

# **HOW DO THE EV PROJECT PARTICIPANTS FEEL ABOUT THEIR EVS?**

James E. Francfort

February 2015



The INL is a U.S. Department of Energy National Laboratory  
operated by Battelle Energy Alliance

# **HOW DO THE EV PROJECT PARTICIPANTS FEEL ABOUT THEIR EVS?**

**James E. Francfort**

**February 2015**

**Idaho National Laboratory**

**Idaho Falls, Idaho 83415**

**<http://www.inl.gov>**

**Prepared for the  
U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy  
Under DOE Idaho Operations Office  
Contract DE-AC07-05ID14517**

# How Do The EV Project Participants Feel About Their EVs?

February 2015

## Key Observations from the Survey of The EV Project Participants

- In June 2013, EV Project survey respondents were very satisfied with their plug-in electric vehicles (PEVs), and 96% would replace their current PEV with another PEV.
- The EV Project survey respondents had an average of 2.6 vehicles in their household and 70% reported the PEV as their primary vehicle.
- The number one reason EV Project survey respondents selected the PEV was that PEVs are energy efficient and cheaper in the long run than gasoline vehicles.
- 94% of survey respondents reported they drove their PEVs the same or more miles per day than when they first acquired it.

## Introduction

The EV Project is an infrastructure study that enrolled over 8,000 residential participants. These participants purchased or leased a Nissan Leaf battery electric vehicle (BEV) or Chevrolet Volt extended range electric vehicle (EREV) and were among the first to explore this new electric drive technology. Collectively, BEV, EREV, and plug-in hybrid electric vehicles (PHEVs) are called plug-in electric vehicles (PEVs). The EV Project participants were very cooperative and enthusiastic about their participation in the project and very supportive in providing feedback and information. The information and attitudes of these participants concerning their experience with their PEVs were solicited using a survey in June 2013. At that time, some had up to 3 years of experience with their PEVs.

## Why is Plug-In Electric Vehicle Satisfaction Important?

Everett Rogers sought to explain how new technologies can spread through a culture in his book, *Diffusion of Innovations*. According to the theory, the innovators and early adopters must be satisfied with a new technology product before it can be accepted by the larger market. Any market consists of the groups identified in Figure 1, which also shows their typical share of that market.

Were The EV Project participants satisfied with electric drive transportation? These participants were the innovators and early adopters and their feedback on how they felt about their PEVs is of interest because it can shape this new technology for wider adoption.

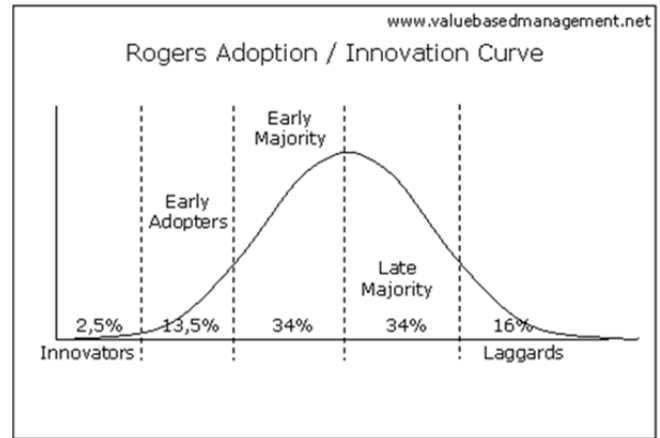


Figure 1. Rogers adoption/innovation curve.<sup>1</sup>

## Participant Information

Understanding the demographics of The EV Project participants is important in understanding their choices and attitudes toward electric transportation. The age, gender, average household income, and education level were explored in "Who are the Participants in The EV Project?"<sup>2</sup>

The Nissan Leaf sales rollout plan defined the initial five regions of The EV Project, anticipating them to be the locations of the innovators and early adopters of EVs. Later expansion of The EV Project included 16 metropolitan areas in nine states plus the District of Columbia. Within these regions, physical study boundaries were established. The views and attitudes of project participants nationally and regionally are explored in this report.

## Which PEV did They Acquire?

The EV Project achieved full enrollment of residential participants early in 2013. The final enrollment in each market was ultimately determined by the PEV market conditions, which was driven by local PEV dealer promotions, along with local government incentives and local demographics. Table 1 identifies the number of participants driving Nissan Leafs and Chevrolet Volts in each region. Because of other U.S. Department of Energy (DOE) projects in the area, Chevrolet Volt drivers were not included in The EV Project in the San Francisco region.

The original completion date of The EV Project was December 2012. Later expansion of the project also extended the completion date to December 2013. Some participants retired from the project at the end of the original period. In addition, some other participants retired

because they sold their vehicles or their vehicles were destroyed in accidents.

Table 1. Regional participation in The EV Project.

	Leaf	Volt
Arizona	376	156
Los Angeles	471	344
San Diego	722	277
San Francisco	1,874	—
Oregon	558	136
Washington State	969	177
Tennessee	942	144
Texas	34	288
Washington D.C.	50	291
Atlanta	176	77
Chicago	34	129
Philadelphia	32	54
Overall	6,238	2,073

## Participant Survey

One goal of The EV Project is to gain an understanding of the participants' experience and attitudes toward many aspects of their PEV usage. In support of this goal, an online survey was sent to 7,730 active EV Project participants. The survey solicited 3,236 responses for a 42% response rate. Among the topics identified were questions related to participants' PEV use and attitudes. Table 2 presents the responses received by region and vehicle type.

Table 2. Survey responses by region.

	Leaf Responses	Volt Responses	Leaf and Volt Responses
Arizona	159	74	1
Los Angeles	133	120	7
San Diego	244	109	7
San Francisco	553	—	4
Oregon	211	74	2
Washington State	378	83	3
Tennessee	345	54	2
Texas	11	119	2
Washington D.C.	13	114	2
Atlanta	74	39	1
Chicago	15	67	—
Philadelphia	13	26	1
Unknown	159	2	2
Overall	2,308	881	34

Thirty-four of the respondents reported having both a Leaf and a Volt in The EV Project and 13 reported they were no longer participating. One hundred and sixty-three responses were provided that identified the type of vehicle, but not the region of The EV Project.

## Why did They Purchase or Lease Their Electric Vehicle?

Participants were asked, "Why did you purchase or lease your Volt or Leaf?" They were provided with six possible responses and asked to rank them in order of importance, with 1 being the highest rank. The response choices were as follows:

- EVs are environmentally friendly and reduce greenhouse gas emissions.
- EVs are energy efficient and cheaper in the long run than gasoline vehicles.
- For philosophical reasons (i.e., I like being an adopter of high-tech/advanced technologies, I like the image of driving a "green" car, etc.)
- I'm doing my part to reduce U.S. reliance on imported petroleum.
- For performance benefits (i.e., quite ride and smooth acceleration).
- To have access to high-occupancy vehicle traffic lanes.

In all, 3,034 responses were received. Figure 2 shows the spread of the responses.

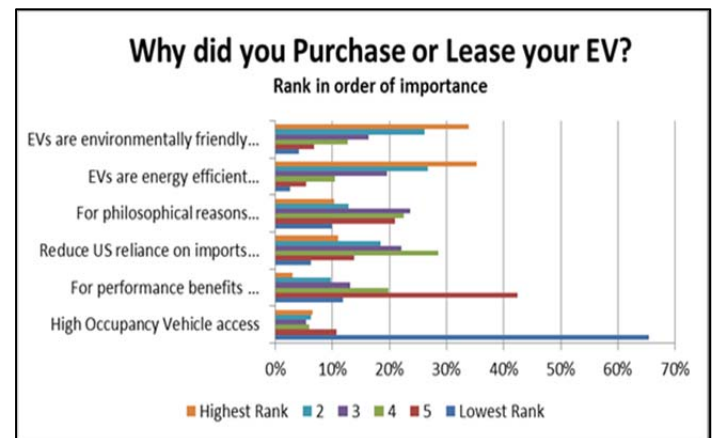


Figure 2. EV purchase motivation.

Table 3 presents the overall average ranking of the responses.

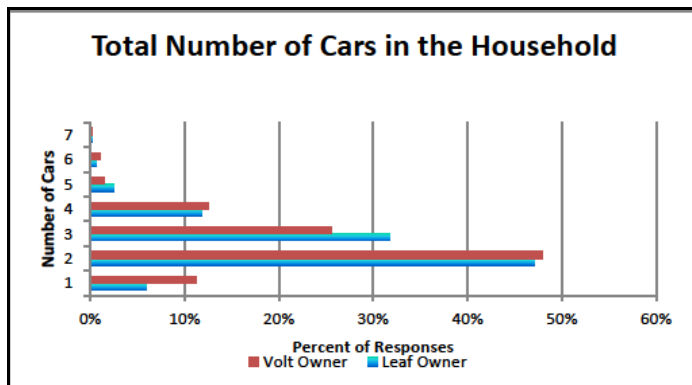
The highest-ranking responses deal with energy efficiency and financial savings, which are more pragmatic responses than most of the other possible responses. This is important in moving the EV market beyond the innovators of Figure 1. It is noted that having access to high-occupancy vehicle lanes received the lowest ranking overall; however, there were 198 responses (7%) where this was listed as the highest-ranking reason.

**Table 3. EV purchase motivation.**

Response Choice	Average Rank
EVs are environmentally friendly...	2.44
EVs are energy efficient...	2.32
For philosophical reasons...	3.61
Reduce U.S. reliance on imports...	3.34
For performance benefits...	4.24
High occupancy vehicle access	5.04

## How Many Vehicles are in the Participant's Household?

Participants were asked, "Please select the amount of vehicles in your household, including your EV." The survey provided six choices of vehicle types (Table 4) and quantities of 0, 1, 2, or 3 or more for each vehicle type. For example, a response may show 3 or more BEVs, 2 gasoline, and 1 diesel vehicle. The question did not ask the specific number of vehicles above 3, but assuming that "3 or More" is exactly 3, the total number of cars in the household is shown in Figure 3.



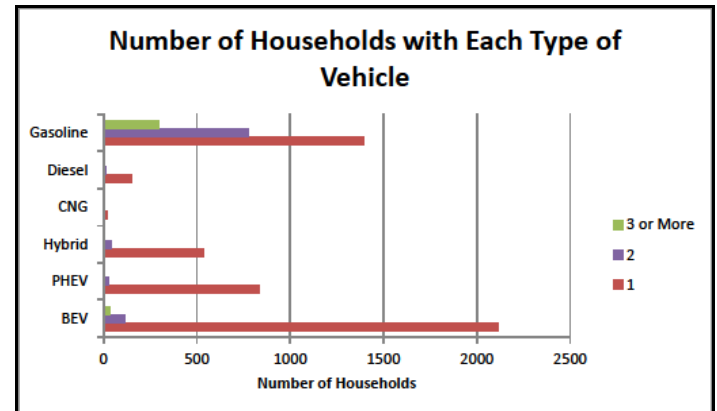
**Figure 3. Total number of vehicles in the household.**

On average, the Leaf Owner has 2.61 vehicles in the household and the Volt Owner has 2.49 for an overall average of 2.58 vehicles per household. Fifteen percent of Leaf owners and 15% of Volt owners report having more than 3 vehicles in the household.

The vehicle choices in the question were as follows:

- All battery EV (like the Nissan Leaf)
- Plug-in hybrid/extended range EV (like the Chevrolet Volt)
- Hybrid vehicle (does not plug in)
- Natural gas/CNG
- Diesel vehicle
- Conventional gasoline vehicle.

In all, 3,004 responses were received. Figure 4 provides the responses.



**Figure 4. Number of households with vehicle types.**

Fifty-two Volt drivers and 48 Leaf drivers did not identify their vehicle as that type in this question, even though the choices identified the specific model in that category and they selected their type in a previous question.

Table 4 provides this information in tabular form. For each category, the total number of vehicles in that category is reported with the percent of responders with that response identified below it. Because more than one response is allowed, the total may sum to more than 100%.

**Table 4. Number of vehicles in household by type**

Number of Households Reporting Vehicle Type and Quantity	1	2	3 or More
All battery EV (like the Nissan Leaf)	2,116 68%	116 4%	31 1%
Plug-in hybrid (like Chevrolet Volt)	836 27%	26 1%	1 0%
Hybrid vehicle (does not plug in)	537 17%	38 1%	1 0%
Natural gas/CNG	18 1%	5 0%	1 0%
Diesel vehicle	148 5%	13 0%	2 0%
Conventional gasoline vehicle	1,395 45%	775 25%	298 10%

A comparison of responses by Leaf or Volt owners is shown in Figure 5. Figure 5 shows that 98% of Leaf owners identified they have at least one BEV. In addition, 3% of Leaf owners identified they also had at least one PHEV and 80% indicated they also had at least one conventional gasoline vehicle.

Ninety-four percent of Volt owners identified they had at least one PHEV, 7% identified they owned at least one BEV, and 78% identified they owned at least one

conventional gasoline vehicle. There were six Volt owners who reported one PHEV and three or more BEVs.

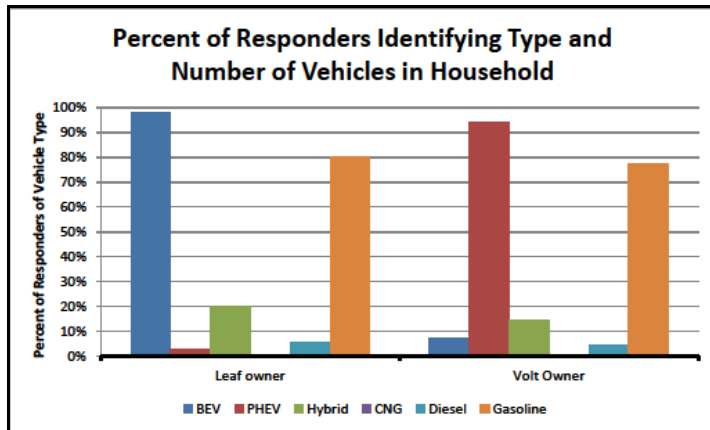


Figure 5. Percent of responders on vehicle type and number.

For unknown reasons, not all Leaf owners identified owning a BEV and not all Volt owners identified owning a PHEV.

Twenty-five Leaf owners identified they owned three or more BEVs, while 166 Leaf owners (7%) reported having only PEVs (i.e., no other vehicle type) and 338 Leaf owners had one BEV and one conventional gasoline vehicle only.

Twenty-five Volt owners identified owning two or more PHEVs, while 105 Volt owners report they had PEVs, but no other vehicle type and 153 Volt owners had one PHEV and one conventional gasoline vehicle only.

## Primary Vehicle

Participants were asked, “Which of your vehicles would you consider your family’s primary vehicle?” In all, 3,124 responses were received (shown in Figure 6).

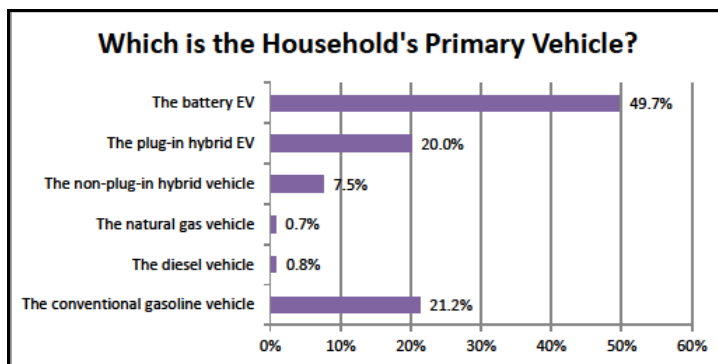


Figure 6. Household primary vehicle.

Segmenting the responses by vehicle owner provides the responses shown in Figure 7.

As might be expected, Leaf owners relied more heavily on their conventional gasoline vehicle than the Volt owners; however, it is revealing that 17% of the Volt owners

identified that their conventional gasoline vehicle was their primary vehicle.

It is noted that for those who had both BEVs and PHEVs, 9% of Volt owners identified that the BEV was their primary vehicle, whereas 1% of Leaf owners identified the PHEV as their primary vehicle.

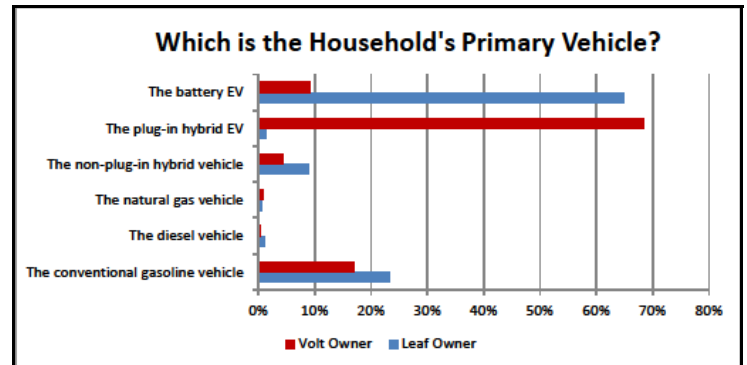


Figure 7. Household primary vehicle by vehicle owner.

## Electric Vehicle Use

Participants were asked, “Which of the following describes how you use your PEV today?” Respondents were allowed to select all that apply and to specify other uses.

Response choices were as follows:

- I use my EV for work commuting.
- I use my EV for occasional short-distance trips for shopping, errands, or office visits.
- I use my EV for most of my vehicle uses (it is my primary vehicle.)
- I use my EV for all of my trips (It is my only vehicle).
- Other (please specify).

Multiple responses were allowed, with 3,222 responses being received (see Figure 8).

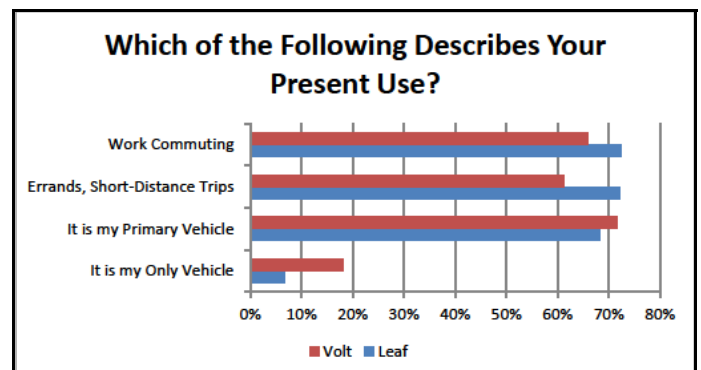


Figure 8. Present day EV use.

Responses for work commuting, short trips, and primary vehicle choices were nearly equal for both the Volt and Leaf owners, with the primary vehicle choice getting the



most responses from Volt owners (71%) and the work commuting choice getting the most responses from Leaf owners (72%).

Fifty-three respondents provided unsolicited additional information related to their present use. They were categorized into the comments noted in Figure 9.

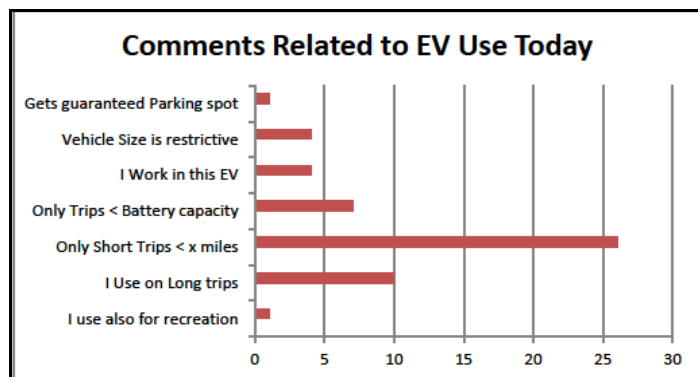


Figure 9. Comments related to present-day EV use.

“Gets guaranteed parking spot” was reported by one person as a reason for selecting the PHEV. “Vehicle size is restrictive” summarizes comments indicating that the respondent would use the vehicle more, but finds the passenger or cargo area is too small to meet all needs (i.e., carpooling or carrying luggage). “I work in this EV” were comments related to the vehicle being a tool for their work (e.g., appraisers, etc). “Only trips < battery capacity” was reported, indicating they only select the PEV for trips that would be less than the battery capacity. Some specified a specific maximum distance as the criterion for selecting the PEV. Some made a point of identifying that they like their Volt for long trips and for recreation.

The survey then asked, “Think back to when you first bought your EV. Are you using it for the same purposes today as you had originally intended?” 95% responded in the affirmative.

## Daily Miles Traveled

Participants were asked, “Has the daily miles driven on your EV changed since you brought it home?” This question, like the one above, was intended to identify whether driving habits have changed with more experience. The responses are shown in Figure 10.

Overall, 94% of responders reported they drove the same or more miles in June 2013 than when they purchased their PEV, with 41 responders specifying a difference as categorized in Table 5.

This question is also being evaluated by reviewing driver charging and travel data obtained through the charging stations and vehicle telematics. This will be the subject of a separate report.

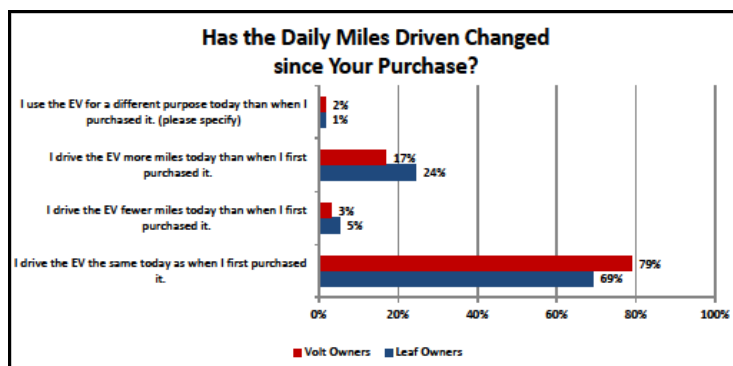


Figure 10. Change in daily miles traveled.

Table 5. Change in owner miles driven.

Comment	Number
Changed use from commuting to running errands	1
My confidence has grown and I use public charging more	1
My vehicle's range has diminished	3
I was driving for errands only, but now I'm driving more	1
A different family member is now using the EV	1
My job/school change is now beyond the range of the EV	2
The EV has a more limited range than I was told or thought	2
I was commuting only, but now have expanded its use	6
I am now retired or work less than before, so drive less	24

## Meeting Driving Needs

Participants were asked, “What percent of your driving needs are met by your EV?” In all, 3,029 responses were received and are shown in Figure 11.

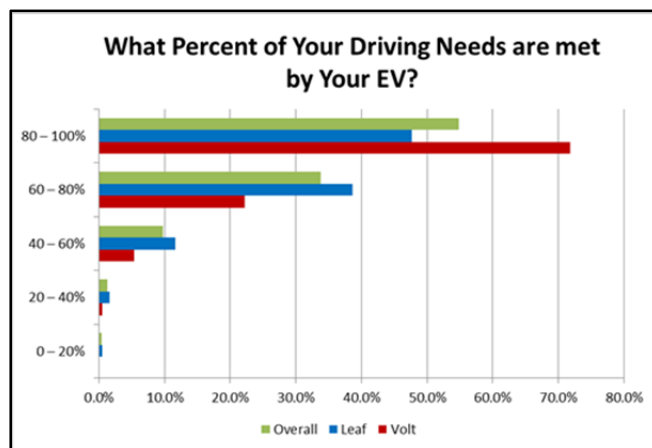


Figure 11. Driving needs met by EV.

Ninety-four percent of Volt owners and 87% of Leaf owners reported more than 60% of their driving needs were met by their PEV. Figure 12 considers this question on a regional basis. Over 85% of responders in all regions noted that more than 60% of their driving needs were met by their

PEVs. Variations between the top two categories are reflected in Figure 12, where Los Angeles and Texas reported the highest percentages of needs met.

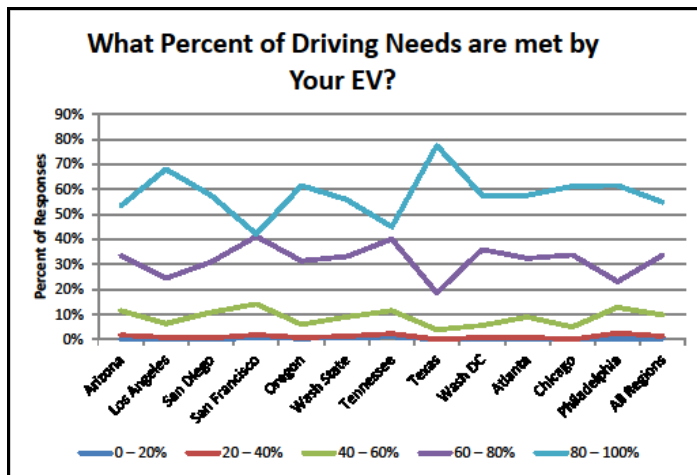


Figure 12. Driving needs met by The EV Project region.

## How Do You Decide which Vehicle to Drive?

Participants were asked, “Since you may have a choice of vehicles, how do you decide between using your EV and choosing the other vehicle?” Response choices were provided, along with an open-ended response for other comments. The response choices were as follows:

- I generally use the EV for specific purposes.
- I generally use the EV for trips I know I can make on battery power only without recharging away from home.
- I will use the EV for longer ranges if I know there is public charging available where I’m going.
- I’m cautious about putting too many miles or battery charges on my EV.
- I try to use my EV whenever I can.
- Another member of the household uses one vehicle and I use the other.
- Other (please specify).

Participants could select all that apply; therefore, response totals could be greater than 100%. In all, 3,246 responses were received and are shown in Figure 13.

It is noted that 53% responded that they would use the PEV for trips within the capacity of their battery; therefore, they would not have to use public charging, and 25% would use the PEV if they knew that public charging would be available.

Of all responses, 190 respondents offered comments in the “Other” category. Those responses are summarized in Table 6.

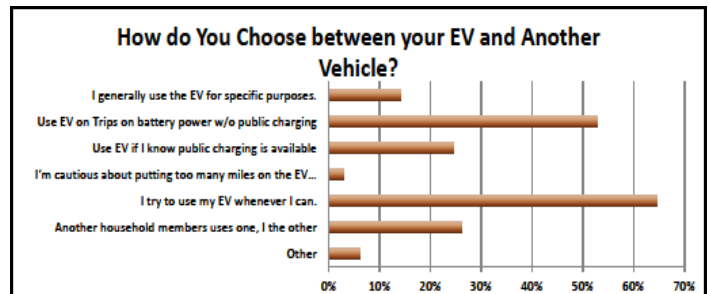


Figure 13. Choosing vehicles.

Table 6. Other comments on choice of vehicle.

Other Comments on Choice	Number of Responders
EV vehicle characteristics can be too restrictive for passengers or cargo	31
I avoid away-from-home charging	13
I avoid using too many public chargers on one outing	1
I would use the EV more if DCFC were available	7
We enjoy driving the other vehicle (i.e., convert)	4
Our PEV is our first choice always	44
We limit the miles to avoid lease issues	10
For longer trips, we use the PEV	9
Sometimes we need to use both at the same time	1
EV is our only car	41
Spouse always uses one and I the other	3
We use the EV only for short trips	19
It is used for work commute primarily	7

Attitudes toward public and workplace charging will be explored further in other EV Project reports. Regional variations in responses were considered. The results are shown in Figure 14.

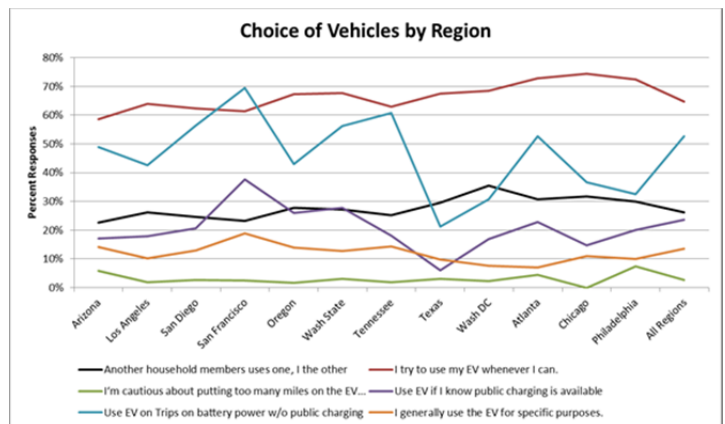


Figure 14. Choice of vehicle by EV Project region.

Consistently between regions, the EV owners tried to use the EV whenever they could. It also appears to be common practice that one household member typically used the EV, while another member used a different vehicle.

While overall, 53% of drivers avoided trips beyond the capacity of their PEV battery, this attitude varied widely between regions, with San Francisco having the greatest agreement (69%) and Texas showing the greatest



acceptance of charging away from home (21%). At the same time, 38% of the San Francisco responders noted they would use the EV for longer ranges if they knew public charging was available.

For San Francisco, the total response for these two questions is greater than 100%, indicating some responders selected both answers. For these, and perhaps many others, the key may be whether they have the *knowledge* of the availability of public charging where they want to go.

## Replacing Your Electric Vehicle

Finally, participants were asked “If you were to replace your current EV, would you:” and the following choices were provided:

- Replace it with a BEV
- Replace it with a PHEV
- Replace it with a conventional hybrid vehicle
- Replace it with a conventional gasoline vehicle.

In all, 3,035 responses were received (Figure 15).

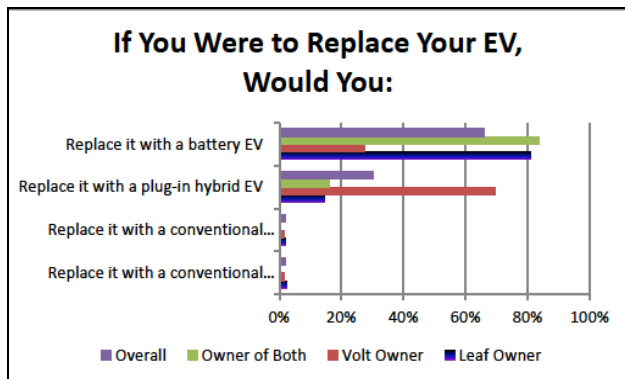


Figure 15. Replacing the current EV.

Overwhelmingly, the PEV owner would replace their existing PEV with another, with 96% of responders saying they would buy a PEV, while only 4% would buy a hybrid or gasoline vehicle. It is noted that owners of both vehicles in The EV Project would select a BEV as a replacement over the PHEV by 84% to 16%. As noted above, there were many survey respondents who own both BEVs and PHEVs. Fully, 81% of Leaf owners would replace their Leaf with another BEV, while 70% of Volt owners would replace their Volt with another PHEV. Twenty-seven percent of Volt owners would replace their Volt with a BEV and 15% of Leaf owners would replace their Leaf with a PHEV.

## Observations

PEV owners in The EV Project were very satisfied with their PEV. While most had a choice of vehicles in the household, 70% selected the PEV as their primary vehicle and used it

as much as possible. Ninety-four percent drove as much or more in June 2013 as they did when they bought it, and 96% would select another PEV if they were to replace the one they have.

This satisfaction is important in expanding the PEV market to the early majority noted in Figure 1.

## About The EV Project

The EV Project was the largest PEV infrastructure demonstration project in the world. Equally funded by the DOE through the American Recovery and Reinvestment Act and private sector partners, it supported the initial rollout of the Nissan Leaf and Chevrolet Volt PEVs, as well as the first deployment of PEVs in an all-PEV ride share application. The EV Project deployed over 12,000 alternating current Level 2 charging stations and over 100 dual-port direct current fast chargers in 16 metropolitan areas in nine states plus the District of Columbia across the United States during the period January 1, 2011, through December 31, 2013. Drivers of approximately 8,300 Nissan Leafs, Chevrolet Volts, and Smart ForTwo Electric Drive vehicles were enrolled in the Project.

Project participants allowed EV Project researchers to collect and analyze data from their vehicles and chargers. Data collected from project vehicles and charging infrastructure document nearly 125 million miles of driving and over 4 million charging events in significant detail, characterizing the earliest days of electric vehicle adoption through significant penetration of both the vehicles and charging infrastructure. The data reside at Idaho National Laboratory, which is responsible for analyzing the data and publishing summary reports, technical papers, and lessons learned on vehicle and charger use.

## Company Profile

Idaho National Laboratory is one of DOE's 10 multi-program national laboratories. The laboratory performs work in each of DOE's strategic goal areas: energy, national security, science, and the environment. Idaho National Laboratory is the nation's leading center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

For more information, visit <https://www.inl.gov/>, <http://avt.inel.gov> and [avt.inel.gov/evproject.shtml](http://avt.inel.gov/evproject.shtml)

## References

<sup>1</sup>"Acceptance and Diffusion of Innovations", [http://www.valuebasedmanagement.net/methods\\_rogers\\_innovation\\_adoption\\_curve.html](http://www.valuebasedmanagement.net/methods_rogers_innovation_adoption_curve.html), accessed August 14, 2013.

<sup>2</sup>"Who are the Participants in The EV Project," Lessons Learned, [avt.inel.gov/evproject.shtml](http://avt.inel.gov/evproject.shtml).