Distributed Energy Resources:
MEETING CONSUMER NEEDS

SMART ENERGY
CONSUMER COLLABORATIVE

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SMART ENERGY CONSUMER COLLABORATIVE

Working for consumer-friendly, consumer-safe smart energy

SECC's mission is to serve as a trusted source of information on consumer's views of grid modernization, energy delivery and usage, and to help consumers understand the benefits of smart energy.

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Introduction

Throughout the Smart Energy Consumer Collaborative's (SECC) research of consumer attitudes and behaviors around smart energy and energy efficiency, consumers consistently rank saving money, preventing or reducing the length of outages, and making it easier to connect renewable energy to the grid as the three most important benefits of grid modernization. As energy technologies continue to mature, consumers have new choices that enable them to take advantage of these benefits.

At the same time, electricity providers are leveraging digital technologies to address these key interests of cost reduction, reliability and new sources of clean energy. And as costs continue to decline, consumer-driven, clean energy technologies, such as rooftop solar, battery storage and electric vehicles, continue to grow.

These smaller, more localized sources of energy — known as distributed energy resources or DERs — are becoming mainstream alternatives for consumers, businesses and providers. With these newer capabilities come questions about how DERs should be procured and integrated into energy service models that benefit consumers. In this *Distributed Energy Resources: Meeting Consumer Needs* research, we specifically sought to answer:

- What do consumers know about various DER technologies and programs?
- What benefits do consumers expect from DERs and what barriers hinder adoption?
- How would consumers like DER technologies and programs to be delivered and what are the expectations around this delivery?
- Finally, what attitudes, behaviors, processes and policies are shaping the adoption of these technologies?

The goal of this research is to provide deep insights to energy industry stakeholders regarding consumer knowledge, motivations, barriers and experiences with DER technologies and programs. At the end of the day, industry stakeholders must understand the role consumers expect them to play in developing and deploying DERs to remain successful in the smart energy future.

Background & Methodology

As the need to move away from traditional energy sources and strengthen the grid intensifies, distributed energy resources, or DERs, are quickly becoming part of the solution. The Smart Energy Consumer Collaborative (SECC) has completed in-depth consumer research to provide the industry clarity on awareness, familiarity and engagement with DERs today. This research is important as DERs are becoming increasingly leveraged by utilities, "92% of electric utilities say they have DERs on their system, up from 80% three years ago."[1] However, many utilities are not effectively addressing the opportunity, as 60% have no specific management services for DERs. The following research report provides direction to DER providers by shedding light upon the services and support consumers desire.

Defining DERs

DERs are defined herein as any resource on the distribution system that produces electricity and is not otherwise included in the bulk electric system.[2] As such, DERs include, but are not limited to, customer-sited energy resources. Demand-side management, including demand response programs and home energy management systems, can also be considered a distributed energy resource and is for the purpose of this report. Although these systems are not producing energy, they are managing resources in the distribution system. Enabling customers to take part in managing their own electricity in the distribution system empowers them — allowing them to influence their electricity rates and service reliability. Delivering a customer-centric approach is important for increasing DER adoption and the future of DERs.

In the research that follows, DERs were introduced in the survey to consumers as:

- Solar panel(s) on a home or property
- Small wind turbines on a home
- A home energy management system
- Demand response programs (e.g., allows an electricity provider to adjust appliances during peak periods)
- Battery storage (e.g., Tesla Powerwall, Sonnen eco, LG Chem RESU)
- Community microgrids (e.g., a small community-based electric grid where some houses may have some renewable sources that can supply their demand as well as that of their neighbors within)
- Community solar panels (e.g., not on a home but within a neighborhood)
- Small wind turbines in a community (e.g., not on a home or property but within a neighborhood)
- Energy storage in a community (e.g., batteries, flywheels, fuel cells)

Methodology

The findings presented in this report are a blend of qualitative research via in-depth interviews conducted with consumers and a large-scale quantitative consumer survey. The qualitative research leverages seven in-depth interviews among those consumers who have DERs. A quantitative survey of n=1,500 U.S. consumers was fielded online between September 4 and 11, 2019. Field work also included an oversample of those who ever had one or more DER technologies. The sample size of consumers with DERs (including oversample) is n=613. The study also includes a separate sample of n=543 Canadian consumers.

Both the U.S. and Canadian general population data sets are weighted to age, gender, region and education within each country. Data for the U.S. general population is also weighted to the consumer segments from SECC's *Consumer Pulse and Market Segmentation – Wave 7* report.

[1] "PLANNING FOR A DISTRIBUTED ENERGY FUTURE." West Monroe Partners. 2019. Accessed November 5, 2019. https://www.westmonroepartners.com/Insights/White-Papers/Planning-for-a-Distributed-Energy-Future

[2] "Distributed Energy Resources: Connection Modeling and Reliability Considerations." NERC. February 2017. Accessed October 2019. https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/Distributed_Energy_Resources_Report.pdf

Overlaying the SECC segmentation

The *Consumer Pulse and Market Segmentation – Wave 7* report released in 2019 updated SECC's segmentation for the first time since 2016. The results in this report are viewed through the lens of this new segmentation framework to understand DER preferences and provide actionable insights among consumers with similar attitudes and behaviors. These segments exist on a continuum of interest, engagement, action and attitudes.[3] *(Figure 1)*

Figure 1. The Segment Favorability Continuum

Delving a little deeper into each segment, the following represents their perspectives and proportions within the general population. *(Table 1)*

Table 1. Segmentation Overview

SEGMENT NAME	PERSPECTIVE ON ENERGY	IMPORTANCE OF ENERGY EFFICIENCY IN THE HOME	PROPORTION OF CONSUMER MARKET
Green Innovators	Strongly value sustainability and lead the way in saving energy with technology.	High	20%
Tech-savvy Proteges	Receptive to changing energy habits and using technology to do so, but need to be shown how to do it without sacrificing comfort.	Med/High	25%
Movable Middle	Not complete rejectors of saving energy and face few barriers; lack interest in technology.	Med	29%
Energy Indifferent	Rejectors of environmental concern and saving energy; keep their energy needs simple and want to be left alone.	Low	26%

[3] The full study is available to SECC members at www.smartenergycc.org/research.

Top 5 Findings

Throughout the course of this research, several key themes around consumer expectations for DERs emerged. These are summarized briefly below, woven throughout the report and then explored in-depth in the Final Recommendations section starting on page 37.

1. **To grow awareness of DERs, providers must build a bridge between technologies, people and possibilities.** Answering the unknowns can break down barriers to DER adoption. Consumers want to know upfront exactly how much money and electricity they will save. They also need clarity on how to maintain or fix equipment. As they become more serious about purchasing, consumers will think about rebates and/or incentives that are available. The onus of searching for these answers and receiving no support from providers constitutes a burden which gives consumers incentive to delay or reject moving forward.

2. **Green Innovators and Tech-savvy Proteges are the most opportunistic customer segments for both current and prospective DER engagement.** These consumers are technologically apt and energy conscious, which makes them a great fit for many distributed energy programs and services. These segments outperform demographic indicators, such as age, region, income and household profile, which makes them worth identifying in an outreach strategy.

3. **Consumers expect electricity providers to be involved in their DER journey.** Whether it is as a provider or a trusted advisor giving recommendations, they want their electricity provider at the forefront.

4. **When experiences and expectations do not match, consumers cancel their DER programs.** Consumers expect to save money and electricity. They expect their investments in DERs to pay off and incentives to continue. If this does not happen, consumers choose to leave DER services and programs.

5. **Many takeaways from the U.S. market can be applied to Canada.** Key customer profiles, motivations and barriers in Canada are similar to the U.S. market. Strategies employed to bolster DER adoption for American consumers can also be applied to Canadian consumers.

Figure 2. Profile of Americans Aware of the Term 'DER'

	Total	Age			Education			Income			Gender		Segment			
		18-34 (A)	35-54 (B)	55+ (C)	HS or less (M)	College/ Assoc. (N)	University+ (O)	<$50K (P)	$50-$99K (Q)	$100K+ (R)	Male (E)	Female (F)	Energy Indifferent (Z)	Green Innovator (a)	Movable Middle (b)	Tech Proteges (c)
27% Aware	37%	28%	19%	23%	24%	35%	22%	26%	44%	35%	20%	19%	34%	19%	40%	
		CD	D				MN			PQ	F			Zb		Zb
9% Familiar	16%	10%	4%		7%	13%	6%	8%	24%	14%	5%	4%	11%	5%	20%	
		CD	D				MN			PQ	F			Zb		Zab
3% Very Familiar	8%	2%	1%	3%	1%	6%	1%	3%	12%	6%	1%	1%	3%	–	10%	
		CD	D				N		P	PQ	F			Zb		Zab

Consumers and DERs at a Macro Level

What consumers know about DERs

At the outset of the survey, we asked consumers about their knowledge of the term "distributed energy resources" and found that the vast majority were unfamiliar, which is unsurprising given its technical nature. Consumers were then provided a definition and surveyed about their views and interests related to the concept. The quantitative survey presented the following definition:

> ***Customers with renewables such as solar systems or wind turbines installed on-site can produce the energy they need for their homes. If these systems produce more energy than needed, customers can purchase/install battery storage devices and store the excess energy which can be used at another time when they need it, or they can sell the excess energy to their energy provider.***
>
> ***When energy providers need to reduce consumption/demand during peak times to reduce costs/achieve environmental/carbon reduction goals, they can call on customers like you to participate in Demand Response programs that aim to shift/reduce energy use during certain hours of the day/days of the year. For example, if you own an electric vehicle, your energy provider may provide incentives/lower rates for you to charge your electric vehicle at night.***
>
> ***These technologies and services are collectively referred to as Distributed Energy Resources (DERs) as they are changing the way power is generated and transmitted. The benefits include cost savings and more control by customers like you of their own power, increased reliability from backup power sources and storage capability in the case of a power outage on the grid, and a reduction in emissions in the move away from fossil fuel-generated power.***

Fewer than one-in-ten (9%) consumers are familiar with the term, and when these consumers were asked to explain DERs in their own words, they responded most often in a localized and residential context.

Consumers who are familiar with the term DER were asked, "In your own words, what are distributed energy resources?"

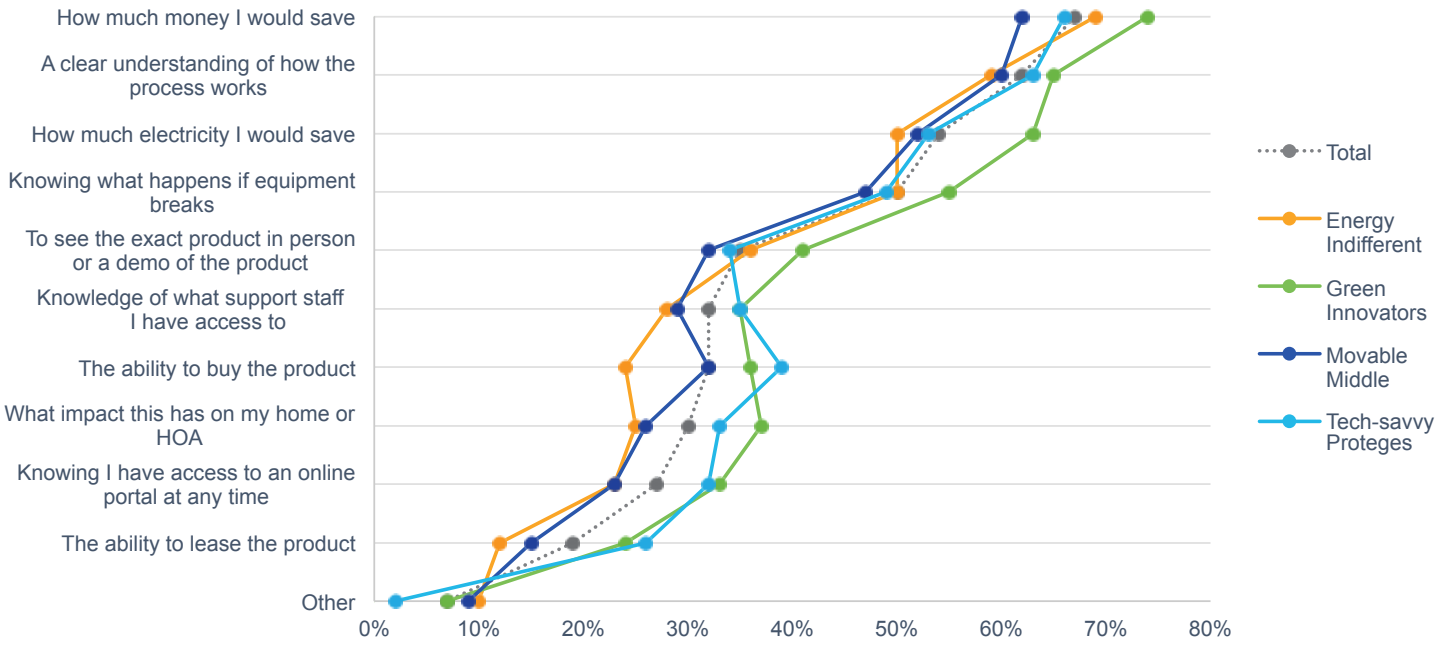
1. "Basically, it consists of the generation of electric energy through small resources near to the user."
   — Consumer who is "very familiar" with DERs
2. "On your property grid-connected generator."
   — Consumer who is "very familiar" with DERs
3. "Where a homeowner who has an electrical generating source can tie into a distribution system and be reimbursed for the power connected to a local distribution system."
   — Consumer who is "very familiar" with DERs

Needs from DERs at a macro level

After grounding respondents with an accurate understanding of DERs, the survey asked respondents about their attitudes and expectations of benefits from DERs. Generally, consumers desire information about the savings from DERs. From a segment perspective, Green Innovators want more information overall: Understanding how much electricity is saved is particularly important for Green Innovators (63%) compared to the national average (54%). This makes sense given the relatively higher importance this segment places on the environment. *(Figure 3)*

Overall, consumers crave information about the savings from DERs — both monetary and usage-related — in order to feel comfortable adopting DERs.

Figure 3. Information Needed to Adopt DERs by Segment



A recurring theme from this research — as well as past SECC research — is that consumers want their information needs to be met by their electricity providers. In the case of DERs, both the in-depth qualitative interviews and the quantitative survey had the same result: consumers want information. Consumers responding to the quantitative survey expect to have this information come from their current electricity provider.

Although in general consumers prefer to receive general information on DERs from their utility, when exploring any particular DER, these individuals reached out to family and friends who had experience with the program or services to explain the process in-depth. Their questions include: What is the full process of getting the system up and running? What are the system's limitations? What happens if something breaks, etc.?

Throughout the process of purchasing or adopting a DER, family and friends were trusted advisors making recommendations.

"Someone my husband worked with found out about the rebate and had them installed. He got a $200 referral for doing it. And we went ahead and got about it. Her and her husband have referred 4 or 5 people now."

— Solar Adopter, Qualitative Interview

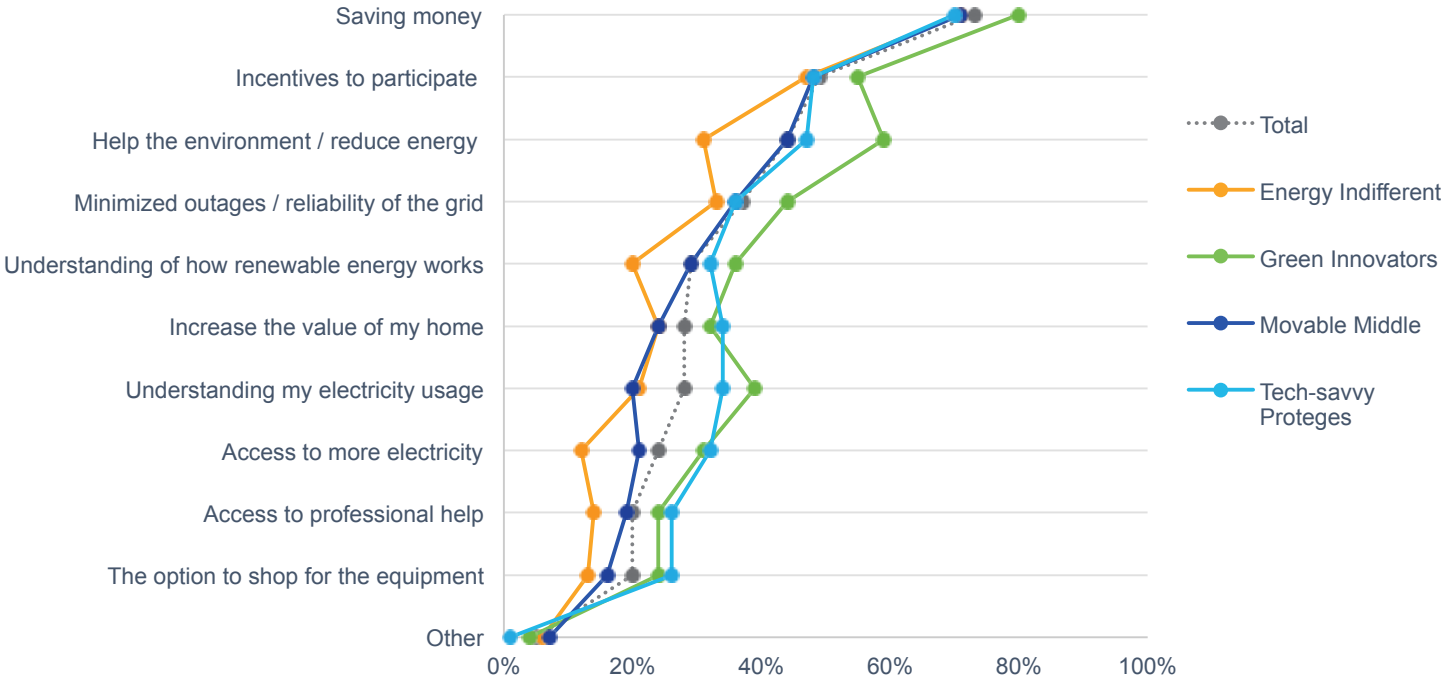
"My son-in-law is knowledgeable about this type of stuff, he helps us on what to do and how to think about it."

— Solar Adopter, Qualitative Interview

Expected benefits and providers

Shifting from information needs to expected benefits, saving money continues to be important for consumers. Three-quarters (73%) expect to save money and half (49%) expect incentives upfront to participate. The benefit of helping the environment follows closely at 44%. While saving money continues to be a top expectation for Green Innovators, helping the environment has a higher beneficial importance than upfront incentives. Similar to information needs, Green Innovators over-index on most of the expected benefits. This suggests that positioning the benefits of a DER program to this segment requires increased emphasis on saving money, saving the grid and/or improving the environment. *(Figure 4)*

Figure 4. Benefits Expected of DERs by Segment



SMUD'S ROOFTOP SOLAR EDUCATION

The need for clean messaging for a DER program is exemplified by the Sacramento Municipal Utility District (SMUD). SMUD customers are given tools online to determine the cost-benefit of installing solar in their home. If it makes sense for a customer to invest, an application is submitted to the utility. During this time, the customer must identify a contractor within the community who will obtain the required permits, install the system and inspect it. SMUD then follows up with a final check of this DER system. Along the way, SMUD customers received information in a robust manner that includes multiple resources, including FAQs, videos and easy-to-access information, in order to ensure a seamless onboarding process.

Overall, there is clear consensus among consumers about who they want to provide DER services — their current electricity provider. More than two-thirds (69%) want them as the provider compared to less than half (45%) for private contractors. However, Tech-savvy Proteges, and to some extent Green Innovators, are more comfortable with a private provider. Over half (54%) of Tech-savvy Proteges and almost half (48%) of Green Innovators are open to a private provider.

We know from *Consumer Pulse and Market Segmentation – Wave 7* that Tech-savvy Proteges are more willing than others to share their energy data with third-party providers and other energy companies. They trust their provider to keep their data safe. However, this trust comes along with skepticism, and therefore, it is important to instill confidence in the security and privacy throughout the installation of any DER service. One reason for this openness is also that these two segments have more volatile rate structures (i.e., critical peak pricing and time-of-use). Therefore, they recognize the tradeoff between changing behavior and saving money.

Tech-savvy Proteges and Green Innovators are the most open to utilizing a private provider, as only two-in-five Movable Middle (39%) and Energy Indifferent (41%) are similarly receptive. Moreover, those who have experience with DERs are much more open to private providers (57%) than those who lack experience (41%). This is likely due to having more knowledge and confidence about DER installations overall.

Half (51%) of consumers who do not want a private provider feel it would be a deal breaker if forced to utilize one. This is primarily due to not knowing what quality of work (21%) the private contractor would provide and not trusting their service (14%). The inconvenience of dealing with an additional vendor (13%) and lack of information (14%) are also factors.

Even those who do not prefer having their electricity provider offer DERs are still open to having them involved. Half (52%) want a vetted list of preferred contractors or ratings/reviews of contractors (48%) from their electricity provider. This is likely due to an established line of trust and accountability attributable to their electricity provider. Consumers also want to offload some of the burden of dealing with a private contractor. About two-in-five (39%) want their electricity provider to communicate with the contractor. This removes the additional need to coordinate with another vendor.

A Deep Dive into Awareness and Participation

What's popular?

Consumers report that home solar, demand response and home energy management systems are their preferred types of DERs with the highest awareness and participation rates. While these top DERs are paving the way, the path consumers take to adoption differs between them.

Besides surveying popularity with different DERs, we asked consumers who already have a DER how willing they would be to sign up for a program that allowed their utility to make adjustments to save energy in their home in exchange for incentives. Almost every program received double digit levels of interest, with adjusting EV charging hours exceeding 50% of consumer interest and several others exceeding 40% interest (*Table 2*).

Table 2. Participation in Energy Savings Programs by DER Technology

How likely are you to sign up for a program that would allow your electricity provider to make the following adjustments to save energy, provided that you received a small discount or a cash incentive? You would have the option to override any adjustments if you choose. Summary of Already BASE: Those Answering

	SOLAR	HOME ENERGY MANAGEMENT	SMALL WIND TURBINES	DEMAND RESPONSE	BATTERY STORAGE
	Currently Have	Currently Have	Currently Have	Currently Have	Currently Have
Adjusting air conditioning (by no more than a couple of degrees and usually for no more than a few hours)	21%	29%	37%	34%	32%
Adjusting heating (by no more than a couple of degrees and usually for no more than a few hours)	30%	32%	41%	30%	30%
Adjusting lighting	20%	25%	36%	25%	29%
Charging a lower rate during off-peak times (along with a higher rate during peak times)	6%	18%	20%	20%	10%
Charging a higher rate during the peak times (along with a lower rate during off-peak times)	26%	30%	44%	33%	39%
Allowing your provider to briefly interrupt your power off (for example, 15 minutes or so)	18%	28%	47%	22%	35%
Adjusting hot water heaters	23%	31%	51%	26%	42%
Adjusting your EV charging hours	48%	40%	61%	48%	55%

Note: Green highlighting represents the top three adjustments by current DER participation

In this section, we unpack each type of DER as a deep dive into awareness and participation.

Demand response

AWARENESS

When asked if they are aware of the concept of demand response, just over half (53%) of consumers say they are aware. Demand response may include specific events, such as a "conservation event" or "peak demand event". SECC segmentation is a strong indicator of awareness of demand response programs. Six-in-ten Tech-savvy Proteges (60%) and Green Innovators (57%) are aware of demand response. This decreases to 48% for the Energy Indifferent and Movable Middle. The Green Innovators and Tech-savvy Proteges tend to be more socially conscious, and those always thinking about social responsibility (63%) tend to be more aware than the national average (53%). Income is also a good predictor of awareness, with 67% of those with a household income of $100k+ indicating awareness.

Purchase or participation in any DER is niche. However, demand response is the most widely adopted, with 8% currently enrolled and 4% lapsed enrollees for a total of only 12% who have engaged with this program. The source of consumers' awareness of demand response is unique compared to other DERs. The electricity provider plays a strong and central role as a source of information (36%). The source of awareness is also unique in that news sources/articles play a smaller role compared to other DERs (24% compared to, for example, 43% for solar).

BARRIERS TO PARTICIPATION

Consumers who are aware of DERs but have not participated in demand response find themselves second-guessing whether or not the estimated savings will come to fruition (27%) and whether any net savings will occur at all (18%). This is consistent across all groups. However, skepticism of a net savings is what prevents over one-quarter (27%) of Energy Indifferent consumers from adopting demand response. In addition, 35% of consumers in this segment don't trust the estimated savings. The Movable Middle are less skeptical with 14% thinking it will not result in a net savings and 27% not trusting estimated savings.

Table 3. Barriers to Demand Response by Age

You previously said you were aware of these products and services but have not participated. Why is that? **Demand response programs** (e.g., allow your electricity provider to make adjustments to your appliances during peak periods)		AGE		
	TOTAL	18-34	35-54	55+
BASE: 'AWARE OF But NOT HAVE' Anything FROM Q_BEHAVIOR OR Q_ACCESS	612	100	181	331
BASE: WEIGHTED	606	162	188	256
I do not want to spend money upfront/could not find a lease option	7%	10%	7%	5%
I do not think it will result in net savings for my investment	18%	13%	15%	22%
It would take too long for this investment to payback	6%	5%	5%	8%
Environmental benefits are not a priority	2%	0%	0%	5%
I am not sure who to contact	8%	10%	11%	4%
The process is too long/complicated	7%	13%	6%	4%
My community does not have access to this	10%	8%	15%	9%
I am concerned about the impact of aesthetics/resale value of my home	2%	4%	1%	1%
My homeowner association (HOA) does not allow it/too many hurdles with my HOA	3%	1%	1%	5%
I am worried about equipment breaking down and maintenance	3%	0%	2%	5%
I don't know what the payback period is for my investment	10%	8%	12%	11%
I don't trust that the estimated savings are going to save me money	27%	29%	24%	29%
Other	19%	15%	22%	20%

Note: Green highlighting represents top three barriers by column excluding 'Other'

PROFILING CURRENT PARTICIPANTS

The top demographic and segment indicators of those actively participating in demand response are:

- Income $100k+ (23%)
- Critical peak or TOU rate structure (22% and 14%, respectively)
- Tech-savvy Protege or Green Innovator (16% and 14%, respectively)
- Kids in the home (16%)
- 18–34 years of age (14%)
- A university+ education (13%)

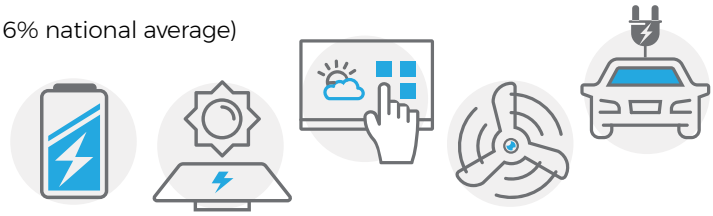
Those with demand response are significantly more likely to be from the South, which may be due to hotter temperatures during peak hours and, hence, the greater need for demand response programs. They are also more likely to be employed full time (72% vs 43% national average). When it comes to selling energy back to a provider, one-in-five (22%) are doing so (compared to the national average of 5%).

DER STACKING

Consumers with demand response are significantly more likely to own a hybrid EV (25%), plug-in EV (26%) and/or battery EV (18%) compared to the national average (7%, 3% and 3%, respectively). As expected, average monthly electricity bills are higher due to their vehicle fuel costs being integrated with their residential electricity costs ($221 vs $142).

Among consumers who participate in demand response, the adoption rates of other DERs are as follows:

- Home energy management system (42% currently have vs. 6% national average)
- Battery storage (23% currently have vs 3% national average)
- Home solar (24% currently have vs 6% national average)
- Small wind turbines (18% vs 2% national average)



THE PATH TO DER ENGAGEMENT

Demand response participants most often hear about this DER from their electricity provider (55%). Internet searches and news sources play a secondary role in delivering information (23% and 22%, respectively). Companies that deliver this service were mentioned as a source by one-in-five (21%).

When consumers contact someone about signing up for demand response, most often it is the electricity provider (77%). This is distantly followed by a private contractor partnered with the electricity provider (14%). Participation in demand response is relatively recent, with 65% of consumers signing up in either 2018 or 2019. Only 23% enrolled prior to 2015.

Among those who have enrolled in demand response, the top benefits for DERs are to save money on their bill (78%), to help the environment (54%) and to minimize outages (37%).

EXPECTATIONS VS REALITY AMONG CURRENT PARTICIPANTS

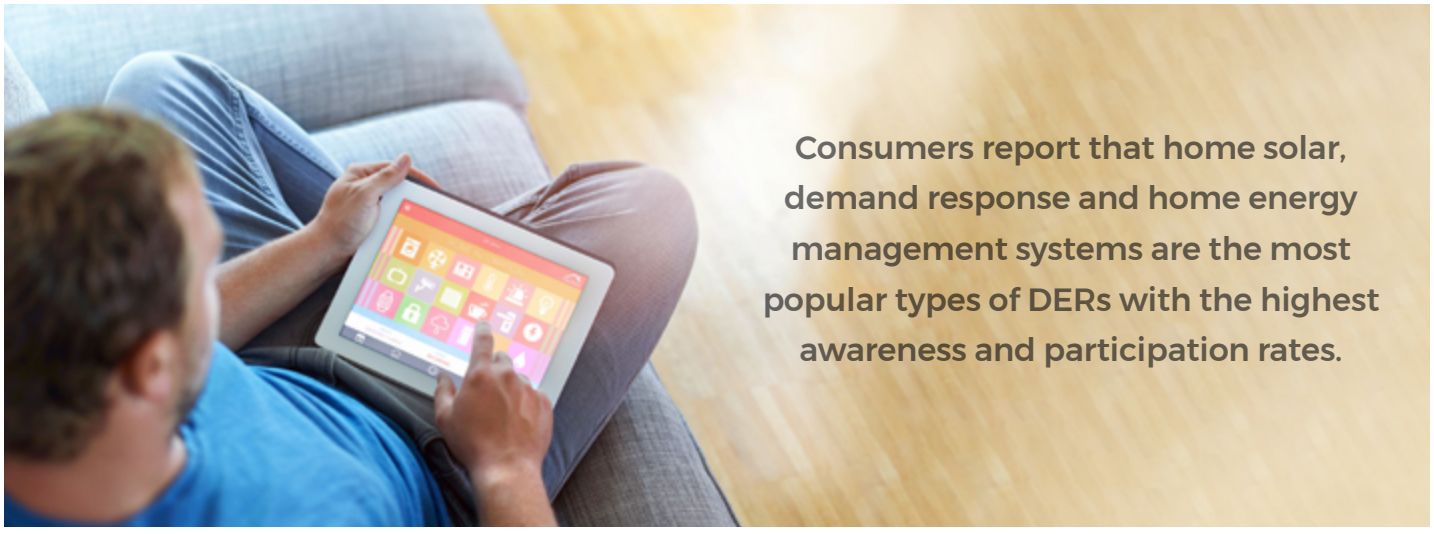
Those participating in demand response are somewhat satisfied. Four-in-ten consumers (42%) feel it is working out "very well" with half indicating "well" (49%). One-in-ten (9%) rate this DER program as "poor" or "very poor".

In the previous section, we looked at demand response participants' perceived benefits towards DERs broadly. Here we recap actual benefits that have been experienced in the context of this technology. *(Table 3.1)*

Table 3.1. Benefits from Using Demand Response

What benefits have you personally experienced from using these products and services? **Demand response programs** (e.g., allow your electricity provider to make adjustments to your appliances during peak periods	
Saving money	61%
Help the environment and/or reduce energy consumption	34%
A better understanding of my electricity usage	29%
Minimized outages and improved reliability of the grid	23%
Increased satisfaction with my electricity provider	21%
A better understanding of how renewable energy works	17%
Being on the cutting edge of technology	17%
Increase in the resale value of my home	13%
Access to more electricity	12%
Other	3%

While satisfaction with demand response is positive overall, we also captured limitations or desired expanded features. The top mentioned limitation of demand response is that it won't operate air conditioning/heating properly during peak times and/or takes long to cool/heat the house (17%). Feedback from lapsed demand response participants reveals that either moving or ineligibility were reasons for the lapse.



Home solar

AWARENESS

Solar installed on the home or property (almost always on the rooftop) has the highest awareness across all DERs, with more than eight-in-ten (84%) stating they are aware. However, a high level of awareness doesn't mean high adoption, as only 9% have purchased or participated in home solar. Adoption rates are higher among Tech-savvy Proteges, 17% currently or used to have it, which is likely due to their affinity for new technologies and their higher-than-average concern for the environment.

Solar awareness hovers between 80% and 90%. Not only is awareness very high, it is consistently at this level across many segments: age, gender, region, income and SECC segment. *(Table 4)*

Diving deeper into where consumers have heard information about solar, it's primarily from news sources and/or articles (43%). Family and friends are also an important resource (27%). Information from "a company who provides these products/services" and internet sources are both worth noting as well (22% and 21%, respectively).

Table 4. Awareness of Home Solar

		AGE			GENDER		US REGIONS				INCOME			CONSUMER SEGMENT			
	Total	18-34	35-54	55+	Male	Female	West	South	Midwest	Northeast	<$50K	$50-$99K	$100K+	Energy Indifferent	Green Innovators	Movable Middle	Tech-savvy Proteges
	1500	316	481	703	731	769	352	566	302	280	625	549	257	295	340	335	530
Solar panel(s) on your home or property	84%	85%	81%	85%	86%	82%	86%	83%	85%	82%	81%	87%	85%	85%	84%	85%	82%

Solar installed on the home or property has the highest awareness across all DERs, with more than eight-in-ten (84%) stating they are aware.

BARRIERS TO PARTICIPATION

The top barrier overall for home solar is the payback period being too long; 19% of consumers mention this. Other financial barriers closely follow payback period, including not wanting to spend money upfront/could not find a lease option (17%), not trusting the estimated savings will yield actual savings (15%) and not thinking solar will result in net savings (13%). These findings reveal that while the financial aspect is critical, there are nuances relating to trust and financing to consider. The Energy Indifferent continue to be the most skeptical of the monetary benefit, as 22% don't trust the estimated savings and 19% don't think it will result in a net savings. This segment is particularly lower income and sensitive to monetary impacts rather than environmental impacts. In contrast, those who always think about environmental impacts are less likely to be concerned about the net savings (12%).

Across all key demographics and segments, age is where barriers differ the most. For millennials (18-34 years of age), wanting to avoid upfront costs is the largest barrier (20%). The payback period taking too long follows at 13%. These findings make sense as young people will generally have less capital to invest. However, young people are unique as their uncertainty about who to contact (13%) and the absence of solar in the community (14%) are near the top of the barriers list. This speaks to young people placing importance on information being pushed to them (rather than pulled), as well as DERs being viewed as a collective responsibility. It also points to a broader need for expertise in messaging as the key to engaging young people.

Barriers among Gen Xers (35-54 years of age) more closely resemble those of millennials rather than Boomers (55+). This includes concern about upfront investments (18%) and the length of the payback period (15%). However, this age cohort is unique in perceiving uncertainty about the payback period as a top-three barrier (13%). Among those who indicated "Other", not owning the property and not having the money were by far the most common mentions. Taken together, this suggests a need for a pragmatic messaging approach, providing clear, credible information about financing options and the return on investment.

For Boomers, barriers are unique compared to their younger counterparts. A feeling that the payback period is too long rises to the top with 26% of mentions. This may be related to planning ahead for retirement and the potential for downsizing. There is also a large trust gap that estimated savings will save money (23%). This is related to the third-largest barrier, which is doubt that solar will result in net savings for the investment (17%). Among those who selected "Other", recently moving from or to a new property was commonly mentioned. *(Table 5)*

Table 5. Barriers to Adopting Home Solar

You previously said you were aware of these products and services but have not participated. Why is that? **Solar panel(s) on your home or property**		AGE		
	TOTAL	18-34	35-54	55+
BASE: Aware of home solar but do not have	1118	219	341	558
It would take too long for this investment to payback	19%	13%	15%	26%
I do not want to spend money upfront/could not find a lease option	17%	20%	18%	15%
I don't trust that the estimated savings are going to save me money	15%	12%	10%	23%
I do not think it will result in net savings for my investment	13%	10%	11%	17%
I don't know what the payback period is for my investment	13%	12%	13%	13%
I am worried about equipment breaking down and maintenance	11%	12%	11%	9%
My community does not have access to this	10%	14%	8%	8%
I am not sure who to contact	9%	13%	11%	4%
The process is too long/complicated	8%	12%	6%	5%
My homeowner association (HOA) does not allow it/too many hurdles with my HOA	8%	6%	6%	12%
I am concerned about the impact of aesthetics/resale value of my home	7%	5%	9%	8%
Environmental benefits are not a priority	2%	2%	2%	2%
Other	18%	15%	25%	15%

Note: Green highlighting represents top three barriers by column excluding 'Other'

PROFILING CURRENT PARTICIPANTS

Among the 9% who have ever purchased/participated in solar, 6% of U.S. consumers are active with the remaining 3% being lapsed. The primary reason why consumers no longer use home solar is due to moving. From a consumer who no longer uses home solar:[4]

"I sold the home that had the equipment. I am renting an apartment now."

The top demographic and segment indicators of currently having solar are:

- **Income $100k+ (14%)**
- **TOU rate structure (11%)**
- **Kids in the home (10%)**
- **Tech-savvy Proteges (9%)**

[4] Open end question from quantitative survey: Q_NoLonger. Why are you not currently using these products/services?

Solar consumers are conscious about the future and their community. Four-in-ten always think about social responsibility (42%) or future generations (40%).

Over eight-in-ten (82%) consumers who have purchased/participated in solar own their home. This is significantly higher than the national homeownership average (64.8%). These consumers are also more likely than the national average to live in a detached dwelling (85% vs 70%) and to be employed full time (69% vs 43%). They are also conscious about the future and their community. Four-in-ten always think about social responsibility (42%) or future generations (40%). This is at least 15 percentage points higher than the national average (22% and 25%, respectively). Current solar users are also less likely to fear replacement costs than home energy management system users when it comes to saving energy. Six-in-ten (62%) home energy management consumers very often have this fear compared to half (51%) of solar consumers. However, solar consumers are not as likely to participate in demand response programs as other DER technology adopters.

When it comes to selling energy back to a provider, four-in-ten (41%) who have purchased/participated in solar are doing so (compared to the national average of 5%).

DER STACKING

Consumers with solar are significantly more likely to own a hybrid EV (37%), plug-in EV (34%) and/or battery EV (25%) compared to the total sample of U.S. consumers (7%, 3% and 3%, respectively). In part because of high EV penetration, these consumers' monthly electricity bills are higher ($217 vs $142 national average). This is likely because the amount these consumers used to pay for their vehicles' gas has transferred into their electricity costs. Furthermore, those who have solar are much more likely to be on a TOU rate structure (40% vs 20%). Taken together, this tells us solar is a way to manage high electricity costs rather than to further reduce a "normal" residential electrical load.

Among those with solar, adoption of other DERs is much more common:

- Demand response (37% currently have vs 8% national average)
- A home energy management system (32% currently have vs. 6% national average)
- Battery storage (26% currently have vs 3% national average)
- Small wind turbines (23% currently have vs. 2% national average)

THE PATH TO PURCHASE AMONG CURRENT PARTICIPANTS

For solar consumers, hearing about it from a company that provides these services is the most common (39%). This is followed by news sources/articles (33%) and family/friends (31%).

When consumers contact someone to purchase/participate in solar, most often it's a private contractor selected by the consumer (35%). This is followed by a private contractor partnered with the electricity provider (29%) or an electricity provider (25%).

For six-in-ten (59%), solar was purchased in the past two years (2018 or 2019). One-in-five (19%) purchased prior to 2015. Among those who currently use solar, the top benefits for DERs (in broad terms) are to save money on their bill (78%), to help the environment (55%) and to improve the resale of the home (44%).

The role of incentives in solar DER purchases are vital. They are used by most consumers (82%), and 39% would not have participated without them. These incentives may include rebates or net metering (i.e., crediting home solar owners for the excess electricity they generate that is sent to the grid). *(Table 6)*

Table 6. Incentives Used for Home Solar

Did you use incentives to acquire/purchase/participate in any of the products or services below? **Solar panel(s) on your home or property**	
Yes, I used incentives and I would NOT purchase/participate without it	39%
Yes I used incentives but I WOULD purchase/participate without it	43%
No, I did not use incentives	18%

EXPECTATIONS VS. REALITY AMONG CURRENT PARTICIPANTS

Those who are invested in solar are satisfied. Half of consumers (50%) feel it is working out "very well", with a similar proportion (44%) indicating "well". Only 9% rate this DER technology as "poor" or "very poor".

In the previous section, we looked at solar consumers' perceived benefits towards DERs broadly. Here we recap actual benefits that consumers report in the context of rooftop solar. *(Table 7)*

Table 7. Incentives Used for Home Solar

What benefits have you personally experienced from using these products and services? **Solar panel(s) on your home or property**	
Saving money	56%
Help the environment and/or reduce energy consumption	44%
Increase in the resale value of my home	32%
A better understanding of my electricity usage	27%
Being on the cutting edge of technology	25%
Minimized outages and improved reliability of the grid	24%
Access to more electricity	23%
A better understanding of how renewable energy works	23%
Increased satisfaction with my electricity provider	18%
Other	2%

Although satisfaction with home solar is high overall, there are important limitations that consumers encounter. The most common mentions include:

- Batteries do not hold enough power for running a long time without sun/does not work on cloudy/rainy days (14%).
- It does not have beneficial value/didn't save money as claimed to do (9%).
- Wish it was more affordable (9%).
- Don't have any on-site storage/not able to run off the grid (9%).

Furthermore, feedback from lapsed rooftop solar participants provided one area for improvement. The top reason for no longer using this product/service is the expense/high cost of materials (23%). The next highest reason was moving (10%).

Home energy management systems

AWARENESS

Six-in-ten (59%) consumers are aware of home energy management systems; among those with critical peak pricing, awareness jumps to seven-in-ten (71%). *(Table 7.1)* It makes sense for this to be elevated for those with critical peak pricing given the opportunity to manage and save on energy via this technology. On a related note, of those with TOU rates, awareness is slightly above average at 61%. When observing differences by SECC consumer segment, Green Innovators (62%) and Tech-savvy Proteges (65%) also have an elevated awareness compared to the Energy Indifferent and Movable Middle (55% each).

Despite over half of consumers being aware of home energy management systems, purchase/participation is moderately low (6%). This rate may even be more diminished than consumer research indicates. It is possible that some mistakenly believe home energy management to be the same as simply owning a smart thermostat. The divide between the segments also increases when looking at adoption. Tech-savvy Proteges are the most likely to have ever adopted home energy management systems (18%), followed by Green Innovators (12%). However, relatively few Energy Indifferent (5%) and Movable Middle (2%) consumers have acted. Similar to other DERs, those who are socially responsible are also more likely to be aware (71%) or adopt (17%) these technologies.

Hearing information about home energy management from an electricity provider is a top source of awareness, alongside news sources and/or articles (29% for both). These two sources represent, by far, the most common ways for consumers to learn about this technology.

Table 7.1. Awareness of Home Energy Management Systems

TOTAL SAMPLE SIZE	1500
Aware	59%
Purchase And Use/Purchase And Not Use	9%
I have purchased/participated and am currently using this	6%
I have purchased/participated, but am not currently using this	3%
I have heard of this, but have never purchased/participated this	50%
I have not heard of this and would consider using/purchasing this in the next 2 years	20%
I have not heard of this and would not consider using/purchasing this in the next 2 years	21%
Have Not Heard And Considering/Have Not Heard And NOT Considering	41%

BARRIERS TO PARTICIPATION

The top barriers to participating in home energy management systems center around uncertainty in payback. One-in-five (20%) aren't convinced the investment will result in net savings; however, this is surely an outcome of consumers being unaware of what the payback period will be in the first place (13%). There is both a lack of understanding and knowledge in how to calculate those outcomes. Given that a higher proportion of consumers indicate they are simply unaware of how long it would take to begin generating a net savings on their investment (15%) than those who don't want to make the investment at all (12%), communicating the payback period and net savings clearly would move consumers to spend money up front.

Across all age categories, not wanting to spend the money up front and not being convinced that there is an opportunity for savings are the top barriers.

There is a clear connection between investing in home energy management systems and the level of understanding of long-term benefits when looking at the education level of consumers. Although those less educated (high school or less) and those more educated (some university or higher) are both skeptical of the net savings that will result if they invest in the technology (17%), those who are less educated assume it will take too long for the investment to pay off (10%), while those with more education are just unsure what the payback period would be (14%). *(Table 7.2)*

Table 7.2. Barriers to Adopting a Home Energy Management System

		AGE			EDUCATION		
	Total	18-34	35-54	55+	High school or less	Some college/ Associates	University+
BASE: Aware but do not have a Home Energy Management System	763	132	230	401	248	246	269
I do not want to spend money upfront/could not find a lease option	12%	15%	13%	9%	12%	11%	12%
I do not think it will result in net savings for my investment	15%	6%	14%	22%	17%	12%	17%
It would take too long for this investment to payback	10%	11%	7%	11%	10%	9%	10%
Environmental benefits are not a priority	2%	1%	3%	2%	1%	2%	4%
I am not sure who to contact	8%	11%	10%	6%	3%	11%	13%
The process is too long/complicated	7%	10%	7%	6%	8%	7%	7%
My community does not have access to this	11%	9%	12%	11%	9%	9%	14%
I am concerned about the impact of aesthetics/resale value of my home	3%	5%	5%	1%	3%	3%	3%
My homeowner association (HOA) does not allow it/too many hurdles with my HOA	3%	2%	2%	4%	3%	2%	3%
I am worried about equipment breaking down and maintenance	5%	2%	6%	6%	2%	6%	7%
I don't know what the payback period is for my investment	13%	12%	13%	13%	8%	18%	14%
I don't trust that the estimated savings are going to save me money	20%	17%	18%	23%	22%	18%	20%
Other	21%	21%	25%	19%	23%	24%	17%

PROFILING CURRENT PARTICIPANTS

Similar to purchase/participation levels seen in solar, 9% have had a home energy management system, with 6% of U.S. consumers actively using it and the remaining 3% being lapsed.

The top demographic and segment indicators of currently having home energy management systems are:

- Critical peak rate structure (19%)
- Income $100k+ (17%)
- Kids in the home (15%)
- Tech-savvy Proteges (13%)

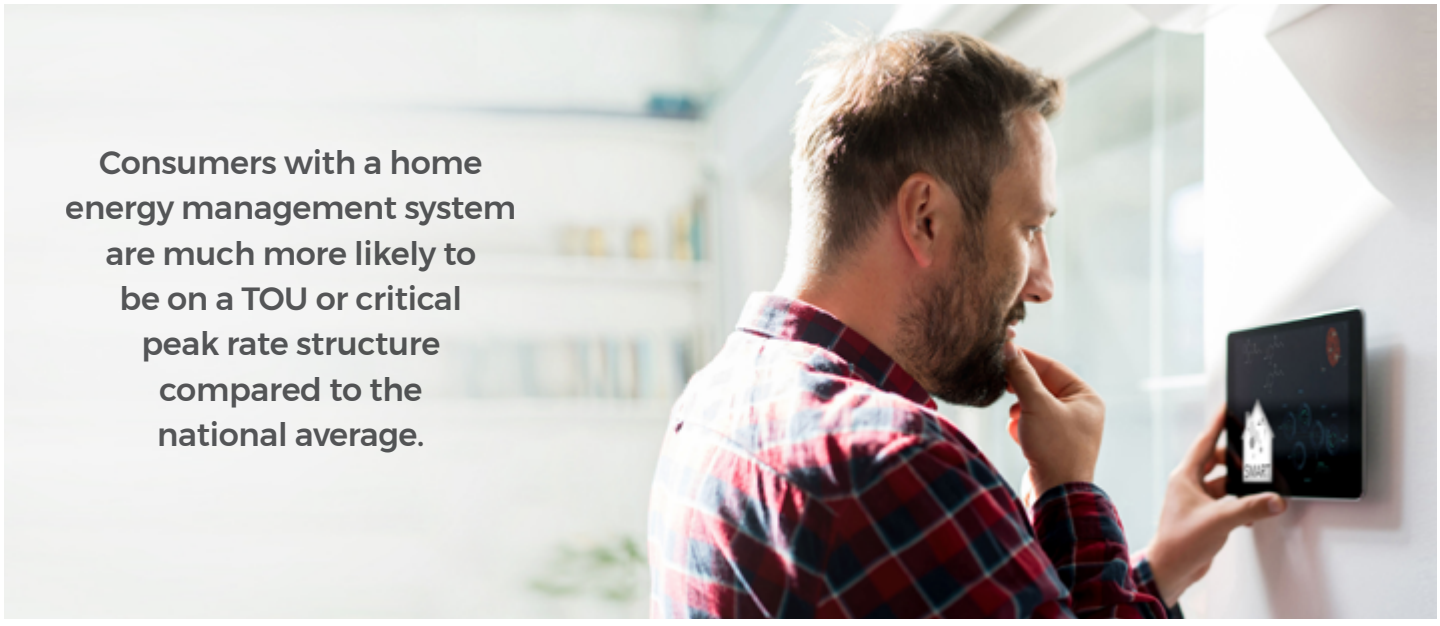
These consumers are more likely to live in the South (43% vs the national average of 38%). More than eight-in-ten (84%) home energy management system purchasers/participants own their home, which is significantly higher than the general population (64.8%). They are also more likely to be employed full time (80% vs 43%).

When it comes to selling energy back to a provider, one-third (32%) are doing so (vs the national average of 5%).

Consumers with home energy management systems are significantly more likely to own a hybrid EV, powered by gasoline and energy stored from braking in a battery (35%); plug-in hybrid EV, powered by gasoline and by plugging into an electrical outlet (38%); and/or battery EV, only recharged by plugging into an electrical outlet (28%) compared to the national average (7%, 3% and 3%, respectively). These consumers' average monthly electricity bills are much higher than those without ($229 vs $142). Furthermore, those with a home energy management system are much more likely to be on a TOU or critical peak rate structure compared to the national average (33% vs 20% and 19% vs 6%, respectively).

Those with a home energy management system have significantly higher adoption rates of other DERs, especially demand response.

- Demand response (62% currently have vs 8% national average)
- Battery storage (31% currently have vs 3% national average)
- Solar (30% currently have vs 6% national average)
- Small wind turbines (26% currently have vs. 2% national average)



THE PATH TO PURCHASE AMONG CURRENT PARTICIPANTS

When consumers contact someone to purchase/participate in home energy management systems, most often it is the electricity provider (53%), followed by a private contractor partnered with the electricity provider (28%).

For home energy management participants, hearing about it from the electricity provider is the most common source (46%). Another top source of information is from internet searches (34%). Hearing from a company that provides these services was a source for one-third of consumers (33%).

Purchases/participation in home energy management systems, for most, began either this year or last year (71% in 2018 and 2019). One-in-six (15%) purchased prior to 2015.

Among those who have invested in home energy management systems, the top benefits for DERs (in broad terms) are to save money on their bill (75%), to help the environment (62%), to minimize outages (44%) and to improve the resale of the home (43%).

The role of incentives in home energy management systems is important, but to a lesser extent than solar. For example, one-third did not use incentives (32%). *(Table 8)*

Table 8. Incentives Used for Home Energy Management Systems

Did you use incentives to acquire/purchase/participate in any of the products or services below? **Home energy management**	
Yes, I used incentives and I would NOT purchase/participate without it	34%
Yes I used incentives but I WOULD purchase/participate without it	34%
No, I did not use incentives	32%

EXPECTATIONS VS. REALITY AMONG CURRENT PARTICIPANTS

Those who currently have a home energy management system are very satisfied. Six-in-ten consumers (61%) feel it is working out "very well" with one third indicating "well" (34%). Only 5% rated this DER technology as "poor" or "very poor".

In the previous section, we looked at home energy management consumers' perceived benefits towards DERs broadly. Here we recap actual benefits that have been experienced in the context of home energy management. *(Table 9)*

Table 9. Benefits From Using Home Energy Management Systems

What benefits have you personally experienced from using these products and services? **Home energy management**	
Saving money	54%
Help the environment and/or reduce energy consumption	43%
A better understanding of my electricity usage	39%
Increased satisfaction with my electricity provider	26%
Being on the cutting edge of technology	26%
Minimized outages and improved reliability of the grid	25%
Increase in the resale value of my home	23%
A better understanding of how renewable energy works	22%
Access to more electricity	18%
Other	2%

While satisfaction with home energy management systems is high overall, several limitations and/or desired expanded features were identified. The top mention was being interested in knowing more about any potential expanded features (11%). On a related note, feedback from lapsed home energy management system consumers reveal that the top reason for no longer using this product/service is the expense/high cost of materials (18%). *(Table 9.2)*

Table 9.1. Limitations or Expanded Features Among Current Home Energy Management System Users

Currently have home energy management systems in US gen pop	35
Demand program won't run air conditioning/heating properly during peak times/takes long to cool/heat the house	3%
Batteries do not hold enough power for running long time without sun/does not work on cloudy/rainy days	–
Does not have beneficial value/didn't save money as claimed to do	3%
More affordable solar panel system	9%
Need more knowledge on how to use/maintain solar panels	6%
Unreliable functioning/does not work as supposed to/does not provide expected service	6%
Would be interested in knowing about any expanded features	11%
A home energy management system that allows to adjust/manage electric usage of the house	9%
System has too much control/difficult to override	9%
Need large system to cover normal needs of my house/more storage	–
Don't have any on-site storage/not able to run off the grid	–
Poor quality of equipment/does not last long	–
Limited to how much electricity can use in a day	–
Amount of rebate/discount is not as good as used to be	3%
A better system to notify if a panel stops working	–
Recover time (unsp)	–
Never use this product	–
Other	11%
None/all is good	37%
Don't know/NA	9%

Table 9.2. Reasons for Not Using a Home Energy Management System Anymore

BASE: No longer have home energy management systems	79
Expensive/high cost of material/installation/maintenance	18%
Haven't thought about it/not interested/not needed	13%
Already using it/considering it	11%
Can't install it/not available where I live/program was cancelled/they stopped offering it	9%
Have chosen better options/alternatives	8%
Moved to another place/state	6%
Inconvenient/no advantage to using them	6%
Not familiar with them/need more information	4%
Not convinced it is a good money saver	3%
They malfunction/don't work well	3%
Poor durability/quality/easily damaged	1%
Don't like them/had them removed	1%
No time/hassle of installing it/too much work required	1%
Other	4%
Nothing	4%
Don't know/NA	11%

Small wind turbines

AWARENESS

For small wind turbines installed on the home or property, just over half of consumers are aware of this DER technology (54%). Being a Tech-savvy Protege and being socially responsible are good indicators of awareness, with 63% of Tech-savvy Proteges and two-thirds (67%) of those who always think about social responsibility reporting being aware. As with other DERs, such as solar and home energy management systems, purchase/participation of small wind turbines is niche at just 6% currently using.

BARRIERS TO PARTICIPATION

Perceptions of not having access to small wind turbines is the main barrier for adoption of this DER (18%), regardless of age, gender, region, education or income. Secondary barriers vary but focus around not understanding what the payback period will be in the investment (12%) and, closely linked to that, not trusting that savings estimated will translate into reality (13%).

PROFILING CURRENT PARTICIPANTS

Digging further into current participation, 3% have experience with small wind turbines on the home, with 2% of U.S. consumers being active and the remaining 1% being lapsed.

The top demographic and segment indicators of those currently having small wind turbines are as follows:

- Tech-savvy Proteges (6%)
- Income $100k+ (5%)
- Having kids in the home (5%)
- TOU or critical peak rate structure (both 5%)
- Living a rural setting (4%)

DER STACKING

Consumers with small wind turbine systems have very high adoption rates of other DERs:

- Home energy management system (74% currently have vs. 6% national average)
- Demand response (73% currently have vs 8% national average)
- Battery storage (64% currently have vs 3% national average)
- Solar (62% currently have vs 6% national average)

THE PATH TO PURCHASE AMONG CURRENT PARTICIPANTS

Among consumers who contacted someone to access small wind turbines on the home, most often it's the electricity provider (41%) followed by a private contractor partnered with the electricity provider (36%).

Purchases/participation in small wind turbines are, similar to other DERs, recent. Seven-in-ten (72%) invested either this year or last (2018 or 2019). One-in-six (29%) purchased prior to 2015 (note that it is possible for totals to exceed 100% as purchases can be made in multiple years).

Among those who invested in small wind turbines, the top benefits for DERs are the environment (71%), to save money on their bill (59%), to have access to more energy when needed (53%) and to improve the resale of the home (52%).

EXPECTATIONS VS REALITY AMONG CURRENT PARTICIPANTS

Those who currently have small wind turbines on their home are very satisfied. Six-in-ten consumers (62%) feel it is working out "very well" with one quarter indicating "well" (28%). Only 10% rate their small wind turbine investment as "poor" or "very poor".

In the previous section, we recapped small wind turbine consumers' perceived benefits towards DERs broadly. Below are the benefits that have been experienced through participation in this technology. *(Table 10)*

Table 10. Benefits From Having Small Wind Turbines

What benefits have you personally experienced from using these products and services? **Small wind turbines on your home**	
Increased satisfaction with my electricity provider	36%
Help the environment and/or reduce energy consumption	34%
A better understanding of how renewable energy works	34%
Saving money	31%
Minimized outages and improved reliability of the grid	28%
Being on the cutting edge of technology	24%
A better understanding of my electricity usage	22%
Increase in the resale value of my home	19%
Access to more electricity	17%
Other	5%

Battery storage

AWARENESS

Awareness of residential battery storage is among the lowest of the home DER technologies tested at 49%. This increases to six-in-ten among those who think about social responsibility (60%) and the environment (61%). Age is also a factor in awareness. Millennials (18-34 years of age) are more likely than their Boomer counterparts (55+ years of age) to have heard of it (58% vs 42%, respectively). Males (60%) and those from the West (56%) are also significantly more likely to have heard of battery storage. Overall, participation is minimal at just 3%.

For the source of consumer awareness for battery storage, news sources/articles are central (43%), possibly due to several high-profile stories on Tesla's home battery products and the relative dearth of offerings from electricity providers. Secondary sources are internet searches (21%) and family/friends (17%).

BARRIERS TO PARTICIPATION

When it comes to battery storage, some consumers perceive that their community does not have access to this type of technology (19%). Whether accessibility is a myth or reality, it's the main perceived barrier across all demographic groups. A report from 2019 states that the main energy storage pilot programs are from electricity providers in the Northeast, with the primary programs being from National Grid, Green Mountain Power and Liberty Utilities.[5] Consumers located outside of these areas may have limited accessibility. Uncertainty around payback periods (13%) and whether there are any savings that will come of the investments (13%) follow as secondary concerns.

5 Fields, Spencer. "Utility energy storage pilot programs: what you need to know." Energy Sage. August 16, 2019. Accessed October 28, 2019. https://news.energysage.com/utility-energy-storage-pilot-programs-what-you-need-to-know/

Gen Xers find more barriers to adopting battery storage than their younger (18-34 years old) and older (55+ years old) counterparts. In addition to perceived community access, uncertainty around payback periods (18%) and distrust around actual savings made (11%), they also find upfront investments challenging (11%) and the period of time to accrue savings from the investments to be too long (18%). Boomers also feel a time crunch when it comes to DER investments. One-in-six (15%) indicate barriers around seeing the investment paying back for them — which may be indicative of retirement goals being prioritized over energy investments. *(Table 11)*

Table 11. Barriers to Adopting Battery Storage

You previously said you were aware of these products and services but have not participated. Why is that? **Battery storage** (e.g., Tesla Powerwall, Sonnen eco, LG Chem RESU, Enphase)		AGE		
	TOTAL	18-34	35-54	55+
I do not want to spend money upfront/could not find a lease option	10%	10%	11%	11%
I do not think it will result in net savings for my investment	10%	6%	9%	14%
It would take too long for this investment to payback	11%	7%	11%	15%
Environmental benefits are not a priority	3%	2%	3%	3%
I am not sure who to contact	7%	9%	9%	4%
The process is too long/complicated	8%	14%	6%	3%
My community does not have access to this	19%	18%	22%	18%
I am concerned about the impact of aesthetics/resale value of my home	3%	4%	4%	2%
My homeowner association (HOA) does not allow it/too many hurdles with my HOA	6%	5%	5%	9%
I am worried about equipment breaking down and maintenance	7%	7%	6%	9%
I don't know what the payback period is for my investment	13%	10%	18%	10%
I don't trust that the estimated savings are going to save me money	13%	12%	11%	15%
Other	17%	12%	20%	18%

Note: Green highlighting represents top three barriers by column excluding 'Other'

PROFILING CURRENT PARTICIPANTS

For battery storage, 4% of consumers have engaged with this DER technology; 3% are active users and the remaining 1% are lapsed. The top demographic and segment indicators of actively participating in battery storage are:

- Income $100k+ (8%)
- Critical peak or TOU rate structure (7% and 5%, respectively)
- Tech-savvy Protege (7%)
- Kids in the home (7%)

Those who currently have battery storage are significantly more likely to be from the West (29% vs 24% national average). This is an urban consumer base (100%) who is employed full time (87%). They are also three times the national average to have an income of $100,000-$149,999 (31% vs 10%) and a graduate or professional degree (37% vs 12%). One-third are selling energy back to their provider (32% vs the national average of 5%).

Consumers with battery storage are significantly more likely to own a hybrid EV (59%), plug-in EV (51%) and/or battery EV (48%) compared to the national average (7%, 3% and 3%, respectively). These consumers' monthly electricity bills are also much higher than average ($262 vs $142).

DER STACKING

The adoption rates of other DERs are high overall:

- Demand response (76% currently have battery storage vs 8% national average)
- Home energy management system (69% currently have battery storage vs. 6%, national average)
- Solar (54% currently have battery storage vs 6% national average)
- Small wind turbines (50% currently have battery storage vs 2% national average)

THE PATH TO PURCHASE AMONG CURRENT PARTICIPANTS

Social media plays a big role in awareness for those who invested in battery storage (43%). The news, internet searches and the electricity provider are also top information sources (40%, 38% and 35%, respectively).

Most often, when consumers contact someone to purchase/participate, it is the electricity provider (44%). This is followed by a private contractor partnered with the electricity provider (38%).

Battery storage purchases/participation are, like other DERs, recent in nature. For 79% of consumers, it was implemented in 2018 or 2019. More than half invested this year (54%). One-in-ten investments are from prior to 2015 (9%).

Among those who have invested in battery storage, the top benefits for DERs (in broad terms) are to save money on their bill (69%) and help the environment (65%).

The role of incentives in purchasing battery storage is outlined below. *(Table 12)*

Table 12. Incentives Used For Battery Storage

Did you use incentives to acquire/purchase/participate in any of the products or services below? **Battery storage** (e.g., Tesla Powerwall, Sonnen eco, LG Chem RESU, Enphase)	
Yes, I used incentives and I would NOT purchase/participate without it	29%
Yes, I used incentives but I WOULD purchase/participate without it	46%
No, I did not use incentives	25%

EXPECTATIONS VS REALITY AMONG CURRENT PARTICIPANTS

Those who have used battery storage products at home are satisfied. Half of consumers (51%) feel it is working out "very well" with four-in-ten indicating "well" (37%). Only 12% rate this DER technology as "poor" or "very poor".

In the previous section, we looked at battery storage participants' perceived benefits towards DERs broadly. The actual benefits that have been experienced in the context of this technology are related to learning, outage prevention and the environment. *(Table 13)*

Table 13. Benefits From Having Battery Storage

What benefits have you personally experienced from using these products and services? **Battery storage** (e.g., Tesla Powerwall, Sonnen eco, LG Chem RESU, Enphase)	
A better understanding of how renewable energy works	40%
Minimized outages and improved reliability of the grid	38%
Help the environment and/or reduce energy consumption	37%
A better understanding of my electricity usage	34%
Being on the cutting edge of technology	32%
Increase in the resale value of my home	31%
Saving money	29%
Access to more electricity	28%
Increased satisfaction with my electricity provider	28%
Other	–

Community-based DERs

AWARENESS

For the most part, awareness of community-based DERs is somewhat lower than residential DERs, particularly for microgrids and energy storage.

- Community solar: 54% aware, 5% currently access
- Small wind turbines in the community: 49% aware, 3% currently access
- Microgrids in the community: 37% aware, 4% currently access
- Energy storage in the community: 37% aware, 5% currently access

For these four community-based DER technologies, millennials, males, Tech-savvy Proteges and those with an income of $100k+ are more likely to be aware. For community-based DERs, awareness is not only higher among those who are socially responsible but also those who think about reducing the need for foreign energy and America's ability to compete with other countries. *(Table 14)*

Table 14. Awareness of Community-Based DERs

	TOTAL	REDUCING NEED FOR FOREIGN SOURCES OF ENERGY	TO BE SOCIALLY RESPONSIBLE	TO IMPROVE AMERICA'S ABILITY TO COMPETE WITH OTHER COUNTRIES
	A	D	E	G
All Respondents	1500	325	363	297
Microgrids in your community	37%	52%	53%	58%
Community solar panels	54%	72%	70%	69%
Small wind turbines in your community	49%	65%	65%	65%
Energy storage in your community	37%	48%	52%	53%

Note: Light green highlighting represents percentages that are 15-19 percentage points higher than the total

Note: Dark green highlighting represents percentages that are 20+ percentage points higher than the total

Sources of awareness across various community DERs is similar. It is primarily from news and/or articles (e.g., microgrids at 35% and community solar at 36%). This overshadows secondary information sources, such as social media, internet searches and from an electricity provider (for example, microgrids 18%, 18% and 17%, respectively).

For these four community-based DERs, the top barriers to participation are very similar. *(Table 15)* The top barrier, by a considerable margin, is the perceived lack of access in the respondent's community. A skepticism of the estimated savings is a distant second, followed by uncertainty around the payback period.

Table 15. Barriers to Community DER Technologies

You previously said you were aware of these products and services but have not participated. Why is that?	COMMUNITY SOLAR	SMALL WIND TURBINES IN COMMUNITY	MICROGRIDS IN THE COMMUNITY	ENERGY STORAGE IN THE COMMUNITY
My community does not have access to this	35%	30%	38%	31%
I don't trust that the estimated savings are going to save me money	12%	12%	13%	14%
I don't know what the payback period is for my investment	12%	11%	10%	12%
I am not sure who to contact	9%	9%	10%	13%
I do not want to spend money upfront/could not find a lease option	8%	9%	7%	7%
My homeowner association (HOA) does not allow it/too many hurdles with my HOA	7%	8%	8%	6%
It would take too long for this investment to payback	8%	7%	7%	6%
The process is too long/complicated	6%	8%	6%	8%
I do not think it will result in net savings for my investment	6%	7%	4%	6%
I am worried about equipment breaking down and maintenance	5%	6%	5%	5%
I am concerned about the impact of aesthetics/resale value of my home	3%	4%	3%	2%
Environmental benefits are not a priority	2%	4%	3%	2%
Other	13%	14%	13%	13%

Note: Green highlighting represents top three barriers by column excluding 'Other'

PROFILING CURRENT PARTICIPANTS

The top demographic and segment indicators of actively participating in community based DERs are:

- Income of $100k+ (10% access small wind turbines, 13% access community solar and/or microgrids, 16% access energy storage in the community)
- Critical peak rate structure (9% access community solar, 14% access small wind turbines in community, 16% access microgrids and/or energy storage in the community)
- 18–34 years of age (9%-12%)
- Tech-savvy Protege (11%-14%)
- Kids in the home (9%-13%)

Among those participating in community DERs, EV penetration is higher than average. This trend is especially pronounced among those who access small wind turbines in their community. It suggests that to find those receptive to community-based DERs, the point of sale for EV cars is a good place to start. *(Table 16)*

Table 16. Vehicle Type by Community DER Technology Adopters

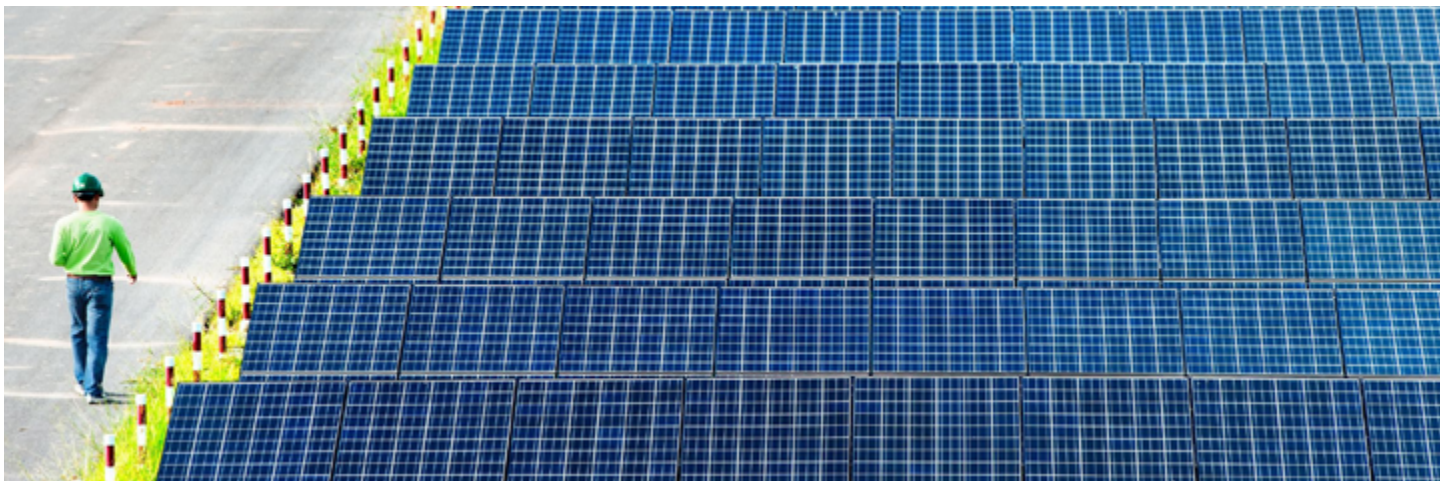
Which of the following types of vehicles do you have? Please select all that apply.	PROPORTION OF U.S. MARKET	CURRENTLY ACCESS COMMUNITY SOLAR	CURRENTLY ACCESS SMALL WIND TURBINES IN COMMUNITY	CURRENTLY ACCESS MICROGRIDS IN THE COMMUNITY	CURRENTLY ACCESS ENERGY STORAGE IN THE COMMUNITY
Hybrid Electric Vehicle (HEV)	7%	39%	60%	43%	46%
Plug-in Hybrid Electric Vehicle (PHEV)	3%	42%	57%	47%	46%
Battery Electric Vehicle (BEV)	3%	41%	47%	40%	41%
Standard internal combustion engine	85%	71%	60%	75%	75%
I do not have a vehicle	9%	1%	3%	—	2%

Among those who access community DERs, participation/purchase of residential DERs is high. For example, among the 5% who currently access community solar, 39% have solar on their home. *(Table 17)*

Table 17. Community DER Adopters by Residential DER Adopters

COMMUNITY DERs: CURRENTLY ACCESS	RESIDENTIAL DERs: CURRENTLY HAVE				
	SOLAR ON THE HOME	HOME ENERGY MANAGEMENT	SMALL WIND TURBINES	DEMAND RESPONSE	BATTERY STORAGE
Community Solar	39%	43%	68%	33%	64%
Small wind turbines in community	28%	40%	67%	23%	55%
Microgrids in the community	33%	49%	74%	34%	72%
Energy storage in the community	34%	52%	67%	38%	82%

This finding reveals that it is not uncommon for community and residential DERs to be leveraged together. Therefore, information about DERs should not exist in a silo. Communicating the synergistic value of DER bundles to consumers will boost adoption. For example, solar + storage allows consumers to store any production in excess of what they can use in daylight hours for the evening when production is low/nil.



A Canadian Perspective on DERs

In addition to sharing the longest international border in the world, Canada and the United States share many other characteristics, including close historical, economic and cultural ties. Within the energy industry, Canadian electric utilities are undergoing transformations in grid modernization and consumer empowerment like their U.S. counterparts. On both sides of the border, utilities are transitioning from the delivery of a commodity to becoming a trusted energy partner to their customers. In addition, Canadian consumers have access to new and affordable types of DERs just as U.S. consumers do. How do their wants, needs and interests differ from their U.S. neighbors?

In order to answer these questions and assist with this transition, SECC conducts several consumer research studies each year that include both U.S. and Canadian survey populations and compare and contrast consumers' views between the two countries. The aim of this research is to help provide the Canadian energy industry with relevant, timely insights on their customers and assure that grid modernization progresses along the lines of what consumers want and need.

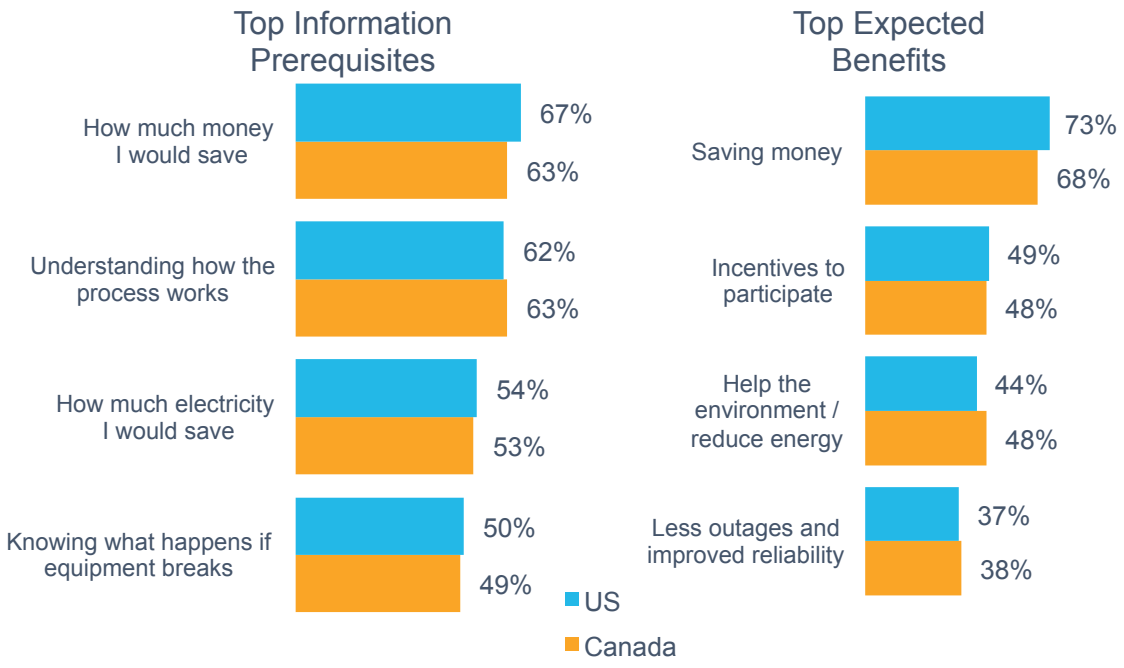
Canadian consumers and DERs at a macro level

Awareness of the technical term "distributed energy resource" is somewhat lower among Canadians compared to the U.S. Just under one-quarter (23%) have heard of the term and 6% are familiar. This is lower than U.S. consumers, where 27% heard the term and 9% are familiar. How Canadian consumers describe DERs was consistent with the U.S: It is seen as a local resource to generate power for residential purposes.

Canadian consumer needs

When presented with the DERs definition, Canadian consumers' values are similar to their U.S. counterparts. Information needs and expected benefits are both financial in nature. Other desired information closely matched what American consumers needed — knowing the how's and what's (i.e., how the process works, how much electricity they will save and what happens if equipment breaks). However, helping the environment is equally as important as receiving incentives to participate. When looking at attitudinal preferences, Canadians are slightly more likely than U.S. consumers to "always" think about the environmental benefits to savings energy (30% vs. 27%) or being more socially responsible (24% vs. 22%). *(Figure 5)*

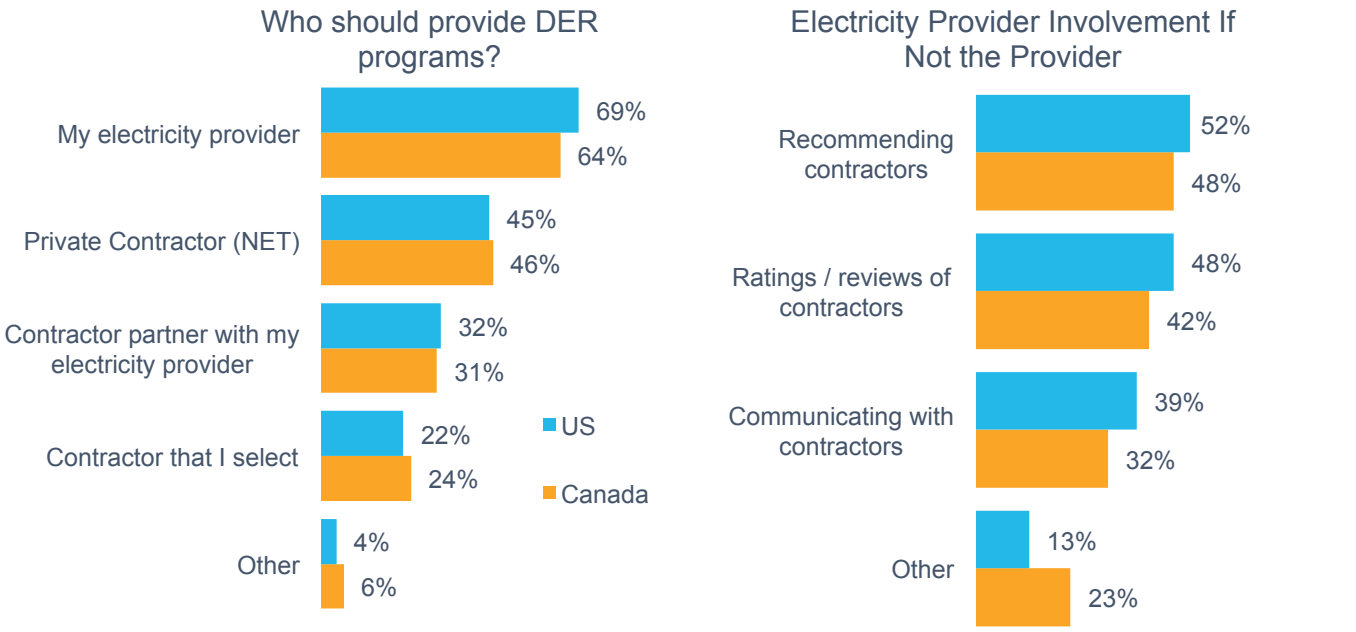
Figure 5. Consumer Needs and Expectations of DERs



Instead, Canadians may be less likely to expect incentives to participate due to recent policy changes. Ontario elected to end the Green Ontario Fund, which provided rebates for environmental building upgrades, in the fall of 2018. Homeowners who had not completed all upgrades had to scramble to get submissions approved. This fund also had changes with the previous government. It had promised adding solar onto the program, which never happened.[6] This unpredictability led to consumers to not factor incentives into their expectations.

When implementing DER programs or services, Canadian consumers also want their electricity provider at the forefront. *(Figure 6)* Similar to the U.S., they want electricity providers to offer DERs and/or provide recommendations and ratings for private contractors.

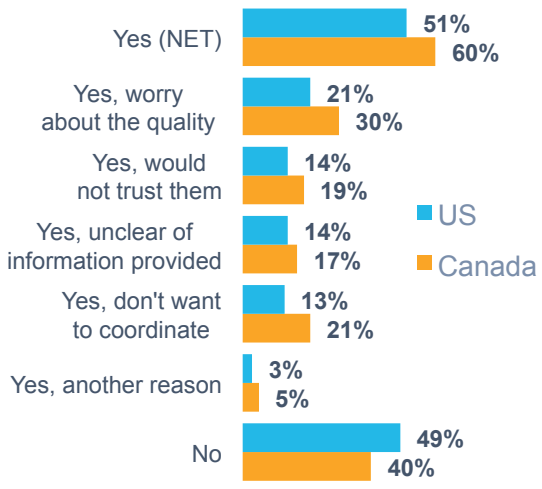
Figure 6. Consumer Preferences for DER Providers



Canadians tend to be more wary of third-party contractors, as 60% of those who prefer their electricity provider say if they had to use a private contractor then they would not move forward with the DER service or program. This is nine percentage points higher than Americans. When asked why, worrying about the quality (31%) is the primary concern. Again, this is nine percentage points higher than in the U.S. *(Figure 6.1)*

Canadian consumers want electricity providers to offer DERs and/or provide recommendations and ratings for private contractors.

Figure 6.1. Are Private Providers a Deal Breaker?

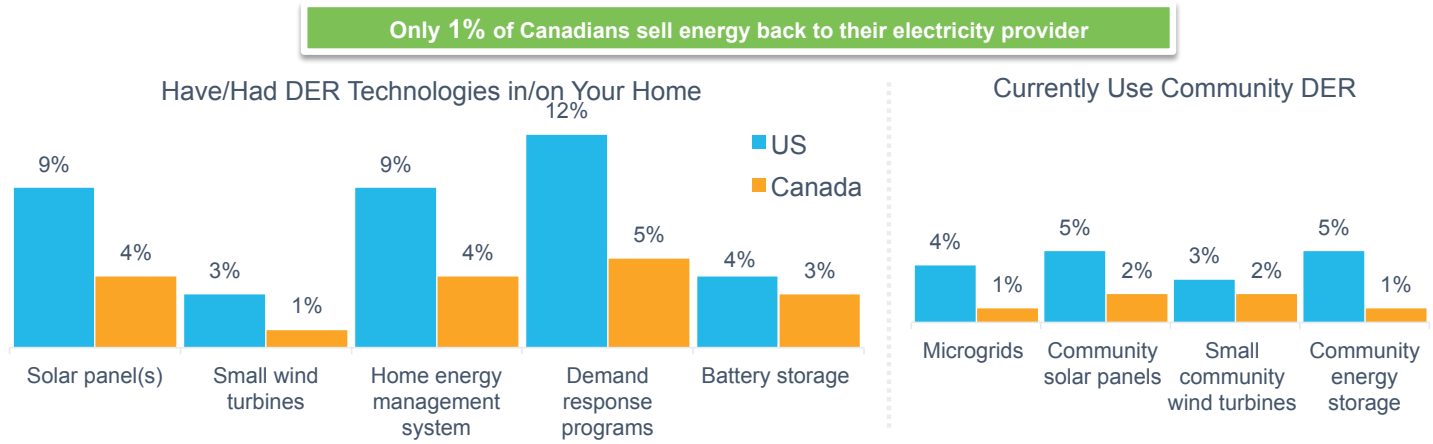


[6] Kalinowski, Tess. "Green Ontario cancellation leaves homeowners, industry scrambling." The Star. June 20, 2018. Accessed October 2019. https://www.thestar.com/business/real_estate/2018/06/20/green-ontario-cancellation-leaves-homeowners-industry-scrambling.html

What DER usage looks like today

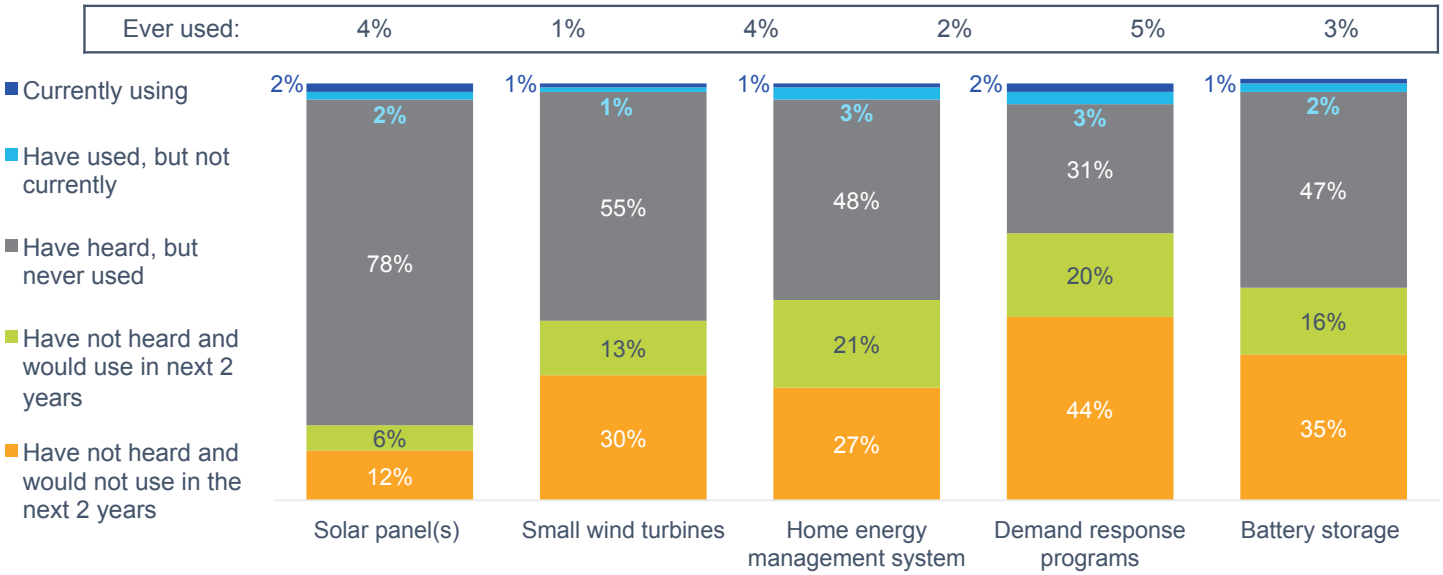
Overall, DER programs and services are less popular in Canada than in the U.S. Each program or service only has five percent or less of the population participating. However, demand response programs, home energy management systems and home solar continue to be the most popular programs. Like the U.S., over half of Canadians are aware of home energy management systems (52%, Canada vs. 59%, U.S.) and more than four-in-five are aware of solar (81% Canada vs. 84% U.S.). Though, when it comes to demand response, the two countries differ. Less than two-in-five Canadians (37%) are aware of demand response programs compared to over half of Americans (53%). *(Figure 7)*

Figure 7. Summary of DER Usage (US vs. Canadian Populations)



Regardless of awareness levels, the future is bright for both demand response programs and home energy management systems. For either of these services, one-in-five of those who never heard of the service before would be open to it in the next two years. This is the same as U.S. consumers (20% for home energy management and 19% for demand response programs). *(Figure 8)*

Figure 8. Detailed Breakdown of DER Programs at Home (Canadian Population)

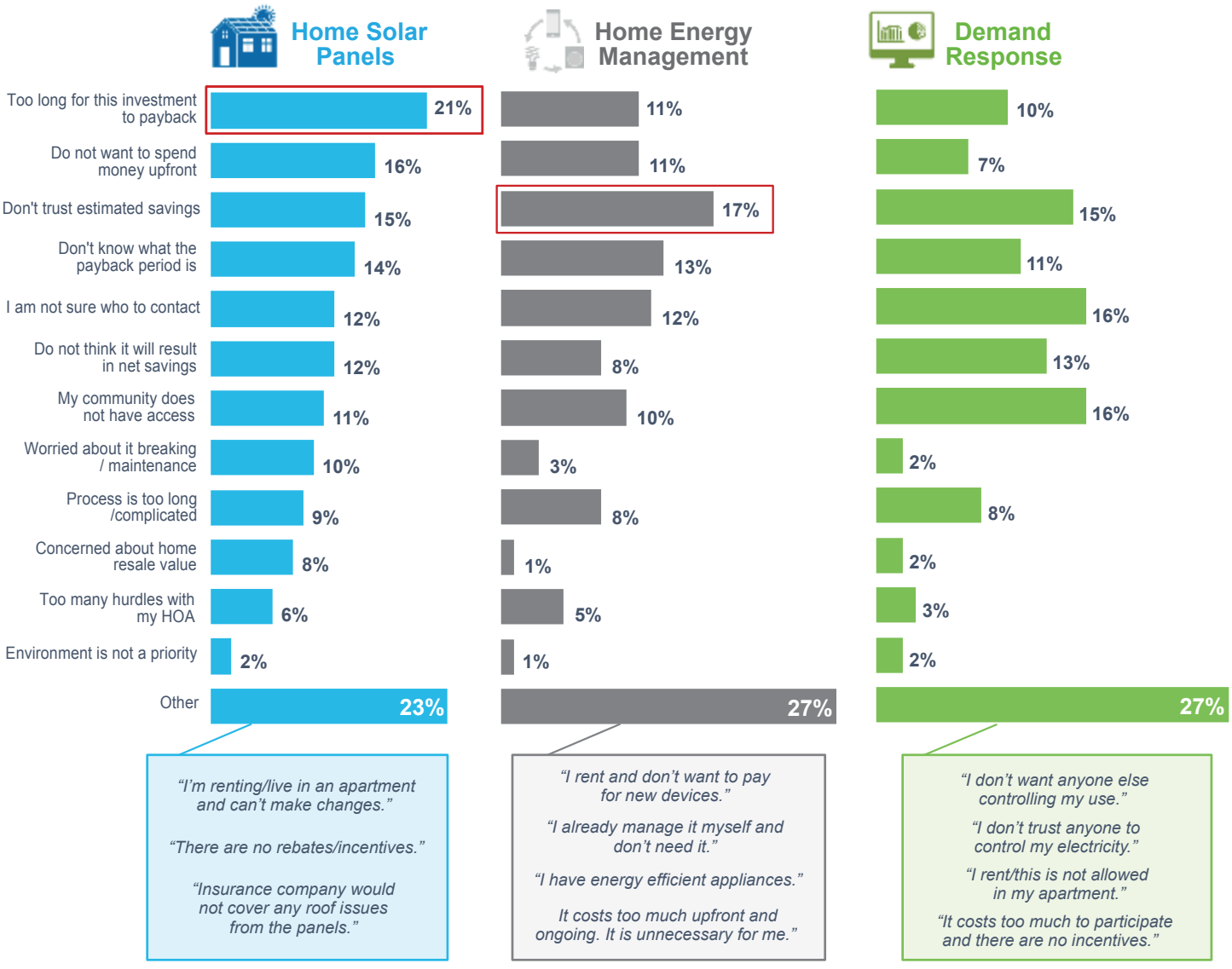


What roadblocks do Canadian consumers face?

For Canadian consumers, the major barriers to DER adoption are financial in nature. One-in-five Canadians (21%) cite an excessively long payback period as the primary reason for not adopting rooftop solar (compared with 19% of Americans), and not trusting the estimated savings is one of the top barriers for rooftop solar, home energy management systems and demand response alike. Concern about upfront costs is a top barrier for rooftop solar in particular, and across all DERs, Canadians cite the lack of incentives as a barrier more often than American consumers.

In addition to these primarily financial barriers, there are some concerns among Canadians about the availability of DERs in their area and about who to contact to purchase and/or participate. For example, for demand response, consumers cite "I am not sure who to contact" and "My community does not have access" as the top two barriers (16% for both) — just above concerns about estimated savings (15%). This contrasts with the U.S. where over one-quarter (27%) cite a lack of trust as their primary roadblock. *(Figure 9)*

Figure 9. Barriers to DER Programs in Canada



Final Recommendations: Meeting Consumer Needs

There are several drivers behind the increasing DER penetration and growing interest from consumers that industry is experiencing, including lower costs, concerns about climate change and increasing consumer desire to control their energy usage. There are many things we learned from consumers about DERs during this research. We now understand their levels of awareness per type of DER, the reasons consumers have for DER participation and the perceived barriers for DERs from both those who do and do not participate. Here we conclude with a few suggestions on ways to increase consumer awareness and address barriers for industry stakeholders who wish to partner with consumers as they continue to seek out DERs.

1. Awareness Building: Opportunities by DER technology

Consumer awareness of DERs varies considerably, as does the source of consumers' awareness (e.g., friends and family, media, the electricity provider and the internet), and understanding both of these variables is a good starting point for building engagement.

Consumers are most aware of home solar (84%), and this is consistently high across segments, age, gender and other demographics. **Consumers are mostly learning about home solar through friends and family, the internet or the media** — not their electricity providers. Unlike some of the other DERs, one challenge of rooftop solar will be making consumers aware of the role that electricity providers have with regards to rooftop solar. Electricity providers can do more to help address consumers' major financial concerns in understanding payback, could provide vetted lists of contractors to reduce misinformation or fraud and can address lack of understanding throughout the process.

Conversely, for home energy management systems, the electricity provider is the primary source of information, whereas family and friends are not. Therefore, creating easy-to-digest information to spark discussions in social settings can help to grow awareness. **To ensure home energy management communications are effective, energy stakeholders should consider tailoring via education levels.** Those with less education may have incorrect assumptions about payback period, which can be rectified with clear, engaging communications. The next highest method for learning about home energy management systems is through internet search, and hence, stakeholders can utilize search engine optimization and other digital marketing tactics to boost awareness of their program offerings.

Demand response has moderate awareness relative to other DERs but has relatively good levels of participation. Electricity providers are the main source of consumer awareness for demand response, and most consumers (90%) with demand response feel their program is working out "well" or "very well". Providers could build more awareness in their customer base through positive testimonials. Providers with existing demand response programs may also be able to capitalize on current DR participation to introduce these consumers to other DERs, such as home energy management systems and battery storage, that can further ease the load on the grid during peak times. For consumers who have demand response currently, the benefit is largely financial. Therefore, framing new DERs as having a similar financial benefit could drive interest.

For other DER programs and technologies, electricity providers can build awareness by focusing on engaging, multi-channel communications that emphasize the energy-saving potential (particularly the return-on-investment) and the environmental benefits. **For community-based DERs, consumer awareness is generally low** — both of the technology itself and whether it's available in the community. Providers offering these DERs should start with basic communications on what these DERs are, what's being offered in the community and what the benefits are. As always, residential consumer segmentation is the best way to engage consumers around the values and attitudes they have for energy technology.

2. Contrasting Consumer Interest: Leverage existing relationships and comfort with technology

With awareness of DERs being low, this research makes it clear who will be interested when exposed to the idea. Similar to those who are already aware, **Green Innovators and Tech-savvy Proteges rise to the top**. While segment is a stronger indicator of interest compared to most demographics, **age is a good proxy**; those under 55 years of age show heightened interest in DERs.

Among those unaware and who reject the idea of DERs, it is the Energy Indifferent and Movable Middle segments. Americans over 55 years old are also most likely to be DER rejectors. These two segments need simplicity, and it is likely that DERs are on the more complex end of the spectrum.

By contrasting interest, the path forward is clear. **The SECC target segments and those who are younger are more receptive targets**. Because Green Innovators are the segment most likely to already be involved in various energy efficiency initiatives, chances are they are already known to you. Leveraging this relationship, demand response programs, home energy management systems and/or home solar will be of interest to many of these customers. While both target segments (and young people) are relatively tech-forward, home energy management systems could be of particular interest to Tech-savvy Proteges because the comfort with technology already exists.

Among Energy Indifferent and Movable Middle, there is less interest, and it is recommended to deprioritize them from an outreach perspective. The Energy Indifferent will be a particularly challenging segment because they are not comfortable with technology, nor do they have the capital to spend on DER-related investments. If there is planned outreach to these groups, **keep it simple. Being clear about the potential benefits and risks** and framing the return on investment in the short term (e.g., potential savings on the next bill) will optimize chances of adoption.

3. Needs from Providers: Consumers will look to their electricity provider as DER stewards

Information needs are about meeting consumers where they are — and for most consumers, they're at the beginning with little to no knowledge about DERs. A great starting point is money-saving potential and how the set-up process works. Environmental benefits are also top of mind.

Consumers will not find details like leasing terms or online portals as relevant as big picture information. It will be most impactful for DER-related information to come from their electricity provider.

It is also important to recognize that those with DERs are often very satisfied with their investment. Therefore, it is not a stretch to **leverage current DER users as advocates for those considering signing-up**. They could also prove to be influential in providing tips in social forums, such as YouTube, Instagram, Facebook, etc. Enabling and empowering consumers to share their stories publicly makes a great deal of sense looking ahead.

Trust is a key reason that consumers want energy providers involved; half would walk away if their provider could not be involved. This is currently a missed opportunity. DER users currently rely on friends and family for this information. Also, those hearing about DER technologies are often doing some from the news. Consumers need providers to be stewards for the DER process. This includes **providing credible information about savings, but also tactical details,** such as contractor ratings and recommendations.

4. Consumers need a committed, long-term adviser

Those who use DERs currently tend to be younger. This means that a longer-term perspective on DER investments will resonate. In fact, those who signed up for DERs did so primarily to save money long-term on their bill. But it's a double-edged sword. **A poor experience with DERs can impact the provider relationship for decades**. Helping the environment is important, but to a lesser extent than bill savings.

Green Innovators and Tech-savvy Proteges are two segments who are light-years ahead of the Moveable Middle and Energy Indifferent in likelihood to have DERs. However, based on findings from the *Consumer Pulse and Market Segmentation – Wave 7* research, each will have slightly different challenges that will need to be addressed. **Green Innovators** will be most receptive but **will need reassurance about the environmental benefit. Tech-savvy Proteges** have the highest bill among all segments, so DER represents a real opportunity to save. However, they tend to see more barriers, especially when there is a large capital investment. To offset this, **financing or pay-as-you-go programs will help alleviate concerns**.

As an overarching takeaway from those who already have DERs, it's **critically important to have a tailored consumer-centric approach** from discovery, to implementation, through to ongoing support.

5. Takeaways from the U.S. applied to Canada

Canada is slightly behind the U.S. in awareness and adoption of DERs. The information needs of Canadians are similar to those of their U.S. counterparts. **Leveraging existing materials and U.S. success stories may make sense for Canadian providers.**

There are, however, a few divergences. Canadian consumers tend to me more skeptical of third-party involvement, and the Canadian market today is less driven by government incentives. Instead, **the environment plays a slightly larger role** in the decision to adopt a DER. The Canadian market, therefore, would respond well to a message developed with Green Innovators in mind.

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