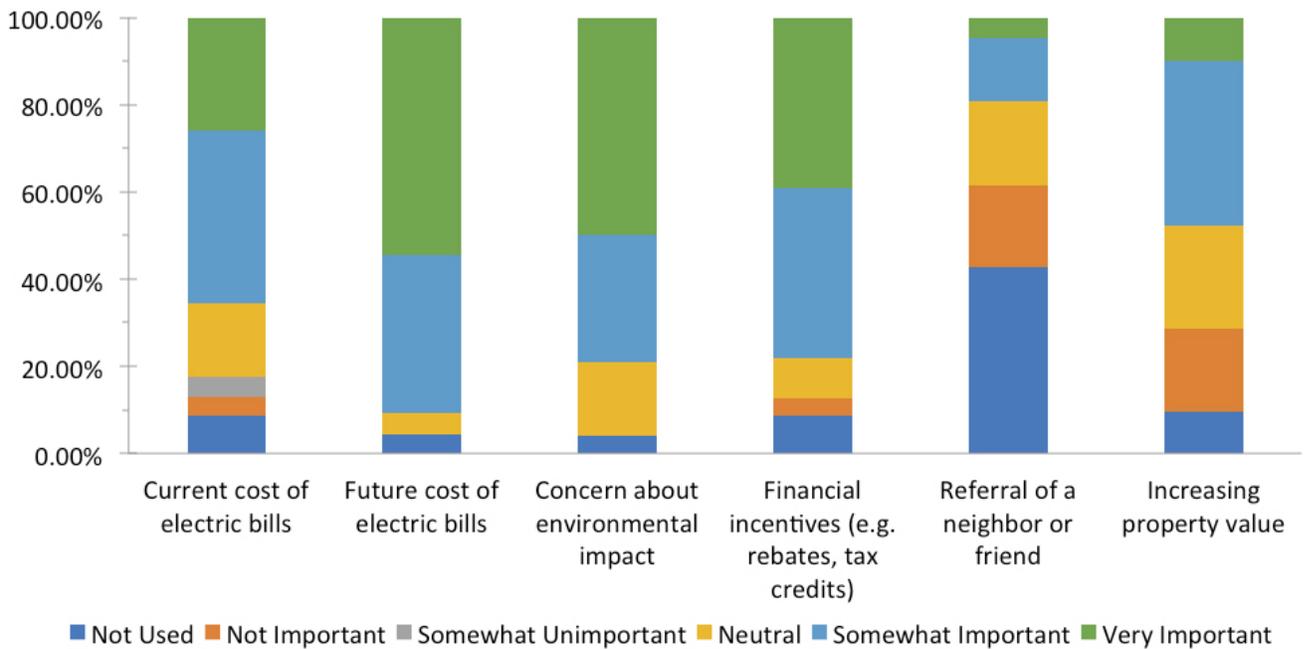


### Motivations

Consistent with the 2013 survey, electricity costs remain the primary motivation behind adoption of geothermal systems. This survey, however, found that the concern is specifically focused on future bills rather than current ones. As shown in Figure 3.3, 91% of respondents ranked future bills at least “somewhat important” with 55% describing them as “very important”. Current bills, on the other hand, are at least “somewhat important” to 65% of respondents and “very important” to only 26% of respondents.

In addition, environmental impacts and financial incentives, although still important considerations to geothermal customers, are valued slightly less than they were in the 2013 survey. For instance, concern for environmental impact was at least “somewhat important” to 79% of respondents surveyed compared to 86% in 2013. With regards to financial incentives, 78% of respondents described them as at least “somewhat important” and only 39% as “very important.” This is slightly less than the 83% in 2013 who described them as at least “somewhat important” but much less than the 64.5% who described them as “very important.”

**Figure 3.3: Importance of purchase motivations for geothermal customers surveyed.**



## Satisfaction

Geothermal customers remain satisfied with the performance of their systems and the installation process, consistent with the 2013 survey findings. Over 70% of respondents were “very satisfied” with choosing their installer and the work of the installation company and 67% were “very satisfied” with securing project permits. With regard to the operation of the geothermal systems, the significant majority of customers were happy with their purchase. 79% of respondents reported being “very satisfied” with the performance of their system, and 75% were “very satisfied” in terms of system maintenance.

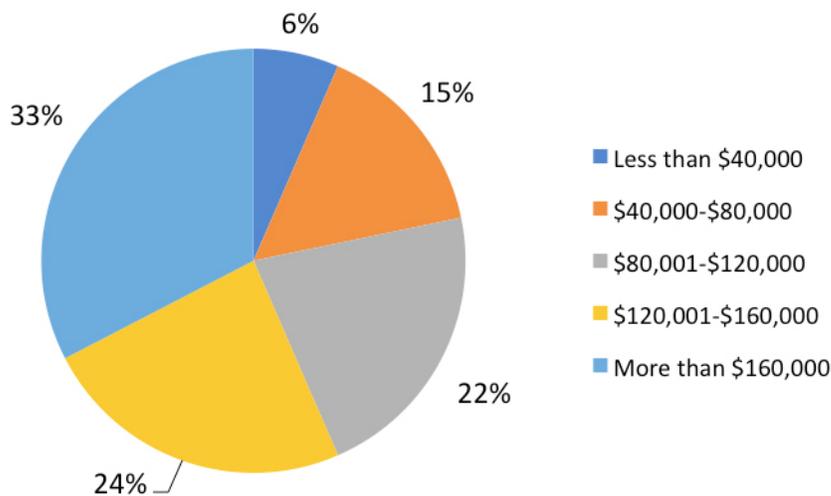
## Electric Vehicles: A New Field of Study

The survey generated 68 electric vehicle respondents with a high concentration (75%) of vehicle purchases occurring after 2013. The respondents hold a diverse array of electric vehicle makes and models with the most popular options being the Nissan Leaf, Chevrolet Volt, Tesla Model S, and Toyota Prius. 78.5% of respondents bought their vehicle from a dealership, and a plurality spent \$15,000-\$30,000 for their vehicle.

## Demographics

Electric vehicle customers, of all technologies surveyed, were the most concentrated in the upper income classes. As Figure 4.1 shows, over half of respondents claimed an annual household income above \$120,000, and around a third of respondents claimed an annual household income above \$160,000.

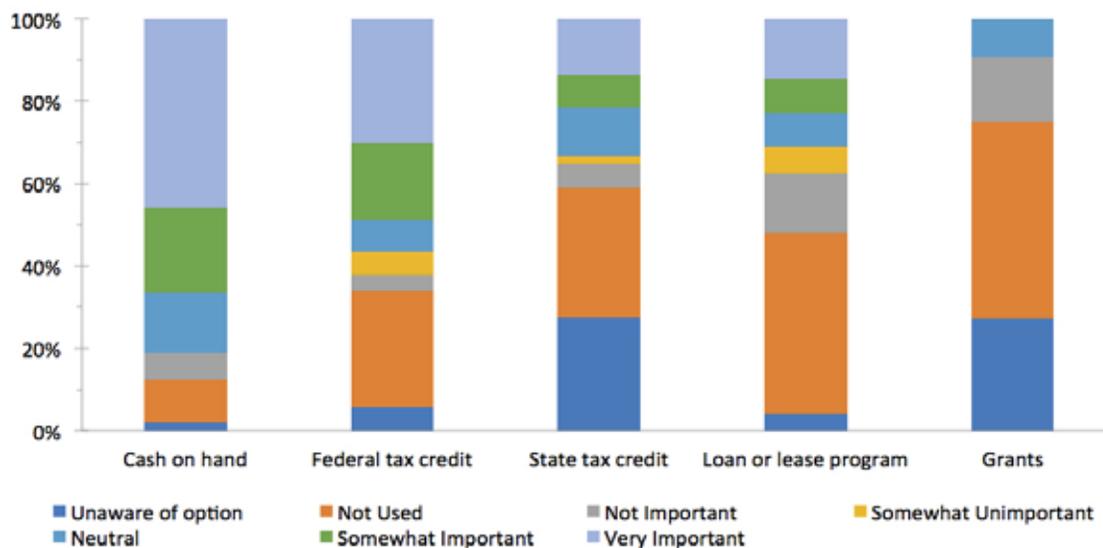
**Figure 4.1: Distribution of annual household incomes among electric vehicle customers.**



## Financing

Consistent with the other clean energy technologies surveyed, the majority of electric vehicle customers used cash on hand to finance their purchase (62%) with less than 20% leasing and only 30% using a loan. Figure 4.2 shows the importance that electric vehicle customers attached to each financing option, and cash on hand appears to be the primary option. Electric vehicle customers, however, did not pursue tax credits to the same degree as other clean energy technologies. In fact, only 13% and 4% claimed to use the federal and state tax credits, respectively. This finding is further confirmed by the assigned importance of the tax credits depicted in Figure 4.2. Contrary to other technologies, nearly half of respondents viewed the federal tax credit as at least “somewhat important.” Perhaps this finding could be attributed to the greater income levels of electric vehicle customers, but more research would be needed to make that determination. Although 4% of EV owners claimed to have used a state tax credit when making their purchase, North Carolina has never offered a state EV tax credit. This means that this 4% is either an anomaly or that those respondents purchased their vehicles in states that did offer an EV tax credit.

**Figure 4.2: Importance of financing options for electric vehicle customers.**

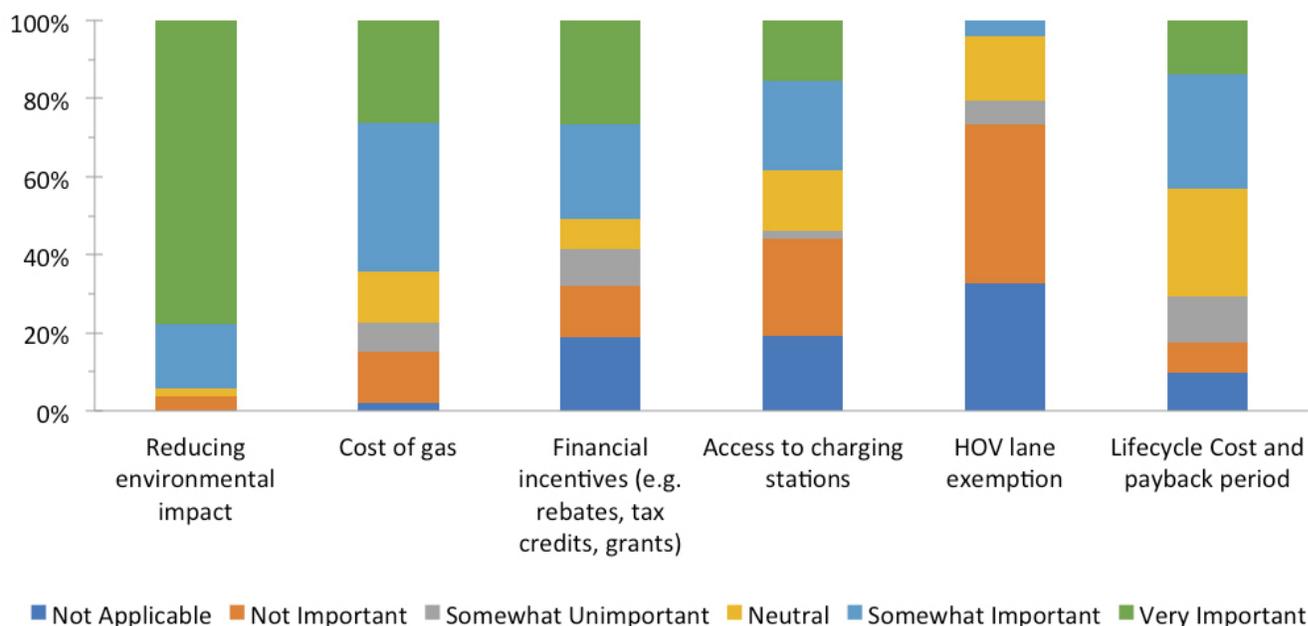


## Motivations

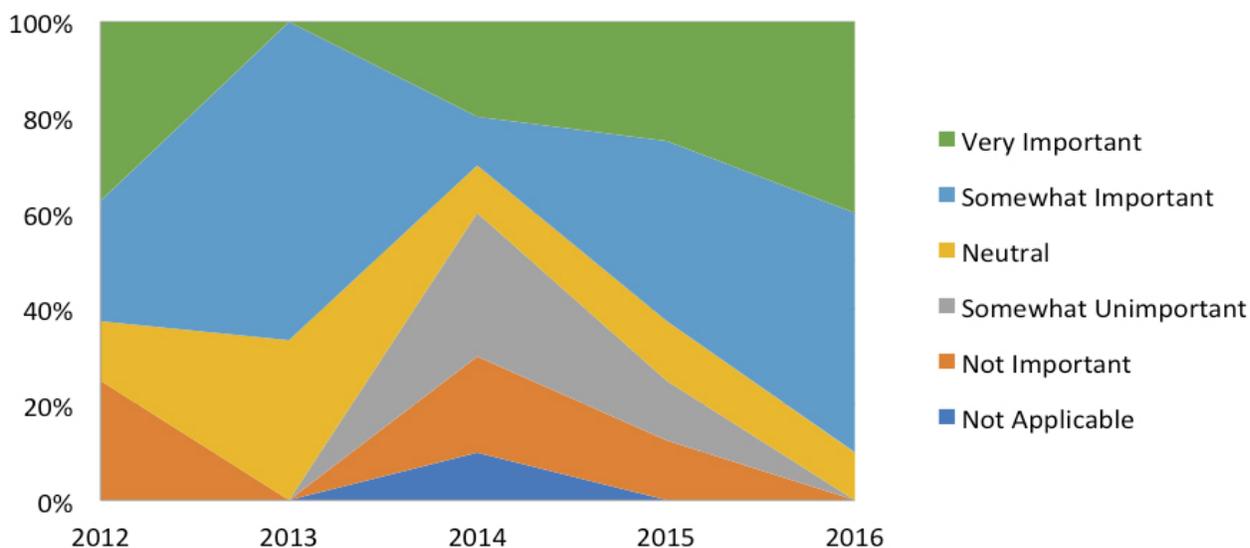
Similar to other technologies, electric vehicle customers appear to be primarily motivated by concern for the environment in purchasing their vehicle. As Figure 4.3 shows, in precisely the same proportion as solar PV, 95% of respondents ranked environmental impacts as at least “somewhat important” and 78% ranked them as “very important,” overwhelming feedback unmatched by the other motivations. The runner-up, the cost of gas, received a ranking of at least “somewhat important” from 64% of respondents, but a “very important” ranking from only 26% of respondents. When projected over time in Figure 4.4, the past two years have seen a significant increase in customer value of the cost of gas and by 2016, the percentage of customers who value the cost of gas (90% at least “somewhat important” and 40% “very important”) reached the highest level of the decade.

Other potential motivations such as access to charging stations and lifecycle cost of the vehicle, as shown in Figure 4.3, received a diverse range of importance feedback, likely due to the varying uses of the vehicle. Future surveys of electric vehicle customers should question respondents on their vehicle use. For instance, if EVs are just being used for relatively short commutes to work and back, access to charging stations is not necessarily a significant concern. In addition, it is important to note that the survey population only consisted of individuals who actually went through with their purchase and not potential customers, who perhaps chose not to buy an electric vehicle due to cost or access to charging stations. Future surveys that attempt to understand purchasing motivations should attempt to broaden the survey population.

**Figure 4.3: Importance of purchasing motivations for electric vehicle customers.**



**Figure 4.4: Importance of the cost of gas for electric vehicle customers over time.**



## Satisfaction

EV customers demonstrated significant satisfaction with the quality and performance of their vehicle, car maintenance, and the dealership experience. When asked to rank their satisfaction with several aspects of their purchase, 84% of respondents were “very satisfied” with the performance and quality of their electric vehicle, and 70% were “very satisfied” with car maintenance.

EV customers had more diverse responses with the range of their vehicle, access to charging stations, and their dealership experience. Less than half of respondents were at least “somewhat satisfied” with vehicle range and access to charging stations. Both were mentioned commonly in the open-response section of the satisfaction questions, but more research would be needed to determine the reasoning behind those rankings. Notably, while access to charging stations did not receive a resoundingly positive satisfaction ranking, 30% of respondents were “neutral” and 23% of respondents described them as “not used/not applicable.” It is for this reason that future surveys should ask about the customer’s use of their vehicle. With regards to dealership experience, while the majority of customers were at least “somewhat satisfied” (71%), only 47% were “very satisfied.” A few customers, in the open-response section, pointed to lack of dealer knowledge about electric vehicles as frustrating when wanting to pursue an electric vehicle purchase.

# Conclusion

---

As the clean energy market continues to evolve, maintaining an understanding of customer motivations and experiences is necessary to ensure continued adoption and growth of the industry. The survey on which this report is based sought to provide insights into the demographics, motivations, and experiences of end-use customers in the North Carolina clean energy market. With the foundational work of the 2013 UNC-NCSEA survey in mind, this survey yielded key updates to the 2013 conclusions, new perspectives for consideration, and confirmation of trends that have not appeared to change since 2013.

Overall, the demographics of clean energy customers appear to be similar to those found in the 2013 survey with regards to race, education, age, and income. The internet continues to be a key source for information, and the majority of energy efficiency upgrades occur before installation of clean energy technologies. Further, most clean energy customers use cash on hand and make use of available tax credits to finance their purchases, except in the case of electric vehicles, which was a finding similar to that of the 2013 survey.

Clean energy customers appear to be primarily motivated by environmental concerns but still value financial incentives as an enabling mechanism for their purchase. Other concerns, such as current and future costs of electricity, while very important for geothermal customers, were not as influential to customers of other technologies. As electric utility rates increase over the coming years, this survey should be repeated to see if current and future cost of electricity become more important motivations for clean energy technology adoption, and if so, at what household income levels.

Since the survey population consisted of actual clean energy customers and not potential customers, determining if environmental concern is the primary issue that companies should prioritize when engaging all potential customers cannot be determined. Nevertheless, the resounding findings from this survey's motivational research show that current customers care about their environmental impact. Thus, clean energy companies should consider ways to further incorporate the positive environmental impact of purchase decisions into their marketing strategies in the future. In addition, sharing the customer satisfaction with utility bill savings and the usage of the federal tax credit found in the survey can be used to leverage against financial concerns that could deter new clean energy purchases.

For further understanding, future surveys should consider how customers use their clean energy technologies to provide context to their motivations and satisfaction with their purchases. Additional insights into the considerations that potential clean energy customers make when debating purchases should also be explored. As Sigrin et al. emphasized, the clean energy market needs to learn how to expand its reach if it wants to continue to grow. Perhaps deeper insight into that growth lies beyond the experience of current customers.

Additionally, new financing mechanisms for energy efficiency are being offered by utilities and novel methods for financing consumer-sited solar in North Carolina were enacted by law in 2017. House Bill 589 provides options that will become available or likely be expanded to more electricity consumers in 2018. These financing options include expanding availability of community solar, the legalization of solar leasing, and the pending creation of a rooftop solar rebate program available to Duke Energy customers. These are in addition to the expanding availability of on-bill financing and tariff based financing programs for energy efficiency, and perhaps renewable energy, from electric membership cooperatives. Future editions of this survey will be necessary to measure the impact of these new and expanding financing options on consumer adoption of clean energy technology in North Carolina.

# Endnotes

---

1. Petrusa, J.; Callihan, R.; Hofmann, J. "Economic Impact Analysis of Clean Energy Development in North Carolina - 2017 Update," June 2017, RTI International, [https://energync.org/wp-content/uploads/2017/06/NCSEA\\_2017\\_Final\\_RTI-6-23-17.pdf](https://energync.org/wp-content/uploads/2017/06/NCSEA_2017_Final_RTI-6-23-17.pdf)
2. Solar Energy Industries Association. "North Carolina Solar," 2017, <https://www.seia.org/state-solar-policy/north-carolina-solar>
3. Rogers, Michael. Injection Well Inventory Request, October 2017, [Excel Spreadsheet], NC Department of Environmental Quality.
4. Shahan, Zachary. "US Electric Car Sales by State-Who's #1, Ohio or California," May 4, 2017, CleanTechnica, <https://cleantechnica.com/2017/05/04/us-electric-car-sales-state-whos-1-ohio-california/>
5. Solar City and Clean Edge. "U.S. Homeowners on Clean Energy: A National Survey," March 2015, <https://www.solarcity.com/sites/default/files/reports/reports-2015-homeowner-survey-clean-energy.pdf> (accessed 6/12/17)
6. Solar City and Clean Edge. "U.S. Homeowners on Clean Energy: A National Survey," March 2015, <https://www.solarcity.com/sites/default/files/reports/reports-2015-homeowner-survey-clean-energy.pdf> (accessed 6/12/17)
7. Hee, C. A.; Wedding, C.; Urlaub, I. "Motivations and Behaviors of Solar PV and Geothermal System Owners in North Carolina," 2014, UNC Kenan-Flager Business School and NC Sustainable Energy Association, [https://energync.org/wp-content/uploads/2017/03/Motivations\\_and\\_Behaviors\\_of\\_Solar\\_PV\\_and\\_Geothermal\\_System\\_Owners\\_in\\_NC.pdf](https://energync.org/wp-content/uploads/2017/03/Motivations_and_Behaviors_of_Solar_PV_and_Geothermal_System_Owners_in_NC.pdf)
8. Sigrin, B.; Pless, J.; Drury, E. "Diffusion into new markets: evolving customer segments in the solar photovoltaics market," 2015, *Environ. Res. Lett.*, 10, 084001
9. Balcombe, P.; Rigby, D.; Azapagic, A. "Motivations and barriers associated with adopting micro-generation energy technologies in the UK," 2013, *Renewable and Sustainable Energy Reviews*, 22, pg. 655-666
10. Sommerfeld, J.; Buys, L.; Mengersen, K.; Vine, D. Influence of demographic variables on uptake of domestic solar photovoltaic technology. 2017, *Renewable and Sustainable Energy Reviews*, 67, pp. 315-323
11. Residential Renewable Energy Tax Credit." NC Clean Energy Technology Center, March 17, 2017. Accessed from: <http://programs.dsireusa.org/system/program/detail/1235>.
12. Renewable Energy Tax Credit (Personal)." NC Clean Energy Technology Center, Feb. 2, 2017. Accessed from: <http://programs.dsireusa.org/system/program/detail/541>.