



# CONSUMER DRIVEN TECHNOLOGIES

*EXECUTIVE SUMMARY FOR NON-SGCC MEMBERS*

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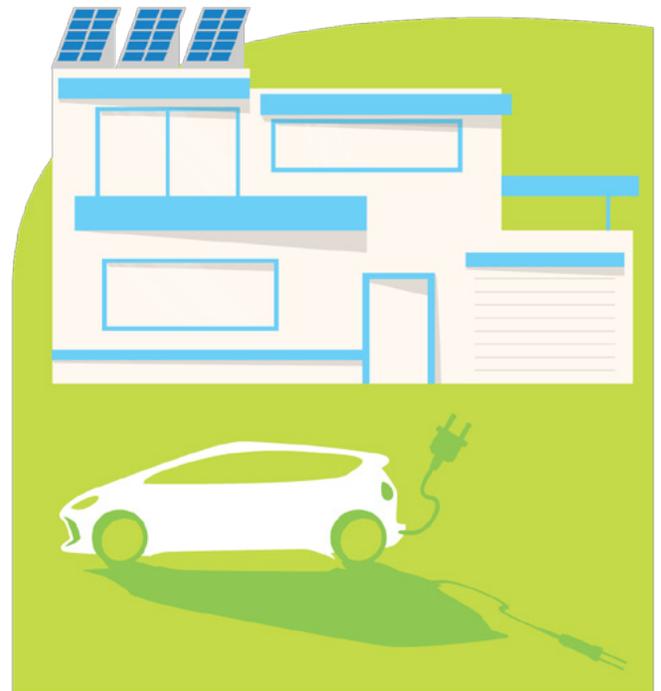
# 1 EXECUTIVE SUMMARY

The electricity grid is evolving from one designed for unidirectional flows of electricity to the consumer to one that also integrates intermittent generation from the consumer into the grid. Gaining an understanding of consumer adoption of solar and electric vehicles is essential as these and other distributed energy resources introduce increased variability in the supply and demand relationship for energy. SGCC's Consumer Driven Technologies (CDT) study examines consumer adoption of solar photovoltaic (PV) and electric vehicle (EV) technologies. The CDT study equips interested stakeholders with actionable insight on the consumer producers or "prosumers" to help this transition to the future grid.

The CDT research was conducted as an online survey of 1,571 respondents from across the nation that addressed four distinct technologies and services: residential solar, community solar, green power plans and electric vehicles. The CDT survey results support analysis of the overall patterns of solar PV and EV technology adoption. Through oversampling of adopters of residential solar PV and EV technologies, the survey supports in-depth analysis of the motivations, concerns and experience of consumers who have recently made decisions regarding their purchase and use. The sample size of this study satisfies overall confidence and precision of  $95\% \pm 2.5\%$ , and minimum of  $95\% \pm 10\%$  within each of the segments and state groups.

The research set out to answer the following questions:

- To what extent are residential consumers aware of and interested in solar and electric vehicle technologies?
- What benefits from adoption of these technologies do consumers recognize and value?
- What barriers to adoption do consumers perceive?
- What do consumers expect in terms of technology performance and investment return?
- Which entities (utility and non-utility) do consumers rely upon for accurate information on technologies such as solar and EVs?
- What roles do consumers expect their utility company to play in the solar and EV marketplace (for installation, ownership, connection to the grid and backup supply)?
- Does utility involvement in solar and EV markets boost or deter adoption of those technologies?
- How do the answers to the questions above vary, if at all, by the five SGCC consumer segments, by key demographics and by policy environment?



## 1.1 Key Findings

**1. Demographics and segmentation drive interest in solar PV and EVs.** Consistent with previous research, we found that consumer demographics and segmentation had a much stronger statistical association with interest in solar PV and EVs than other potential influences such as the level of policy and program support available in the consumer’s state. Demographic characteristics of homeownership, income and age have the strongest effect on level of consumer interest. Residence in a state with policies supportive of renewable energy and smart grid technologies had no consistent effect on consumers’ interest in or self-assessed understanding of those technologies.

**Figure 1: Consumers very interested in residential solar PV**



- 2. Barriers exist, but the market is moving towards reducing dominant consumer concerns.** Fewer than 22% of all consumers claim to have a fairly complete understanding of PV or EVs which is a barrier to engagement. The combination of lack of knowledge concerning technology benefits with perceptions of high initial cost constitutes the major barrier to adoption for the majority of consumers. Broader market trends towards alternative acquisition models and falling prices are helping to mitigate cost concerns.
- 3. There is growing interest in alternative acquisition models** for solar PV and EVs towards alternatives such as power purchase agreements (PPAs), shared ownership arrangements like community solar and leases for solar PV and EVs. This reflects broader market trends away from sole ownership and towards the burgeoning shared economy and “as-a-service” models — a promising market trend in an environment where initial adoption costs are a barrier.
- 4. Roughly one-half of consumers who have solar or EV technology have both<sup>1</sup>.** Similarly, consumers who are interested in one of those technologies have interest in the other. This finding has implications for utility planners looking to forecast load as adoption of these technologies ramps up. It also points to opportunities for targeted marketing and service bundling for companies who offer those technologies.
- 5. When using solar, consumers are interested in connecting to the grid as a source of backup power and are willing to pay for it.** This finding suggests that there is potential to offer backup power services for a fee.

<sup>1</sup> The findings presented here are based strictly on the sample for this study. The sample includes an oversample of residential solar PV and EV adopters who comprise 453 and 378 of the total sample of 1,571 respondents respectively. Co-adoption based on the CDT sample is estimated as follows — 45% (204 out of 453) of residential solar PV adopters stated they also had an EV and 54% (204 out of 378) of EV adopters stated that they also had residential solar PV.

**6. Utilities have a role as an information provider and market booster, but less so as a provider of ancillary services for solar PV and EVs.** Consumers indicate that they seek to eliminate middlemen and streamline their transactions. When consumers are making purchases, 70% would prefer to deal directly with the supplier of solar PV and EVs for services such as technical advice, installation and hardware.

## 1.2 Implications for Utility Programs and Related Policies

The implications of findings from this CDT study for interested stakeholders for solar PV and EV technologies are summarized below.

**Promotion of solar electricity for residential consumers.** As discussed above, lack of consumer understanding of the benefits of solar power and high initial investment costs remain the most important barriers to more widespread adoption of solar PV technology. The market has consistently addressed the latter barrier of initial cost: installed costs per kW of PV systems have decreased by over 50% in the past 10 years<sup>2</sup>. The average levelized per kWh of residential solar electricity is now \$0.122<sup>3</sup>, roughly equal to the average retail residential electric rate<sup>4</sup>. PV installation services are widely available throughout the country and leasing services further reduce initial costs.

Public sector-supported programs can be leveraged to address the lack of consumer understanding of the practical workings and benefits of PV technology. Consumer education and outreach reduces information search and other transaction costs for the consumer. Moreover, this kind of activity and consumer protection is an uncontroversial role for the public sector. Facilitation of interconnections and convenient operation through net metering represent the “last mile” in enabling consumers to access solar energy. Most of the respondents reported being willing to pay for back-up service and grid connections to facilitate that back-up. Finally, community solar and green power represent channels to access solar power for renters and homeowners who face physical constraints to owning solar PV systems. However, the complexity of these transactions will require even greater consumer education and promotional efforts to achieve scale.



**Promotion of electric vehicles.** A key tool on the path to decarbonization of the transport sector is widespread adoption of electric vehicles; this has additional benefits of much cleaner air quality and reduced dependence on oil. As in the case of solar, the EV market has begun to provide products priced to be accessible to a relatively broad range of new car buyers.

Improvements in battery technologies and the resultant advances in electric vehicles indicate that the market is poised for growth in the next decade with some estimates at 22% EV penetration by 2025 from less than 3% today<sup>5</sup>. The CDT research indicates that around one-third of EV adopters/potential adopters would value benefits such as special/preferred access to carpool/high occupancy vehicle lanes and parking spaces, a desire that is addressed to policymakers and the public sector. Service providers can facilitate convenient operation with improvements to charging infrastructure. Utilities can educate consumers regarding setup and offer tariffs designed for EV users.

A members-only full report with additional findings and details for the Consumer Driven Technologies study is available for download on our website at [www.SmartGridCC.org](http://www.SmartGridCC.org). This report provides insights on consumer adoption of solar PV and EVs for a wide variety of stakeholders including policy makers, technology vendors, utilities and consumer organizations.

<sup>2</sup> <http://www.seia.org/sites/default/files/Tracking%20the%20Sun%20VIII.pdf> Source: Lawrence Berkeley National Laboratories

<sup>3</sup> <https://about.bnef.com/press-releases/wind-solar-boost-cost-competitiveness-versus-fossil-fuels/> Source: Bloomberg New Energy Finance

<sup>4</sup> [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_5\\_6\\_a](https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a) Source: U.S. Energy Information Administration

<sup>5</sup> <http://www.goldmansachs.com/our-thinking/pages/macroeconomic-insights-folder/what-if-i-told-you/report.pdf> Source: Goldman Sachs Research

## 2 BACKGROUND

SGCC commissioned the Consumer Driven Technologies (CDT) study to help its members understand consumer awareness of and willingness to adopt solar photovoltaic (PV) and electric vehicle (EV) technologies, investigate the prevalence, if any, of co-adoption and to characterize what consumers see as the primary barriers to adoption. The survey sought to understand consumer experiences and attitudes towards solar PV and EV technologies in two types of policy environments: states with net-metering and interconnection policies favorable to the adoption of such technologies and those with less favorable policies.

### The Research Approach

The CDT research was conducted as an online survey with 1,571 respondents from across the nation. To increase resolution on current solar PV and EV adopters, these adopters were oversampled because a truly random sample would yield samples that are too small for making inferences regarding these groups. Statistical weighting techniques were used to balance the sample to reflect the overall US population based on a range of socio-demographic characteristics. A detailed explanation of the sampling and weighting approach is provided in Appendix A. The sample size of this study satisfies overall confidence and precision of 95%  $\pm$  2.5%, and minimum of 95%  $\pm$  10% within each of the segments and state groups.

The topics explored consumer adoption of four distinct technologies and services: residential solar, community solar, green power plans that include utility solar and electric vehicles.

The survey collected information on the following topics:

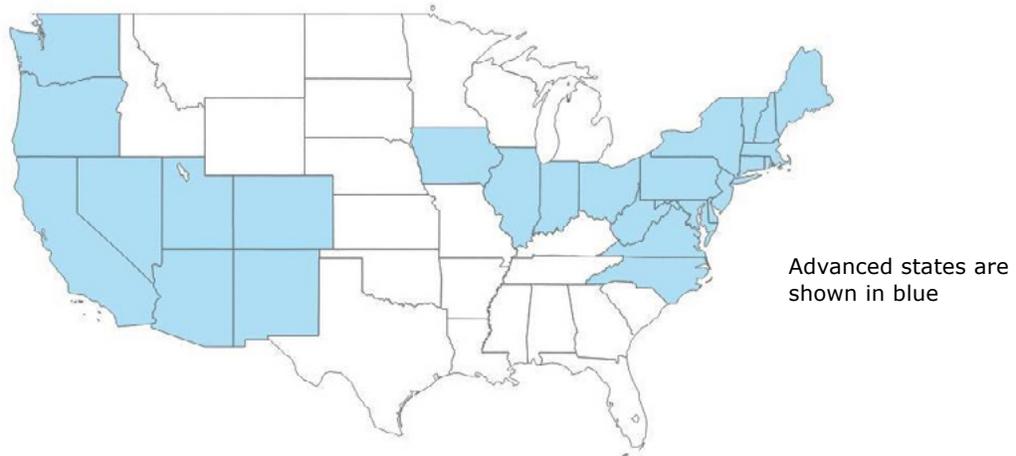
- Awareness of the technology/service
- Perception of technology performance – adopters only
- Interest in adopting the technology/service – non-adopters
- Importance of various benefits when considering adoption of the technology/service
- Level of agreement with perceived barriers/misconceptions for each technology/service
- Preferred entity to provide ancillary services related to the technology
- Most preferred type of solar among residential, community and green power plans
- Value ascribed to grid services in this technology/service market

The CDT study was structured to detect the potential effects, if any, of the policy environment on consumer awareness of and interest in PV and EV technologies. To assess the favorability of states' policy environments for consumers, we used an annual state-by-state report card, *Freeing the Grid 2015* generated by the Interstate Renewable Energy Council (IREC) and Vote Solar<sup>6</sup>. This report card assigns states a letter grade both for interconnection and net metering policies with respect to distributed generation such as solar. Net metering rules and interconnection policies that more effectively smooth the road to allow energy consumers to generate their own electricity earn states a higher grade. Using the report card, we partitioned states into two groups – the “advanced” states comprising those receiving a relatively higher grade and the remainder comprising states that received a relatively lower grade. The advanced states are highlighted in blue in the map below<sup>7</sup>. (*Figure 2*)

<sup>6</sup> <http://www.irecusa.org/2016/01/irec-and-vote-solar-release-2015-freeing-the-grid/>

<sup>7</sup> Appendix B lists the states that are included in each group.

**Figure 2: State classification by net metering and interconnection policies**



CDT also examined consumers’ responses within a framework of five previously-determined SGCC segments: Green Champions, Savings Seekers, Status Quo, Technology Cautious and Movers & Shakers. As shown in Table 1, and previously described in SGCC’s Consumer Pulse and Market Segmentation Wave 5 Study<sup>8</sup>, these segments exhibit distinct levels of awareness, interest and values around solar and EV technologies that prove true to type.

**Table 1: Characteristics of SGCC segments**

SEGMENTS	PERSPECTIVES	KEY DEMOGRAPHICS	AWARENESS AND INTEREST IN SOLAR/EV
<b>Green Champions</b>	<i>“Smart energy technologies fit our environmentally aware, high-tech lifestyle.”</i>	Youngest, more likely to be college-educated	Relatively highest levels of awareness and interest in all types of solar and EV, nearly four times the interest level of Status Quo
<b>Savings Seekers</b>	<i>“How can smart energy programs help us save money?”</i>	Younger, more likely to be college-educated	Lower levels of awareness and interest in all types of solar and EV
<b>Status Quo</b>	<i>“We’re okay; you can leave us alone.”</i>	More likely middle age, lower income renters, living in non-single family dwellings, less likely to be educated	Relatively lowest level of awareness and interest in all types of solar and EV
<b>Technology Cautious</b>	<i>“We want to use energy wisely, but we don’t see how technologies can help.”</i>	More likely homeowners who are older in age, less likely to be college-educated	Marginally higher than Savings Seekers on awareness and moderate interest in solar and EV
<b>Movers &amp; Shakers</b>	<i>“Impress us with smart energy technology and maybe we will start to like the utility more.”</i>	More likely middle age, higher income, single-family homeowners, college-educated	High levels of awareness comparable to Green Champions on average, but moderate interest levels in solar and EV

<sup>8</sup> <http://smartgridcc.org/research/sgcc-research/sgccs-wave-5-consumer-pulse-and-market-segmentation-study-summary/>

The CDT study provides original and actionable insights for interested stakeholders to engage consumers in solar and EV services and technologies. This study will also be beneficial to organizations working to adapt existing business models to accommodate consumer-driven technologies. These insights are summarized as follows:

- **Demographics and segmentation drive interest in solar PV and EVs.** Consistent with previous research, we found that consumer demographics and segmentation had a much stronger statistical association with interest in solar PV and EVs than other potential influences such as the level of policy and program support available in the consumer's state. Homeownership, income and age have the strongest effect on level of consumer interest. Residence in a state with policies supportive of renewable energy and smart grid technologies had no consistent effect on consumers' interest in or self-assessed understanding of those technologies.
- **Barriers exist, but the market is moving towards reducing dominant consumer concerns.** Fewer than 22% of all consumers claim to have a fairly complete understanding of PV or EVs which is a barrier to engagement. The combination of lack of knowledge concerning technology benefits with perceptions of high initial cost constitutes the major barrier to adoption for the majority of consumers. Broader market trends towards alternative acquisition models and falling prices are helping to mitigate cost concerns.
- **There is growing consumer interest in alternative acquisition models** such as power purchase agreements (PPAs), shared ownership arrangements like community solar and leases for solar PV and EVs. This reflects broader market trends away from sole ownership and towards the burgeoning shared economy and "as-a-service" models - a promising market trend in an environment where initial adoption costs are a barrier.
- **Roughly one-half of consumers who have solar or EV technologies have both.** Similarly, consumers who are interested in one of those technologies have interest in the other. This finding has implications for utility planners looking to forecast load as adoption of these technologies ramps up. It also points to opportunities for targeted marketing and service bundling for companies who offer those technologies.
- **When using solar, consumers are interested in connecting to the grid as a source of backup power and are willing to pay for it.** This finding suggests that there is potential to offer backup power services for a fee.
- **Utilities have a role as an information provider and market booster, but less so as a provider of ancillary services for solar PV and EVs.** Consumers indicate that they seek to eliminate middlemen and streamline their transactions. When consumers are making purchases, 70% would prefer to deal directly with the supplier of solar PV and EVs for services such as technical advice, installation and hardware.



## **Working for a consumer-friendly, consumer-safe smart grid**

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