

Trust, Competence, and Innovation: Understanding Customers' Energy and Smart Home Brand Perceptions

Beth Karlin, See Change Institute
Phillip J. Ehret, See Change Institute
Dan Burak, Uplight
Rebecca Ford, See Change Institute
Duncan Ward, See Change Institute

ABSTRACT

Several new and familiar brands have entered the smart home ecosystem in the past decade, offering new opportunities for energy savings and demand response. With penetration in the US expected to hit 44% in 2022 (Statistica, 2022), there is still room for additional energy benefit if customers adopt these technologies and allow third-party access to their energy use. This paper presents results of a national online survey (n = 2,421) investigating customer perceptions of trust, competence, and innovation among 16 technology brands (e.g., Google), smart home products (e.g., thermostats), and service providers (e.g., electric utility) in the smart home ecosystem. We find that trust, followed by innovation, has the strongest associations with willingness to connect and allow third-party control. Further, increases in competence without corresponding increases in trust and innovation can decrease willingness to engage. Although customers had varied perceptions, trust, competence, and innovation serve as gateway beliefs to increased willingness to connect and allow energy management. We discuss barriers to higher levels of trust and product/service adoption and identify leverage points that companies can use to increase customer adoption of clean energy ecosystem products and services. In conclusion, this study marks an important step in moving beyond demographics as predictors of smart home adoption, informing utilities and companies on critical gateway beliefs they must address to grow the smart home market and open opportunities for connection and control.

Introduction

Countries around the world are transitioning toward net-zero energy systems to reduce greenhouse gas emissions in line with the Paris Agreement and more recent Glasgow Climate Pact (IEA 2021). In addition to significant investment in renewable energy generation such as wind and solar (IEA 2020), this transition also requires transformation of demand side energy services. To meet this need, energy utilities and others in the energy space are investigating opportunities for more active participation of the “demand side” (Ford and Hardy 2020).

Innovations in demand side management often fall into two distinct approaches. The first approach relies on energy users to take an active role in modifying their consumption through consciously shifting their use of appliances (e.g., when they do laundry), or changing service level settings (e.g., thermostat settings; McKenna et al. 2018). Smart home technology can maximize these opportunities by connecting devices, such as smart thermostats, to the larger smart home network. To take advantage of this, households must have smart devices connected; the knowledge of what to do to reduce demand; and may need to keep track of when (during the day) they should act to receive a benefit.

The second approach involves third-party control of technologies, such as electric vehicle chargers and battery storage systems which aggregate capacity to a scale at which they can participate in grid scale markets (IRENA 2019). People that own these assets do not need to decide when or how to adjust the power consumption of their devices; this is done on their behalf. Although third-party control offers increased opportunities for energy and cost savings, it faces additional behavioral barriers to adoption as it requires households to relinquish some control over appliances and other technologies, which can be seen as potentially invasive or inconvenient (Adams et al. 2021). If households do not allow third-party management, the added electric load of home management devices may actually increase users' electric demand and resource footprint (Louis et al. 2016). When adopted, third-party management optimizes energy usage and shifts demand to times when costs of energy are lower. This offsets any additional demand smart devices create and lowers overall costs and emissions (Hargreaves, Wilson, and Hauxwell-Baldwin 2018; McKenna and Darby, 2017).

Adopting both approaches—smart home technologies coupled with third-party control—offers the potential to amplify the benefits of demand side management for both participating households and the grid *if* households (1) choose to let this new technology into their home and (2) are willing to cede control to optimize energy use at household and grid levels. While the overall penetration of smart home devices in the United States is expected to hit 44% in 2022 (Statistica, 2022), most connected energy management devices lag far behind the overall adoption (LaMarche et al. 2021), making it important to understand and overcome the barriers to adoption in this category.

While there has been a great deal of research related to smart home technologies over the past decade (Li et al. 2021) very few studies provide empirical evidence around users' perceptions related to the barriers and drivers of adoption and use of smart home technologies (Marikyan, Papagiannidis, and Alamanos 2019). Furthermore, most literature ignores the multidimensionality of the smart home, considering it through the lens of a specific target audience, service, or technology, rather than considering the diversity of perceptions and attitudes associated with different technologies and combinations of technologies that make up the smart home (Balta-Ozkan, Amerighi, and Boetler 2014). These perceptions are likely to be influenced by attitudes relating the specific product, brands, and companies offering smart home products and services (Song et al. 2010; Hubert et al. 2019); to our knowledge, however, no work has explored the importance of brands, or the underlying attributes associated with that brand, in driving uptake and use of smart home technologies.

The current study extends the existing literature on smart home adoption and willingness to allow third-party control in three primary ways:

1. We examine how perceptions of brands, products, and services vary across dimensions of trust, competence, and innovation, as well as willingness to allow them to connect one's home and manage a household's energy decisions.
2. We test the unique contribution of trust, competence, and innovation to willingness to allow them to connect one's home and manage a household's energy decisions.
3. In the United States, third-party energy management is often done in partnership between companies/products and electric utilities (Letendre, Woolf, and Kwok 2020). As such, we investigate which brand, product, and service is seen as the best fit to partner with energy utilities to reduce energy costs and provide green energy.

Literature Review

Our study examines predictors of smart home adoption, with a focus on brand as well as perceptions of trust, competence, and innovation in affecting people's willingness to allow connection and control in their homes. In this section, we review past research on these topics.

Smart Home Adoption and Use

Research exploring smart home adoption has been rising for a decade (Li et al. 2021). Over half of the literature consists of technological articles from engineering, computer science, and architecture; of the remaining studies, classified as "interdisciplinary," 75% of the author affiliations come from a technical background (McIlvennie, Sanguinetti, and Pritoni 2020). Perhaps because of this, the literature on smart home adoption and use is skewed towards technology-centric, control-based solutions to managing home energy use, with customers treated as passive entities despite the potential role they may play in driving adoption and use of smart home technologies (McKenna et al. 2018; (McIlvennie, Sanguinetti, and Pritoni 2020).

A small number of studies have explored user perspectives in terms of motivations and barriers to adoption. Typically, motivations stem from perceived benefits in terms of saving energy, time, and money, as well as making domestic life less effortful and more protective or nurturing (Wilson, Hargreaves, and Hauxwell-Baldwin 2017; Sanguinetti et al. 2018; Marikyan, Papagiannidis, and Alamanos 2019; Li et al. 2021) while barriers relate to (1) lack of trust and perceptions of risk, particularly around increasing dependence of domestic life on technological systems, (2) concerns around usability, reliability, or complexity of the technology, and (3) concerns over how innovative technologies would fit with existing domestic practices (Wilson, Hargreaves, and Hauxwell-Baldwin 2017; Marikyan, Papagiannidis, and Alamanos 2019; Chen et al. 2020; Li et al. 2021). Beyond these descriptive observations of benefits and barriers, the literature typically explores adoption through a socio-demographic lens to segment customers and identify pathways to early adoption of smart home technologies (Ślupik, Kos-Łabędowicz, and Trzęsiok 2021).

When examining the use of smart home technologies to manage energy consumption, very few articles explore the role of users or third parties (such as utilities or aggregators) in setting automation processes or delivering direct load control programs (McIlvennie, Sanguinetti, and Pritoni 2020). Work that has explored these concepts has shown that a significant share of Americans may be willing to let a utility directly control their thermostat, without any conditions, during key summer months; but like the research on adoption of smart home technologies, research regarding willingness to engage in automation programs has segmented customers according to demographic variables (Xu et al. 2018).

Recent literature indicates that the socio-demographic effects that predict smart home adoption and use may be diminished when attitudes and social influences are accounted for, such as views on energy conservation and whether individuals believe their neighbors would also participate in such a program (Kaczmarek, Jones, and Chernak 2022). Therefore, a better understanding of gateway perceptions that more reliably predict uptake of smart home devices and participation in automation and demand response programs may be of use to policy makers, utilities, and service providers seeking to improve energy management in the home.

Brand Perceptions

Research going back to at least the 1980s emphasizes that brand perceptions have a powerful influence on consumer behaviors (Plumeyer et al. 2019). Negative experiences with a brand may lead consumers to subsequently distrust that brand and discount the potential upside of any smart devices that brand may offer (Morgan-Thomas and Veloutsou 2013). Brand trust may play an additional mediating role in consumers' perception of smart home privacy risks.

Attitudes towards products are formed within the context of customers' relationships to the product's brand. Past and ongoing experiences with a brand shape the valence and depth of a customer's relationship to it (Gürhan-Canli, Hayran, and Sarial-Abi 2016). A key component of brand relationships is brand reputation, generated by the consumers cumulative evaluation of their experiences with the brand. Through the emotions associated with past brand experiences, customers form brand relationships. Strong brand relationships create a positive affective filter through which consumers process information about the brand and its products. Across multiple brand and marketplace contexts, brand reputation has been shown to impact technology acceptance via trust. Positive brand reputation increases consumer trust in the brand's technology, decreasing its perceived risk and increasing their willingness to accept it (Morgan-Thomas and Veloutsou 2013). Conversely, negative experiences with a brand create negative reputations, leading to mistrust, which amplifies the perceived risk of new technology offered by the brand and decreases the likelihood that consumers will adopt it. As prior brand experiences create connotations of trust, innovation, and competence that may affect future purchasing decisions, it is important to consider whether different brand perceptions are related to varying attitudes towards new technologies.

The Role of Trust and Competence

Social trust and competence are central factors in decision contexts such as adopting smart home technology (Earle 2010). Customers inherently take on a degree of risk when using a smart device given that they must share private data and open their homes to companies in order to do so. The trust-confidence-cooperation (TCC) model argues that an individual's decision to take on the risk of cooperation—in this case, adopting a smart device—is determined by the degree to which they believe the other party, the product, or the service provider is trustworthy and competent (Earle, Siegrist, and Heinz 2010). Social trust refers to whether the individual trusts the other to act in good faith, with perceived benevolence making cooperation more likely. Additionally, an individual will be more likely to trust the other party and cooperate if past experiences have shown them that the other party is competent in the given area (Siegrist 2021). For example, an individual might be more willing to adopt a smart home energy management device from a utility if their past experiences with the utility have shown that they are really good at helping customers manage energy. Given the significance of trust in cooperative settings, we measure the trust across services, brands, and products to holistically assess its relationship to consumer behavior in a smart home context.

The Role of Innovation

While evaluating the trustworthiness of a new technology is important, consumers also consider the ways in which that technology is innovative when deciding whether to adopt. In particular, the compatibility of smart home devices has been found to be particularly important. If a new product is incompatible with the consumer's existing home technologies, that individual will be significantly less likely to view the new product positively. However, the more an individual finds a product to be innovative, measured as perceived innovation, the more positively they will view it (Nikou 2019). These findings indicate that innovation in the smart home space is not viewed as unequivocally positive by consumers: a smart home device can be viewed as extremely innovative by customers, but if the product cannot be easily integrated with customers' existing technology, they may still be unlikely to adopt it.

Methods

Participants

We recruited a national sample of energy ratepayers (those responsible for making energy-related decisions in their home). Our target sample was 200 participants from each of nine major electric utilities¹ plus a general population of 400 participants from areas not covered by the selected utilities. Within each utility sample and the general population sample, we recruited across multiple household income levels (i.e., less than \$40,000 a year, \$40,001 to \$60,000 a year, \$60,000 to \$100,000 a year, and above \$100,000 a year). The final sample was 2,421 participants. For overall sample demographics, see Table 1. Although the sample was not designed to be nationally representative, the final sample was diverse. While the sample is generally representative, households with income over 100k and younger individuals are slightly underrepresented (cite if needed).

Table 1. Survey participant demographics

Gender (% female)	60% (1463)	Median education level	2-year college degree
Race/Ethnicity		Homeowners	68%
Hispanic/Latino(a)	10% (235)	Annual household income	
Black/African American	11% (270)	Less than \$40,000	22% (499)
Asian	3% (64)	\$40,000 to \$59,999	24% (537)
White	74% (1778)	\$60,000 to \$99,999	33% (721)
Other	2% (39)	More than \$100,000	21% (458)
Age (<i>Median (SD)</i>)	47 years (<i>SD</i> = 17)		

¹ Southern Power, Consumers Energy, Pacific Gas and Electric, Alliant Power, Duke Energy, Sacramento Municipal Utility District, Entergy, Portland General, American Electric Power.

Procedure

Participants completed a 15-minute online survey. The first block of questions asked for their electric utility, cell phone provider, and internet provider, and whether they had heard of smart thermostats, smart speakers, residential solar panels, and furnace/air conditioners. Asking the latter served to define these products and primed them in participants' minds.

Participants were then asked to rate nine brands (Apple, Google, Amazon, Target, Microsoft, Costco, Tesla, Walmart, and Ford), four products (smart thermostats, smart speakers/home assistants, residential solar panels, and furnace/air conditioners), and three services (cell phone provider, internet provider, and electric utility) for five different dimensions. We defined each dimension before participants reported their responses on a ten-point scale from *Not at all* to *Completely*.² The first dimension was trust ("Thinking about the following brands, products, and services, please rate... how much you trust each to do the right thing") The second dimension was competence ("...how competent each is at what they do"). The third was innovation ("...how innovative each is at what they do"). The fourth was willingness to connect ("...how willing you would be to let this brand, product, or service connect your home, or parts of your home. In other words, if this brand, product, or service offered to connect various devices in your home, making parts of your home a "connected" or "smart" home, how willing would you be to let them do that?"). The fifth and final dimension was willingness to allow third-party management of energy ("...how willing you would be to let this brand, product, or service manage some of your energy decisions? Managing your energy refers to actions that would help you save money and make your energy use more "green." This could include optimizing the settings of a smart thermostat, giving you information about different energy rates or offers to help you save energy, adjusting appliance settings, or giving you feedback on energy use.").

After rating the brands, products, and services across the five dimensions, participants were asked how well each one was a fit as a partner with their electric utility both to reduce their energy costs and to provide them with green energy. Participants responded to each question on a three-point scale that included, *Not a fit*, *Somewhat of a fit*, and *Great fit*. The last section of the survey asked about participant demographics.

Results

First, we examined the overall ratings for the five dimensions, and means by each brand, product, and service. Next, we tested the correlations between these dimensions across all brands, products, and services. Then, we used a series of regression models to examine how trust, competence, and innovation, along with demographics, relate to willingness to connect the home and willingness to allow third-party energy management. Finally, we present brand-, product-, and service-specific means for each of the five dimensions and how well each fits as a partner with participants' electric utility to help them save money on their energy bill and to provide green energy.

² Participants recorded their ratings with a slider-type question. The slider started at "1", and participants were instructed to move the slider past 1 and rate between 2 and 10 on the scale. Scale labels included: 2 - *Not at all*, 4 - *Slightly*, 6 - *Moderately*, 8 - *Highly*, and 10 - *Completely*. Approximately 2% of respondents left the slider at "1"; their data were retained in the study.

Descriptive Analysis - What Did People Say?

Overall means and standard divisions (on a 1-10 scale) across all brands are presented in the first row of Table 2, with means for each brand in subsequent rows. Overall means were significantly different (ANOVA $F = 1138.67$, $p < .001$). Participants had positive perceptions across brands, with mean levels of trust, competence, and innovation all above 6. Willingness to allow brands, products, and services to connect their home was lower than brand perceptions, and willingness to allow household energy management was lowest.

Table 2. Means and standard deviations of participant perceptions overall and by brand.

	Mean (SD)				
	Trust	Competence	Innovation	Connect home	Allow Control
Overall	6.98 (1.56)	7.43 (1.53)	7.31 (1.57)	6.36 (2.05)	5.66 (2.32)
Smart thermostats	6.69 (2.35)	7.10 (2.23)	7.45 (2.18)	6.76 (2.64)	6.41 (2.78)
Smart speakers	6.51 (2.51)	7.06 (2.29)	7.44 (2.18)	6.55 (2.75)	5.85 (2.90)
Solar panels	6.75 (2.31)	6.98 (2.27)	7.30 (2.25)	6.55 (2.72)	6.21 (2.83)
Furnace / AC	7.49 (2.09)	7.74 (2.01)	7.22 (2.13)	7.00 (5.52)	6.42 (2.71)
Apple	6.96 (2.51)	7.62 (2.35)	7.79 (2.28)	6.49 (2.91)	5.70 (3.01)
Google	7.25 (2.36)	7.94 (2.08)	7.88 (2.08)	6.81 (2.76)	5.90 (2.97)
Amazon	7.40 (2.36)	8.05 (2.07)	7.92 (2.07)	6.69 (2.77)	5.69 (3.00)
Microsoft	7.06 (2.27)	7.64 (2.11)	7.65 (2.13)	6.55 (2.68)	5.67 (2.93)
Cell provider	7.68 (2.09)	7.87 (2.00)	7.51 (2.10)	6.95 (2.60)	5.96 (2.92)
Internet provider	7.23 (2.22)	7.45 (2.17)	7.22 (2.22)	6.94 (2.58)	5.90 (2.90)
Electric utility	7.22 (2.24)	7.54 (2.14)	7.04 (2.26)	6.81 (2.60)	6.48 (2.76)
Target	7.01 (2.27)	7.39 (2.18)	6.72 (2.25)	6.56 (2.79)	4.81 (2.86)
Costco	6.90 (2.30)	7.34 (2.24)	6.76 (2.24)	5.52 (2.76)	4.85 (2.85)
Walmart	6.82 (2.43)	7.29 (2.28)	6.69 (2.38)	5.61 (2.90)	4.89 (2.97)
Tesla	6.09 (2.51)	6.79 (2.47)	7.50 (2.45)	5.53 (2.86)	5.11 (2.96)
Ford	6.66 (2.33)	7.09 (2.29)	6.85 (2.30)	5.43 (2.79)	4.77 (2.84)

Given the high number of mean comparisons (resulting in higher risk of Type I errors), we do not test for all possible mean differences. Nevertheless, means within brands show considerable variation within and across brands. The following correlation and regression analyses better capture how these differences relate to our outcomes of interest.

Correlation Analysis - How Are Dimensions Related?

Table 3 presents correlations between the five dimensions and finds that trust, competence, and innovation are all very highly correlated ($r_s > .80$, $p_s < .001$); willingness to connect and manage are also highly correlated ($r = .84$, $p < .001$). Trust, competence, and innovation are each positively and significantly correlated with both willingness outcomes. This finding suggests that increases in trust, competence, and innovation will also increase the willingness of participants to allow brands to connect their home and manage their energy.

Table 3. Overall means and correlations between dimensions

	1	2	3	4
1 Trust	--			
2 Competence	.83	--		
3 Innovation	.80	.87	--	
4 Connect	.70	.62	.68	--
5 Manage	.59	.48	.54	.84

All means significantly different and all correlations significant at $p < .001$

Regression Analysis - What Relates to Willingness to Connect and Manage?

Given that trust, innovation, and competence are related both to each other and to the outcomes, we used a regression model to estimate the relationship between each of the three dimensions and each outcome, controlling for the other dimensions. Note that there was evidence of variance inflation, but the variance inflation factor (VIF) was below 5 for each model. Table 4 presents six regression models, with three models for each outcome. For each outcome, we first include only the three dimensions of trust, competence, and innovation. In the second model for each, we include only demographic variables; in the third model for each we include both the dimensions and demographic variables.

For willingness to connect one's home, the dimensions of trust, competence, and innovation were all significantly related to this outcome (see Table 4 for specific model coefficients). Increases in both trust and innovation were related to increased willingness to connect, while increases in competence were related to decreased willingness to connect (Model 1). Given the high correlations between these three constructs, this negative relationship with competence should be carefully considered. Increased competence without corresponding increase in trust and innovation may be harmful; however, as the correlations suggest, this circumstance may be uncommon given how strongly related each of these dimensions are. Regardless, the three dimensions together explain 53% of the variance in willingness to connect. Model 2 only includes demographic variables, and finds that age, income, gender, and race (Black/African American compared to white), are each significantly related to willingness to

connect such that older individuals and lower-income individuals are less likely to connect. Men are also less likely to be willing to connect, and Black/African American participants are less likely to connect than white participants. However, these demographic variables only account for 4% of the variance in willingness to connect. Even when both the dimensions and the demographic variables are included in the model (Model 3), the three dimensions remain significant, suggesting that trust, competence, and innovation have much stronger relationships with willingness to connect than with demographic variables.

Regarding willingness to allow third-party management of energy usage, we found similar results across all three models (Models 4 - 6). Using the same variables, we continue to see that trust and innovation are significantly related to willingness to allow management, and that they account for a much larger percentage of the variance in the outcome than demographics (37% vs. 7%). There were some other differences in the relationships between individual demographic variables and willingness to allow management, but the overall patterns of results stayed the same as the models with willingness to connect. That is, trust, competence, and innovation have much stronger relationships with both willingness to connect and allow management, above and beyond demographics.

Brands As Utility Partners - What Do People Think?

Finally, we examined to what extent participants perceived each brand, product, and service to be a fit as a partner with their utility to reduce their energy costs and provide green energy. Figure 1 shows the varying degrees of “fit” participants saw for each brand, product, and service. For both reducing energy costs and providing green energy, participants generally saw similar levels of fit. Notably, products already in the home were more likely to be seen as great fits (e.g., smart thermostats, solar panels). Walmart, Costco, Target, and Ford were most likely to be seen as not a good fit for a utility partnership. These brands may be perceived to be least relevant to the smart home and energy space, and thus seen as less of a fit.

Table 4. Relationships between brand, product, and service dimensions, demographics, and willingness to connect and allow third-party management

	Willingness to connect			Willingness to allow management		
	Model 1 <i>B (SE)</i>	Model 2 <i>B (SE)</i>	Model 3 <i>B (SE)</i>	Model 4 <i>B (SE)</i>	Model 5 <i>B (SE)</i>	Model 6 <i>B (SE)</i>
Intercept	-1.63 (0.13)***	7.15 (0.20)***	1.51 (0.18)**	-1.70 (0.17)	7.18 (0.23)	2.01 (0.23)***
Trust	0.65 (0.03)***		0.62 (0.04)***	0.80 (0.05)		0.72 (0.05)***
Competence	-0.17 (0.04)***		-0.16 (0.04)***	-0.38 (0.06)		-0.35 (0.06)***
Innovation	0.51 (0.04)***		0.54 (0.04)***	0.48 (0.05)		0.56 (0.05)***
Age		-0.02 (0.01)***	-0.02 (0.01)***		-0.03 (0.01)***	-0.03 (0.00)***
Gender		-0.23 (0.09)*	-0.15 (0.06)*		-0.33 (0.10)***	-0.26 (0.08)**
Income		0.10 (0.05)*	-0.03 (0.03)		0.02 (0.05)	-0.10 (0.04)*
Education level		-0.02 (0.03)	-0.01 (0.02)		-0.03 (0.04)	-0.01 (0.03)
Race Asian		0.17 (0.27)	0.06 (0.18)		0.46 (0.30)	0.36 (0.23)
Black/African American		0.34 (0.14)*	0.011 (0.10)		0.56 (0.16)***	0.28 (0.12)*
Hispanic		0.20 (0.15)	0.04 (0.10)		0.43 (0.17)*	0.24 (0.13)
Other		-0.54 (0.35)	0.13 (0.24)		-1.01 (0.39)*	-0.36 (0.31)
<i>R</i>²	.53	.04	.56	.37	.07	.44

Adjusted *R*² reported. Gender is dummy coded with “male” as the reference group. Race is dummy coded, with “white” as the reference group. * *p* < .05, ** *p* < .01, *** *p* < .001

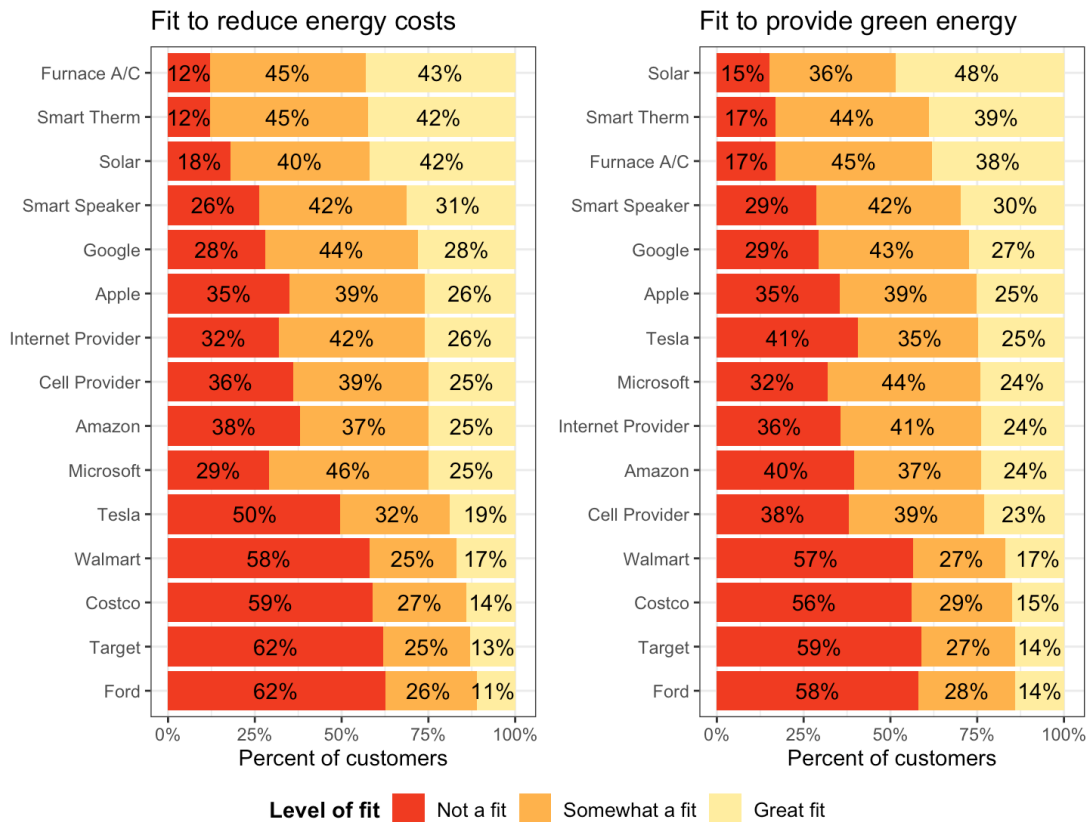


Figure 1. Participants' perceived fit of a partnership between each brand, product, and service with their energy utility

Discussion

Overall, we found that when considering people's willingness to connect the smart home and allow third-party management, brand, product, and service matters—and differences between these are largely driven by perceptions of trust, competence, and innovation. Specifically, our study shows that increases in trust, followed by innovation, are most likely to increase individuals' willingness to connect and allow third-party management. Competence likely also increases this willingness as long as it is accompanied by similar increases in trust and innovation. In other words, a company that is perceived as competent at what they do but not as trustworthy is likely to have lower levels of willingness to connect and allow third-party management. We did not, however, study any specific companies that were likely to be perceived this way, so this result should be interpreted with caution until it can be replicated.

These results highlight the need to move beyond treating the smart home as a unidimensional concept and to recognize the many factors that comprise the smart home across brands, products, and services. Customers' perceptions of these brands, products, and services have an important influence on how likely they are to connect their home and allow third-party management of their devices. Although our studied dimensions of trust, competence, and innovation explained a meaningful amount of variance in willingness to connect and manage energy (53% and 37%, respectively), there is still more to be understood. Our results show that people are more likely to allow brands, products, and services to connect their home than

manage their energy; similarly, we find that our framework explains less of the variance in willingness to manage energy. Thus, there may be other barriers regarding third-party management, such as enhancing the value proposition (perhaps by grouping products to deliver greater benefits), designing products so they are reliable and easy to use, and integrating manual override options (Wilson, Hargreaves, and Hauxwell-Baldwin 2017; Sanguinetti et al. 2018).

For companies in the smart home space, these results emphasize the need to boost or reinforce perceptions of trust and innovation among customers, and to avoid increasing competence without also increasing trust and innovation. In doing so, customers will be more likely to allow them and their products and services into their homes to connect their home and manage their energy. Energy utilities have a distinct advantage in that customers are most willing to allow them to manage their energy, and they should seek to partner with other companies that have high levels of trust and innovation. Further, already being in the energy space or in the customer's home seems to present an advantage in that customers are more willing to allow these companies to connect and manage their energy.

Although our results highlight differences between brands, products, and services, it is important to recognize that these results are a snapshot in time, and that brand perceptions are dynamic and will change. Additionally, our study only included a small sample of different brands, products, and services in the smart home and energy space, and did not consider specific branded technologies (e.g., the Nest Thermostat). It is likely that customers will have unique perceptions related to these branded products and services that may be more predictive of their willingness to connect and manage.

This study marks an important step in moving beyond demographics as predictors of smart home adoption. It enhances our understanding of the gateway beliefs that drive customers to adopt smart home technologies that connect to their home network and manage their energy use.

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