

Electric Wheels

Plugging in to
Consumers'
Perceptions



The image shows a hand pointing at a tablet screen displaying a survey. The survey is titled "How important would it be for your electric company to provide the following services?" and lists four items. The survey is presented in a table format with two columns of response options: "Not Important" and "Somewhat Important".

	Not Important	Somewhat Important
1. Provide information about Plug-In Hybrid Electric or Battery-Only Electric vehicles including availability, others' experiences, charging options, and environmental benefits	<input type="checkbox"/>	<input type="checkbox"/>
2. Offer charging station installation and maintenance services to homeowners	<input type="checkbox"/>	<input type="checkbox"/>
3. Develop a public charging infrastructure (e.g., ensure that charging stations are widely available in your community)	<input type="checkbox"/>	<input type="checkbox"/>
4. Provide for in-home display of ongoing vehicle charging activity	<input type="checkbox"/>	<input type="checkbox"/>

M eet Sam. Sam is about to buy a car, but he doesn't know which one. He stands on the dealer's lot engaged in a host of complex calculations, examining alternatives and weighing the pros and cons of model, cost, fuel efficiency, reliability, and even color. These days Sam has another important choice: gas or electric?

With an electric vehicle, Sam must take into account even more variables: When and where will he charge the vehicle? How much will charging cost? Is he willing to pay a premium to own such a car?

In 2009, EPRI researchers undertook to gauge how Sam and other consumers view electric cars and what they expect of their electric utilities. Electric vehicles represent a tiny fraction of the vehicles on the road today, but Mark Duvall, director of EPRI's Electric Transportation Program, expects production to ramp up quickly. "By 2015," according to Duvall, "it's quite likely we'll have more than a million electrics on the road." As the number of electric vehicles grows, so will demand for power. For an industry accustomed to serving stationary customers, utilities are finding that vehicles present an entirely new set of challenges. "It's a different business," said Bernard Neenan, a technical executive at EPRI. "For the first time, our customers are mobile."

Consumer Survey

EPRI's Electric Transportation Program has long focused on understanding how electric vehicles will affect the power grid and how utilities will accommodate the added demand for power. In 2008, the program's members decided to incorporate another key component of the equation: electricity customers. To prepare for an influx of electric vehicles, utilities need to know when their customers will buy cars, what kinds of cars they will buy, and how those purchases will affect the way they use electricity.

Researchers developed an online survey to examine customers' perceptions of electric cars and the factors that influence electric car purchases. The survey builds on the

THE STORY IN BRIEF

How will consumers react to the auto industry's rollout of electric vehicles, and how do they expect their power companies to be involved? New EPRI-developed surveys gather regional information on the public's interest, assumptions, wants, and needs.

findings of EPRI's 2001 national survey of electric vehicle interest, which focused on what consumers want from an electric vehicle. This time, members wanted a survey to help them understand how customers view the utility's role in electric transportation in their own service areas. "We know electric cars are not going to be adopted uniformly across the county—or even within a utility's service area," said Neenan, the project manager. "So it makes sense to gather information specific to the characteristics of the customers in that area."

As Neenan and his colleagues tested the survey to "work out the bugs," focus group discussions revealed a serious problem: consumers didn't understand the researchers' nomenclature. "They thought an electric car was a hybrid car or a hybrid car was an extended-range car," Neenan said. "That confusion would have been a disaster in the survey." To address this issue, the researchers added an educational component to outline the differences between standard gasoline vehicles, hybrid electric cars, plug-in hybrid electrics, and battery-only electric vehicles.

Electric Future

In July 2009, EPRI collaborated with Southern California Edison and a third-party polling company to administer the survey to SCE's customers. To qualify, participants had to be at least 18 years old and had to be planning to buy or lease a new vehicle in the next five years. The survey focused on issues critical to the electric power industry: consumer charging preferences; accessibility of at-home charging; at-home charging plan preferences; the consumer's interest in acquiring an electric

vehicle; and the influence of gasoline prices, vehicle price, and the consumer's friends and family.

Of 869 respondents, 292 owned a hybrid and 587 owned a conventional gasoline vehicle. Not surprisingly, interest in plug-in hybrid electric vehicles was highest among people who owned a hybrid. Some 20% of hybrid owners said they "definitely" plan to purchase or lease an electric car, compared with only 8% of non-hybrid owners.

Many survey questions dealt with charging, a topic customers identified as important in the 2001 survey. For example, do customers expect that there will be public charging? Where would they be most likely to charge their vehicles? Would they pay a premium for faster charging? Notably, nearly all respondents said they would prefer to charge their electric cars at home. "With a gasoline car, you go to the gas station once a week. With an electric car, you plug in when it's convenient," Duvall said. "That's an incredible benefit to owning an electric vehicle."

Researchers also asked participants when they would charge, if offered three options: an "anytime" plan that would allow them to charge day or night, a "night-time discount" plan that would give participants a discount for charging during off-peak hours, and a "night-time only" plan that would save participants even more money by letting them charge only during off-peak hours for a yearly flat fee. In California, participants preferred the "night-time discount" plan over the other two. Half of all non-hybrid owners and nearly 60% of all hybrid owners said they would choose this option. The "anytime" plan was least



The GM 2011 Chevrolet Volt is a plug-in hybrid. It has an unlimited driving range with its gasoline engine and an EPA-rated range of 35 miles on its battery. It will recharge from “empty” in about 8–10 hours using a 120-volt portable charger or in 3–4 hours from a dedicated 240-volt charger. Photo courtesy of Chevrolet.



The 2011 Nissan Leaf is a 100% battery electric vehicle with an EPA-rated range of 73 miles. It can use a portable 120-volt charger, but most drivers will likely opt for a dedicated wall-mounted 240-volt charger that can completely recharge the battery from “empty” in less than 8 hours. Photo courtesy of Nissan.



Ford plans to release the battery electric version of the Ford Focus in late 2011. The Focus Electric is powered by a lithium ion battery that can recharge from either 120 or 240 volts. Using the wall-mounted 240-volt charger can completely recharge the battery in as little as 3–4 hours. Photo courtesy of Ford.

desirable. The survey also presented an optional discount of \$10 a month if customers would allow the utility to interrupt their charging occasionally. More than half of non-hybrid owners and 70% of hybrid owners were extremely or very likely to choose this option.

Regional Differences

What holds true for California customers may not hold true in other regions. “We looked at their (SCE’s) results and said, we don’t think that’s our typical customer,” said Bryan Coley, a research engineer with Southern Company. In 2010, EPRI researchers helped Southern Company in Atlanta implement its own survey of 500 customers. Atlanta is a city with long commute times and notoriously bad traffic, where residents might be inclined to purchase electric vehicles to cut their gasoline bills. “This was a great opportunity to benefit from a market research study already started by EPRI,” Coley said. EPRI also launched a 1,000-person survey in collaboration with the Tennessee Valley Authority (TVA), which provides electricity to Tennessee and parts of Kentucky, Alabama, Georgia, Mississippi, North Carolina, and Virginia.

Responses to these surveys are strikingly similar, but differ substantially from Cali-

fornia responses in two key areas. First, the percentage of Californians who said they would buy an electric car in the next five years was much higher. “That’s not unexpected,” Neenan said. “California consumers are more inclined to be ‘early adopters.’” Second, California respondents would be more willing to charge at night if the price of electricity were cheaper. That’s important because drivers who come home from work and plug in their cars could be charging during peak demand and increasing stress on the electricity grid.

“Charging behavior is kind of the wild card in all of this,” said James Ellis, senior manager of transportation and infrastructure at TVA. So utilities would like to offer customers an incentive for agreeing to charge when loads are lowest. The survey suggests that might work in California, where 66% said they would charge only at night or late at night, but that strategy might be more difficult to implement in the Southeast. When the survey offered Southern Company’s and TVA’s customers the same discounts, two-thirds of the respondents said they wanted to be able to charge at any time. This may reflect cultural differences or the Southeast’s relatively cheaper electricity. “It really just shows that low cost energy economics is more of a driver here than the environmental benefits,” Ellis said.

While responses differed among surveys, most differences were subtle. “One of the things we’re finding is how alike people are,” Neenan said. “That may mean we can administer surveys over regions rather than just in utility service territories.” Participants from all three surveys said that faster charging would influence their decision to buy an electric car, but few participants indicated that they were willing to pay extra for faster charging options. Similarly, few participants were willing to pay a premium to purchase the car itself. In all three regions, respondents who said they would be likely to buy an electric car tended to be young, male, educated hybrid owners.

One section of the survey explored customers’ expectations of their utilities. Responses indicate that consumers think that electric utilities will play an important role in the transition to electric vehicles. Between 50% and 70% expect the utility to offer home charging installation services and provide car readiness audits to tell them what upgrades they need to prepare their homes for an electric car. Many customers think that utilities should provide public charging stations. “Under the traditional model, a utility delivers power no further than the electric meter,” Ellis said. But the survey results suggest that some consumers may like to see power providers



The plug-in hybrid version of the Toyota Prius, the top-selling hybrid in the U.S., is due to be released in 2012. It will use primarily battery power at low speeds and rely on its hybrid system and efficient gasoline engine at higher speeds. It should recharge from a 120-volt outlet in 3 hours. Photo courtesy of Toyota.



The Ford C-Max Energi is a plug-in hybrid electric vehicle that will be available in 2012. It relies on its battery at lower speeds and for stop-and-go driving. At higher speeds, the battery and gasoline engine work together to power the vehicle. Photo courtesy of Ford.



The Mitsubishi "i" is a battery electric vehicle already commercially available in Japan. Mitsubishi plans to begin selling the "i" in North America in late 2011. Photo courtesy of Mitsubishi.

think beyond that model. "It gives us more insight into what tools TVA can help our power distributors build in order to better meet consumers' needs," Ellis said.

Utilities may not be able to provide the services that customers expect for the prices they want to pay. Coley was surprised at how little customers offered to pay for conveniences such as 240-volt charging stations and faster charging. Purchasing and installing a 240-volt charging station, for example, can cost as much as \$2,000, but more than 90% of customers said they wouldn't pay even \$1,000. "Consumers always want the best value at the best price," Coley said. But the survey results make Coley suspect that customers need more education. Ellis agrees and added that consumers may not be taking into account the benefits of fuel switching. "The up-front costs of hardware and plug-in vehicles are more expensive right now," he said, "but there may be future financing models that can help make buying an electric car and supporting charging infrastructure more like buying a conventional vehicle."

"These surveys help utilities understand what their customers expect from them, but they also help EPRI understand what our research agenda needs to look like to be able to meet some of these requests," Duvall said. For example, given that people who

have relatively cheap electricity seem to want the convenience of charging at any time, EPRI researchers might explore other incentives that could entice customers to charge their cars during off-peak hours; EPRI could then develop the technologies needed to deploy those incentives.

The Road Ahead

EPRI researchers plan more surveys, some of which may cover an entire state and allow several utilities to share the data. Once EPRI has data from several regions, it plans to create a national database of the survey responses. "The more data we have, the more we can learn," said Duvall. Coley would like to see the survey repeated in a few years. "At that point, our customers will have had some hands-on experience with the vehicles," he said.

Neenan calls the survey a first step. "This is an early market, so not everyone who wants an electric vehicle can get their hands on one," he said. "But as more automakers enter the market and the volume ramps up, we'll quickly get to a point where more people will think about buying electric vehicles. Because the current survey doesn't look at decision tradeoffs, the data can't be used to calculate a true adoption curve." Neenan and his colleagues hope to start working on a new survey in 2012 specifically designed

to address those decision factors.

"Through this more probing research," he said, "researchers can look more closely at the decision to purchase an electric car and the impacts of the car's price, gasoline costs, and other factors." And knowing how many consumers will buy electric cars is the first step in preparing the electricity grid for this new fleet. "The industry is trying to anticipate how electric vehicles will change the demand for electricity," Neenan said, "so we don't get caught unprepared."

With better information, both Sam the car buyer and his utility power supplier may expect to arrive at the same plug at the same time for a successful "refueling."

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to prices and information and on quantifying the benefits of disruptive technologies such as hyper-efficient energy devices, smart grid technologies, and electric vehicles. Neenan holds a B.S. and a Ph.D. in agricultural economics from Cornell University and an M.S. in food and resource economics from the University of Florida.