



The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update

Mark Singer
National Renewable Energy Laboratory

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November 2017

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Consumer Views Quick Facts¹

Vehicle Purchasing Behaviors

- 58% of respondent households owned two or more vehicles.
- 51% of respondents stated their last vehicle purchases were sedans.
- 42% of respondents stated their next vehicle purchases would likely be sedans.
- 29% of respondent households had purchased vehicles in the last year.

Plug-in Electric Vehicle Awareness

- 46% of respondents were able to name a specific plug-in electric vehicle make and model.
- 10% of respondents, up from 5% in 2015, reported having a neighbor who has a plug-in electric vehicle.
- 46% of respondents, increased from 2015, believe all-electric vehicles are “as good as”, or “better than” traditional gasoline vehicles. For the first time, that percentage is now equal to those believing the same for plug-in hybrid electric vehicles.
- 24% of respondents stated they would consider or expect to purchase plug-in hybrid electric vehicles for their next vehicle purchase or lease.
- 21% of respondents stated they would consider or expect to purchase all-electric vehicles for their next vehicle purchase or lease.

Barriers to Plug-in Electric Vehicle Acceptance

- In order for 47% of respondents to be willing to consider purchasing an all-electric vehicle, it would need to be able to travel 300 miles on a single charge.
- 26% of respondents, up from 18% in 2015, were aware of charging stations on the routes they regularly drove.
- 54% of respondents could consistently park their vehicles near electrical outlets at home.
- 47% of respondents would be willing to pay incremental costs for plug-in electric vehicles.

Plug-in Electric Vehicle Acceptance

- Respondents aware of plug-in electric vehicle charging stations were more likely than respondents overall to view plug-in electric vehicles positively and be willing to consider purchasing them.
- Respondents aware of plug-in electric vehicle tax incentives were more likely than respondents overall to view plug-in electric vehicles positively and be willing to consider purchasing them.
- Respondents aged 35 or younger were more likely than respondents overall to view plug-in electric vehicles positively and be willing to consider purchasing them.
- Respondents in the West and Northeast census regions were more likely than respondents overall to be willing to consider purchasing plug-in electric vehicles.

¹ The above findings are based on a February 2017 study that is the third in a series of annual studies tracking consumer attitudes toward plug-in electric vehicles. The study covered a 1,017-household sample designed to be representative of the United States population.

Acronyms

| | |
|------|--------------------------------------|
| ACS | American Community Survey |
| AEV | all-electric vehicle |
| EV | electric vehicle |
| HEV | hybrid electric vehicle |
| NREL | National Renewable Energy Laboratory |
| ORC | Opinion Research Corporation |
| PEV | plug-in electric vehicle |
| PHEV | plug-in hybrid electric vehicle |

Acknowledgments

This work was supported by the U.S. Department of Energy’s Vehicle Technologies Office. Additional support came from the National Renewable Energy Laboratory, which is a national laboratory of the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy operated by the Alliance for Sustainable Energy, LLC.

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All judgments in the final analytic methodologies and interpretations are the responsibility of the author.

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Introduction

This report details American public sentiments toward issues surrounding plug-in electric vehicles (PEVs) and is supported by the U.S. Department of Energy's Vehicle Technologies Office in alignment with its mission to research and implement these technologies to improve energy security, enhance mobility flexibility, reduce transportation costs, and increase environmental sustainability.

A PEV is broadly defined as a vehicle that can be plugged in, is powered by an electric motor, and uses energy stored in an onboard battery. The definition encompasses all-electric vehicles (AEVs) that are powered by electric motors only and plug-in hybrid electric vehicles (PHEVs) that can also be powered by an internal combustion engine (ICE) fueled by petroleum fuel. The most recent generation of PEVs has been commercially available in the United States since December 2010. A PEV is different from a hybrid electric vehicle (HEV). An HEV is similar to a PHEV, as it is powered by an ICE and an electric motor that uses energy stored in a battery. However, the battery in an HEV cannot be plugged in; it is completely charged by fuel used in the ICE, either through a generator, or indirectly through regenerative braking.

Understanding consumer sentiments can influence the prioritization of implementation efforts by identifying barriers to, and opportunities for, the broad acceptance of new technologies. The data detailed in this report represents three years of annual studies completed to track public perceptions associated with PEV implementation efforts. This report is intended to support the evaluation of whether advancing vehicle technologies and changing vehicle availability align with evolving consumer expectations and interests over time.

This report primarily summarizes data captured in a February 2017 study focused on respondents' sentiments about factors influencing PEV adoption.

- Section 1 captures respondent vehicle purchasing behavior independent of a particular vehicle technology.
- Section 2 details current consumer awareness and acceptance of PEV technologies.
- Section 3 captures metrics associated with known barriers to PEV acceptance, including battery capacity and vehicle costs.
- Section 4 highlights segments of the respondents in which PEV acceptance may be higher than the respondent group in total.

In addition to the above sections, Appendix A includes a listing of publicly available PEV consumer preference studies completed by other entities. These studies are included to provide context for the data presented in this study.

It is important to acknowledge a person's stated preference in an interview about a hypothetical setting often does not match their revealed preference, which is demonstrated in an actual decision-making situation (Keane and Wasi 2013). This difference makes tracking actual consumer actions ultimately more valuable in understanding potential behavior. However, when technologies are not yet available or are new to a marketplace and actual behaviors cannot be tracked at scale, stated preferences provide some insights into how consumers may react in new

circumstances. In this context, the report provides a supplemental source to validate other data and a new resource when no data are available.

Most of the data presented in this report are the results of interviews conducted by the Opinion Research Corporation (ORC) for the National Renewable Energy Laboratory (NREL). The studies were conducted via telephone with randomly selected telephone numbers. The study in this report used a dual-frame sampling design in which the sample was drawn from independent landline and cell phone sample frames and is based on responses from individuals across the country who were at least 18 years old. Response samples were weight-adjusted by age, gender, region, race/ethnicity, and education to better ensure that the sample reflects the general U.S. population. The study relied on ORC's weighting mechanism, which pulls from data reported in the National Health Interview Survey and the U.S. Census Bureau's Current Population Survey. When ORC study data are presented, the specific ORC study number is noted along with the year of the study and the study sample size. The February 2017 study included 1,017 respondents and had a margin of error of $\pm 3\%$ at the 95% confidence level. Smaller subgroups of the respondents will have larger error margins.

Most findings are compared to studies completed in 2016 and 2015 compatible with this one (Singer 2016b), allowing the assessment of trends between years. In many instances throughout this report, the response percentages in tables and figures do not sum to exactly 100% because the raw data are rounded. For the same reason, summary data points called out in the body of the report may not match the results that were obtained by summing data from the tables and figures.

1 Vehicle Purchasing Behaviors

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1.1 Vehicle Purchasing Behaviors

The February 2017 study began by investigating aspects of the respondents' vehicle purchasing behaviors independent of a specific vehicle technology. Capturing these inherent variables about the market highlights barriers or benefits to PEV or other advanced vehicle technology adoption.

The first of these variables covered is the number of household vehicles. If vehicle ownership decreases, the number of new purchases of any vehicle technology may also decline. Conversely, an increase in household vehicle ownership may provide additional opportunities for all vehicle technologies. Multivehicle households may be better suited for PEVs than single-vehicle households because AEVs specifically can be limited by battery capacity on longer trips. A household with multiple vehicles might be better able to provide alternative transportation for longer trips than one without multiple vehicles. This study found little change in household vehicle ownership overall. Findings indicate an increase in one vehicle households and a decrease in two vehicle households since a 2007 study, but these changes have been within the 3% margin of error of the study.

PEV acceptance depends, in part, on their availability as the vehicle types that consumers desire. PEV offerings were initially focused in smaller sedans, and have since become available in a broader set of vehicle types. More than half (51%) of respondents stated their last vehicle purchases were sedans, down from 56% in 2016. Similarly, the percentage stating their next vehicle would be a sedan declined from 45% in 2016 to 42% in 2017. This decline in interest for sedans highlights the need for PEVs to continue to be available in a broad set of preferred vehicle types, if PEVs are to achieve a high percentage of vehicle purchases.

Consumers also require that PEVs be available in their vicinity. Currently, PEVs are not uniformly available across the country, and the lack of PEV availability in some areas can be a barrier to broad consumer acceptance. Regional variations in PEV acceptance are presented in section 4 of this report.

Consumers' buying habits for vehicle purchases vary. An individual customer may purchase or lease a new vehicle every 3 years or even more frequently; others may keep their vehicles for 10 years or longer. This study found that 40% of respondents (consistent with 2015 and 2016 results) either purchased vehicles in the last year or expected to purchase vehicles in the next year. Purchasers' interests in new or used vehicles also vary. A majority (56%) of respondents stated they might consider a new vehicle for their next vehicle purchase; 43% stated they would be unlikely to consider a new vehicle and would likely purchase a used vehicle. These results have been consistent across all years of the study.

Finally, the study investigated the respondents' currently owned vehicle fuel types. As expected, the overwhelming majority of respondents (83%) owned at least one traditional gasoline vehicle, but this number declined 3% from 86% in 2015. More than one in five respondents (22%) stated they owned an alternative fuel or advanced technology vehicle, including diesel, ethanol, compressed natural gas, HEV, or PEV. Less than 1% of respondents reported owning an AEV or PHEV. Respondent ownership rates of traditional gasoline vehicles tracked closely with actual vehicle registration data. Figure 8 shows that the percentage of respondent households with an alternative fuel or advanced technology vehicle was higher than the share of those types of vehicles counted in actual vehicle registrations.

1.2 Household Vehicle Ownership

Vehicle ownership results appeared similar to prior study results. In February 2017, the mean number of vehicles owned by respondent households was 2.2. A significant majority (64%) reported owning one or two vehicles, while 58% reported owning two or more vehicles. Results were consistent with those from February 2016. Compared to a related April 2007 study, responses showed a slight decline in the number of two-vehicle households and a slight increase in zero- and single-vehicle households. There has been a steady increase in one vehicle households and a steady decrease in two vehicle households since the 2007 study. The increase in one vehicle households is within the study's 3% margin of error, but the decrease in two vehicle households is now larger than the margin of error. Compared to the latest U.S. Census Bureau American Community Survey (ACS) data from 2013, February 2017 respondents had fewer one- and two-vehicle households and more households with four or more vehicles.

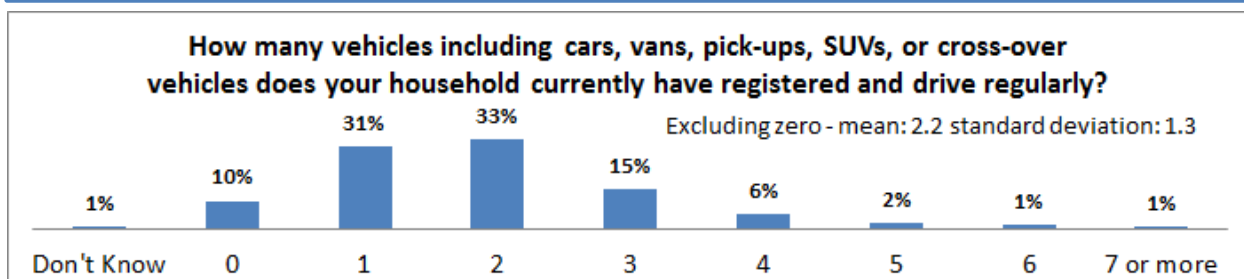


Figure 1. Question 1: Registered vehicles per household

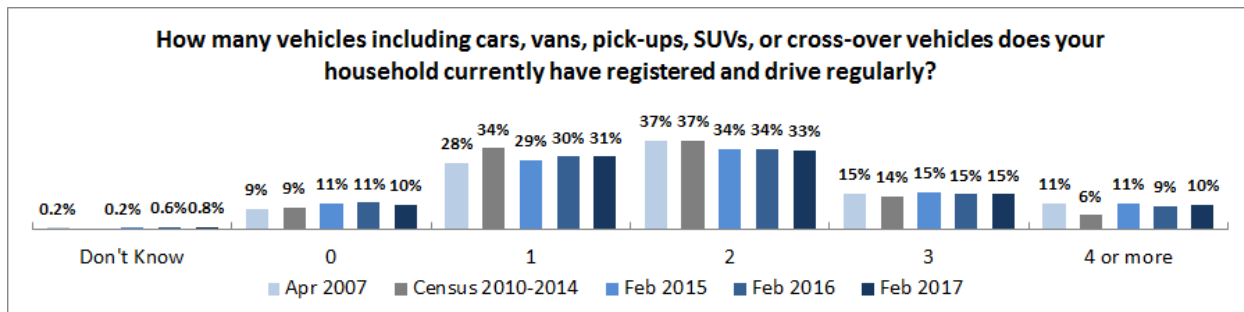


Figure 2. Comparison of registered vehicles per household over time

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015. For 2007: ORC for NREL (2007), Study No. 716159, n=1,000.

U.S. Census Bureau. 2011-2015. "Household Size by Vehicles Available." American Community Survey 5-Year Estimates, USACS_15_5YR_B08201. Washington, D.C.: U.S. Census Bureau. Accessed August 30, 2017: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B08201&prodType=table.

Notes: Given that the current study covered 1,017 households and the ACS covered more than 3.5 million households, it is not concluded that the current study identifies a clear change in household vehicle ownership rates from those captured by the ACS. Rather, the comparison is shown to put the respondent group in context with the broader general public.

Section 4 of this report uses these results to classify single- and multivehicle households for investigation of how PEV acceptance may vary by respondent segments.

1.3 Household Vehicle Types

The February 2017 study asked respondents to provide the vehicle types of their last vehicle purchases and the vehicle types they expected to purchase next. A majority of respondents (51%) were interested in sedans, which were categorized in the study as small and large cars. When their latest purchase choices were compared to what they expect to purchase next, the responses showed that interest may be shifting away from sedans and toward pickup trucks and sport utility vehicles. This shift is small and may represent the respondents' aspirations to shift to a new vehicle type rather than what their next vehicle purchase will ultimately be. Results are generally consistent with 2016 results.

For your last/next household vehicle purchase or lease, which one of the following did/will you purchase or lease?

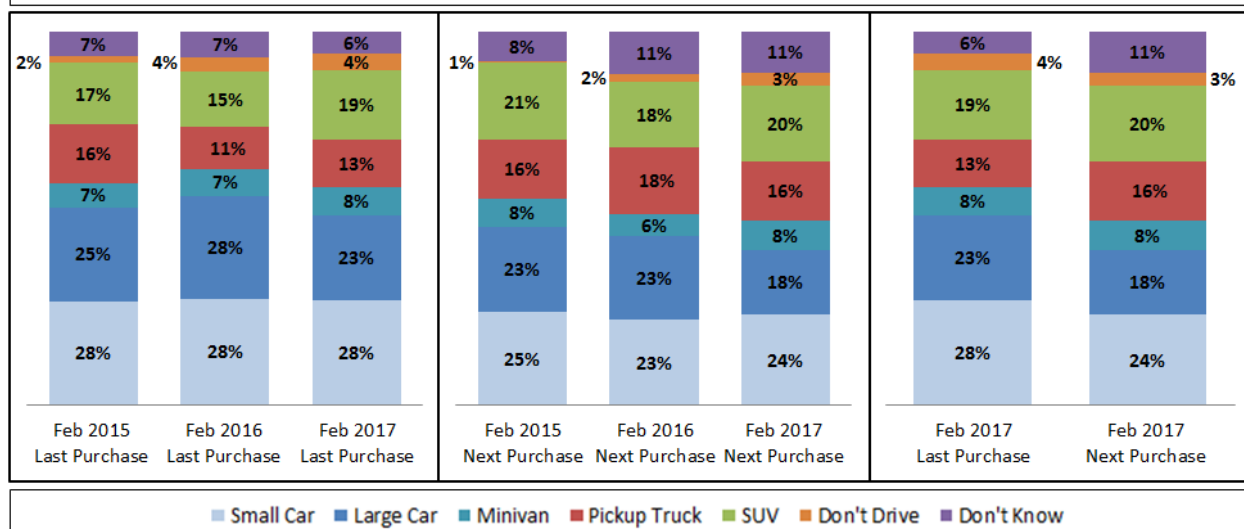


Figure 3. Questions 2 and 3: Last and next vehicle type choices

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

Note: Small cars were defined as being “smaller than the Chevy Malibu, Toyota Camry, or Ford Fusion” and large cars were defined as being the “same size or larger than the Chevy Malibu, Toyota Camry, or Ford Fusion.”

1.4 Time Since Last and Until Next Vehicle Purchase

Respondents in February 2017 were asked how long it had been since their last vehicle purchases and how long it would be before their next vehicle purchases. Consistent with 2016, a majority (60%) of respondents purchased vehicles in the last 3 years, and 46% expected to purchase vehicles within the next 3 years.

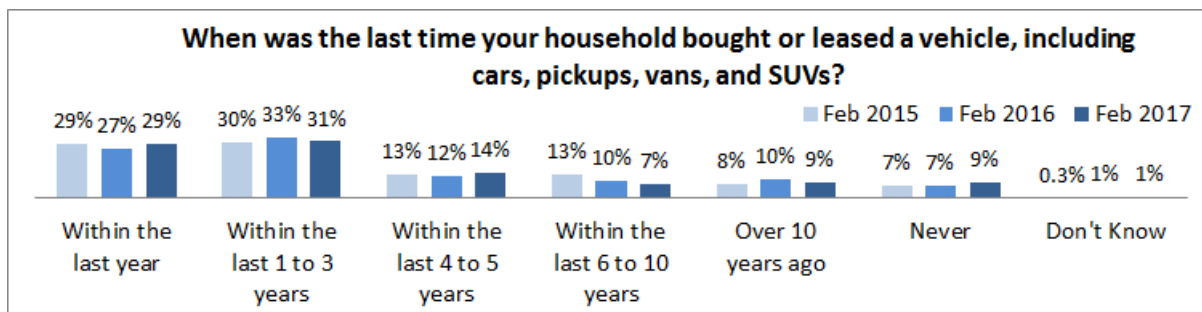


Figure 4. Question 4: Time since last vehicle purchase

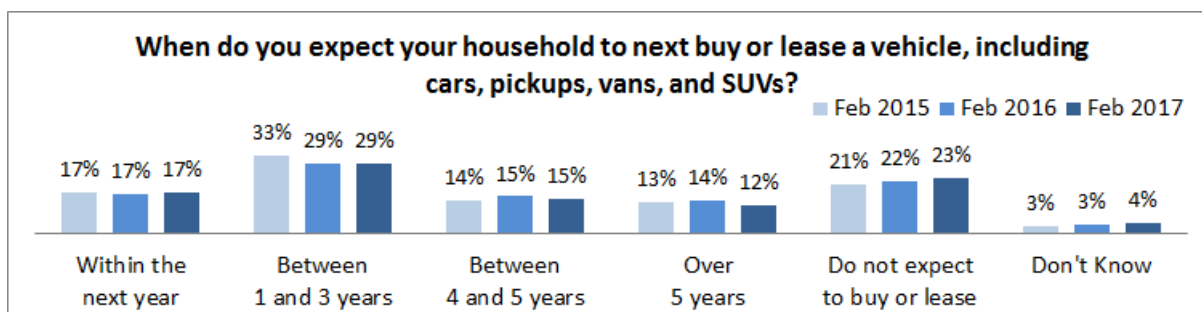


Figure 5. Question 5: Time until next vehicle purchase

Figure 6 displays a measure of how active respondents are in the market. Respondents who had either purchased a vehicle in the last year, or intended to do so in the next year, were classified to be within one year of a vehicle purchase. Of the remaining respondents, those that had purchased a vehicle in the last 1–3 years or intended to do so in the next 1–3 years were classified as being within 1–3 years of a vehicle purchase. The remaining segments followed similarly. Ultimately, 40% of respondents were within 1 year of vehicle purchases.

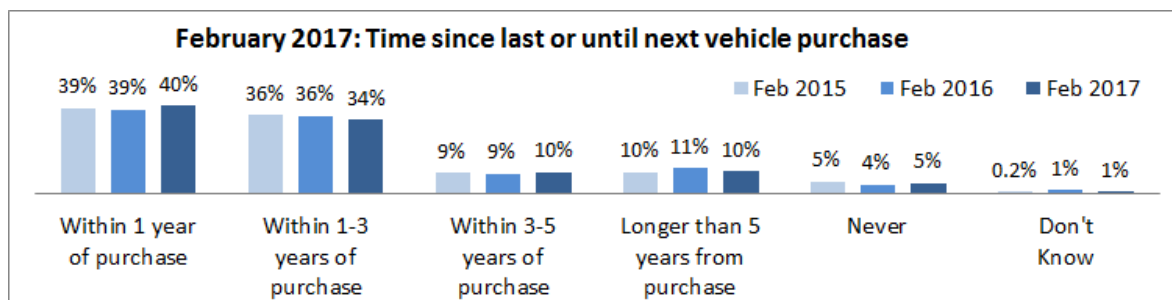


Figure 6. Time since last or until next vehicle purchase

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

1.5 New and Used Vehicle Purchasers

Respondents in February 2017 were asked how likely they would be to purchase brand new vehicles versus used vehicles. Those that stated they “probably” or “definitely” will buy new vehicles made up 40% of respondents, and a similar percentage (43%) stated that they were “not very likely” or “not at all likely” to buy new vehicles. The remaining 17% stated they would “maybe” purchase new vehicles. Results were similar to the 2016 study data.

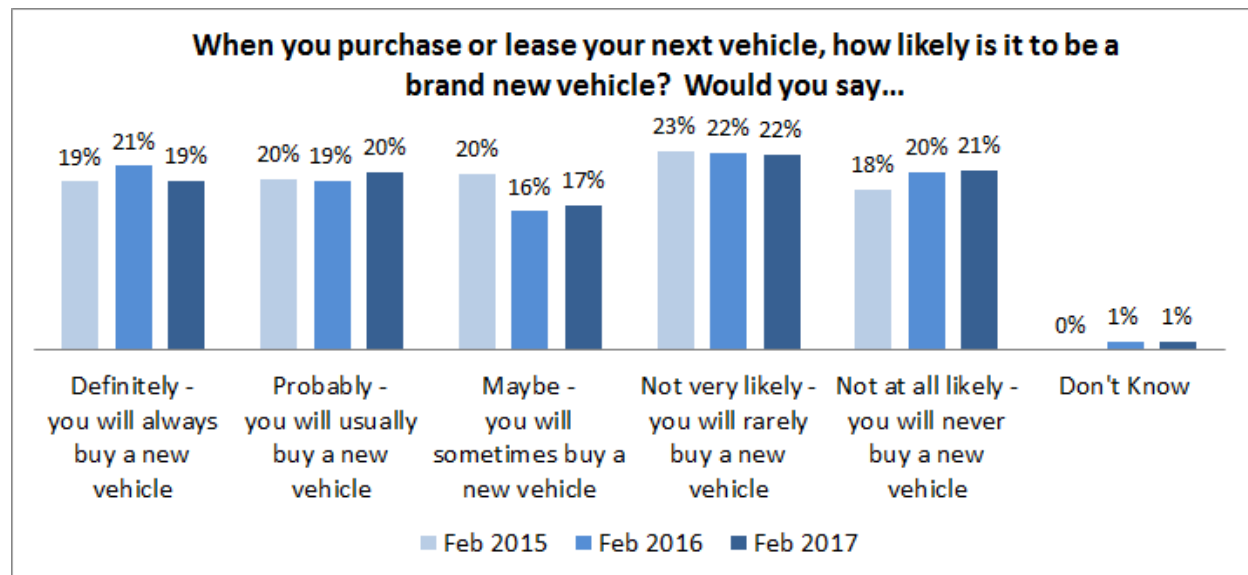


Figure 7. Question 5A: Likelihood of purchasing a new versus a used vehicle

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=781. For 2016: ORC for NREL (2016), Study No. 725068, n=789. For 2015: ORC for NREL (2015), Study No. 724068, n=806.

Notes: Those respondents who answered “do not expect to buy or lease another vehicle” when asked about the time until their next vehicle purchase in question 5 were not asked about the likelihood they would purchase a new or used vehicle in question 5A.

In Section 4 of this report, the 56% of respondents who stated they would “definitely,” “probably,” or “maybe” purchase new vehicles were classified as “new vehicle purchasers” because they all seemed to be stating they would consider new vehicles. The 43% of respondents who stated they were “not very likely” or “not at all likely” to purchase a new vehicle were classified as “used vehicle purchasers”. This classification is not intended as a measure of an expected split between new and used car sales; rather, it is interpreted as an indication of whether or not a respondent would even consider a new vehicle. To put this split in context, in 2014 more than 42 million used vehicles were purchased while 16.5 million new vehicles were sold (NIADA 2015)—28% of vehicle purchases in 2014 were for new vehicles.

1.6 Household Vehicle Fuel Types

The overwhelming majority of households (83%) owned traditional gasoline vehicles in February 2017. Ethanol-capable and diesel vehicles were owned by 11% and 7% of respondents, respectively. Compressed natural gas and PEV technologies were owned by small percentages of respondents. More than one in five respondents (22%) reported owning vehicles other than traditional gasoline vehicles. A small percentage (4%) owned only vehicles of fuel type(s) other than traditional gasoline. Respondent ownership rates of technologies other than traditional gasoline were all higher than percentages of overall vehicle registrations. This is expected as some respondent households own multiple vehicles. Results are generally consistent with 2015 and 2016 results. However, the percentage of respondents who owned traditional gasoline vehicles declined 3% (the margin of error for the study) compared to 2015 and similarly respondents who stated they did not own any of the technologies increased 3%.

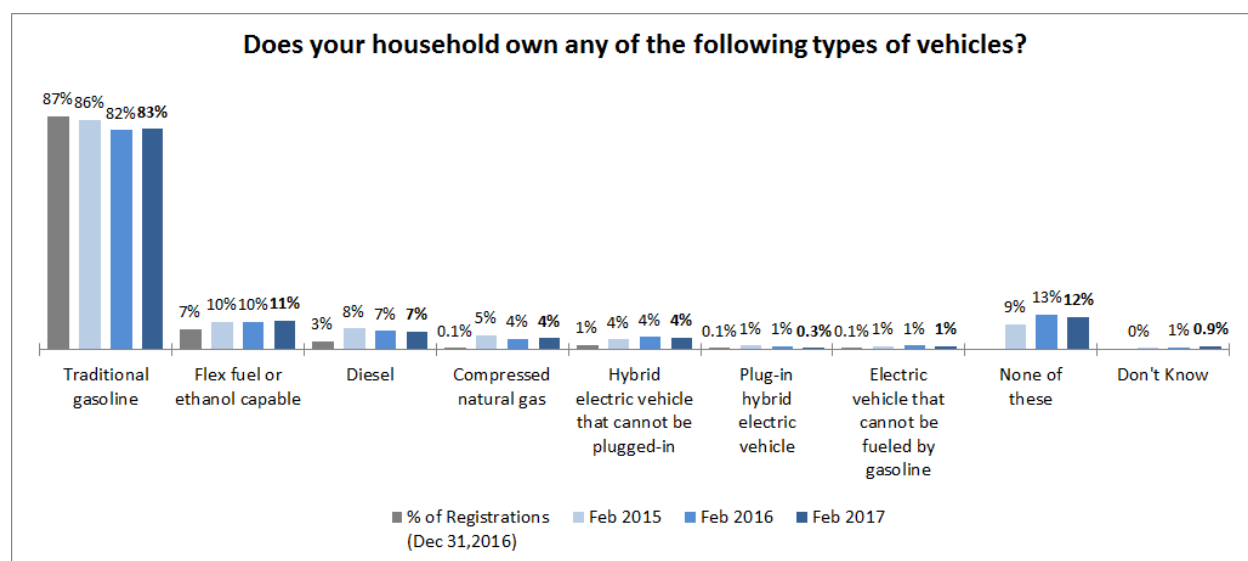


Figure 8. Question 6: Household vehicle fuel types

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

Polk, R.L. 2017. "POLK_VIO_DETAIL_2016." Golden, CO: National Renewable Energy Laboratory. Accessed August 10, 2017.

2 Plug-in Electric Vehicle Awareness

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2.1 Plug-in Electric Vehicle Awareness and Acceptance Overview

Consumers will purchase PEVs in large numbers only after they become aware of the technologies and accept them as practical alternatives to traditional gasoline vehicles. This study attempted to quantify respondent PEV awareness, acceptance, and interest.

The study asked respondents if they were able to name a specific PEV make and model. Nearly half (46%) were able to, and 37% were able to name one of the top 10 best-selling makes and models at the time of the study. Conversely, 54% were not able to name a specific PEV make and model. There was a decrease in the percentage of respondents able to name one of the top 10 best-selling PEV makes and models compared to 2016 results (from 41% to 37%). Based on this measure, respondents are not increasing their awareness of specific PEVs.

Respondents were also asked about their levels of exposure to PEVs. The theory of diffusion of innovations (Rogers 2010) describes how new technologies become accepted. Accordingly, a measure of exposure can serve as a prerequisite and proxy measure for future vehicle purchases. Since 2015 respondents have increasingly reported having sat in, having driven, or having a neighbor with a PEV at or beyond the 3% margin of error. While these increases are small, based on this metric, it can be assumed that respondents' first-hand exposure to PEVs has increased. This increase has occurred simultaneously with a decrease in exposure to PEVs through advertisements, social media, and a decrease in awareness of PEV tax incentives. All of these measures dropped beyond the margin of error of the study.

PEV acceptance is measured in this study by how respondents view the technology compared to the current standard technology (i.e., traditional gasoline vehicles). Results show that both AEVs and PHEVs are viewed by 46% of respondents as being "as good as" or "better than" gasoline vehicles. In both previous studies, respondents were more likely to state PHEVs were "as good as" or "better than" AEVs. Further, the percentage of respondents saying AEVs are "not as good as" traditional gasoline vehicles has decreased beyond the margin of error of the study. By these measures of acceptance, respondents are showing an increased acceptance of AEVs.

Finally, respondents reported their willingness to consider purchasing PEVs. Nearly a quarter of respondents (24%) stated they expect to purchase or expect to consider purchasing PHEVs. Similarly, 21% stated the same about AEVs. These percentages are similar to the 2016 results, and the largest change is a drop in the percentage of respondents stating they would not consider an AEV. The top reasons given for considering PEV purchases were that the vehicles were viewed as being better for the environment and they would save money on fuel. The top reason for not considering the technology was that PEVs are viewed as too expensive.

2.2 Ability to Name a Specific Plug-in Electric Vehicle Make and Model

Respondents were asked if they could name a PEV, and 46% were able to name a specific vehicle make and model. Further, 37% were able to name at least one of the 10 top best-selling makes and models at the time of the study. These results are generally consistent with results from 2016. There was a decline in awareness beyond the 3% margin of error for the Tesla Model S and the Toyota Prius Plug-in. The Tesla Model X replaced the Chevy Spark in the top 10 list compared to the 2016 study.

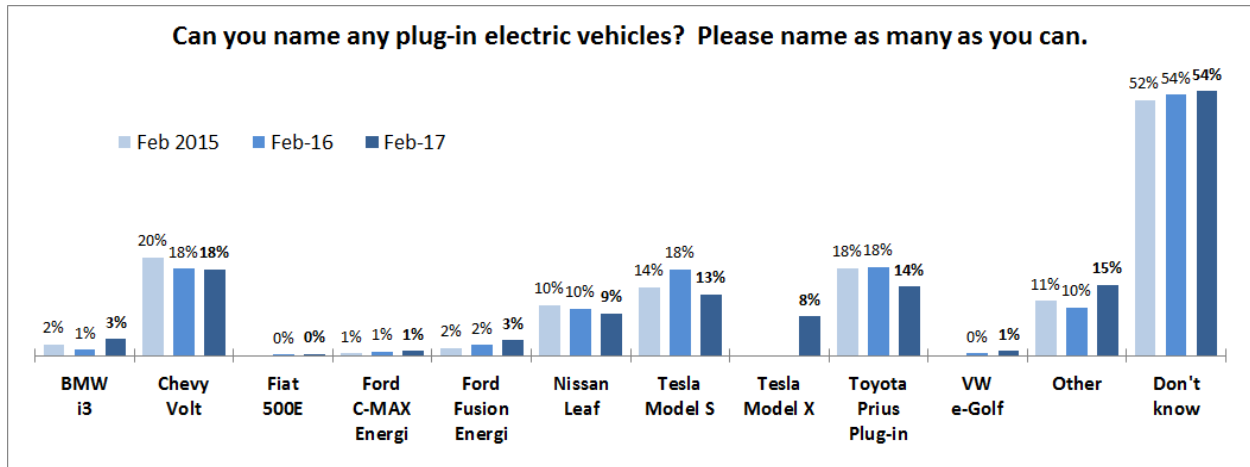


Figure 9. Question 7: Ability to name a PEV make and model

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

Note: The Toyota Prius was available at the time of the study as both an HEV and a PHEV; some respondents may have confused the two versions. A follow-up question asked respondents who mentioned only the Toyota Prius Plug-in in the initial question to name another make and model. Just 4% of respondents overall could name only the Toyota Prius Plug-in. If all these respondents were unaware of the Toyota Prius Plug-in PHEV, the percentage who were unable to name a PEV make and model would climb to 59% (rounding) and the percentage who were aware of the Toyota Prius Plug-in would fall from 14% to 10% (rounding).

2.3 Exposure to Plug-in Electric Vehicles

Respondents were asked about their exposure to PEVs. More than half (51%) reported having firsthand exposure to PEVs by having been in one, having a neighbor with one, or having seen one in parking lots. A large majority (67%) reported exposure to PEVs from advertisements or social media. Less than a quarter of respondents (23%) have heard of PEV tax incentives. Reported exposure through advertisements or social media dropped in 2017 compared to 2016. Similarly, awareness of PEV tax incentives also declined. Overall, 78% of respondents reported having been exposed to PEVs by one of the categories described in Figure 10. Since 2015, there have been increases in respondents reporting having sat in, having driven, or having a neighbor with a PEV, at or beyond the 3% margin of error. Respondents in 2015 were not asked about PEV ads, PEVs in social media, or PEV tax incentives.

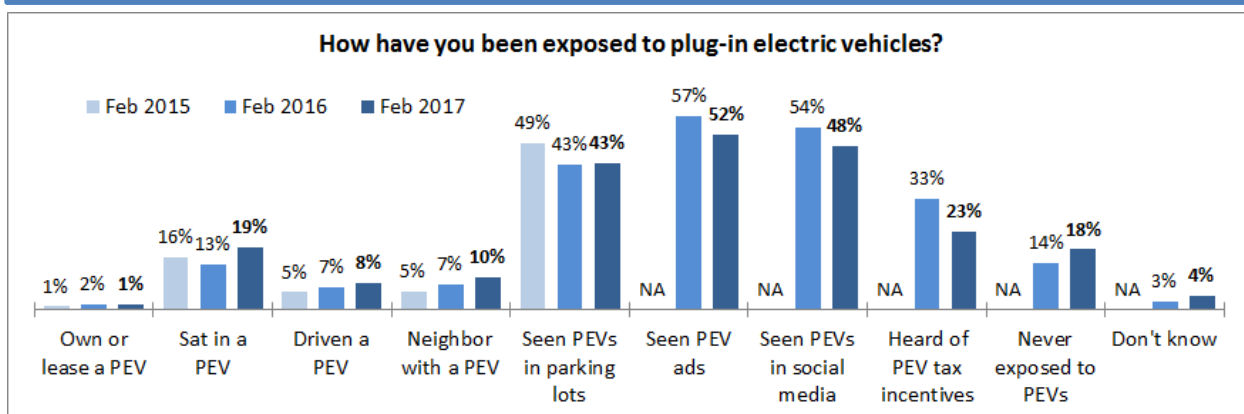


Figure 10. Question 8: Exposure to PEVs

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

Note: Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: “Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries.”

2.4 Opinions of Plug-in Electric Vehicles

When asked about their opinions of PEVs, respondents had similar opinions of PHEVs and AEVs compared to traditional gasoline vehicles. Nearly half (46%) stated that both AEVs and PHEVs were “as good as” or “better than” traditional gasoline vehicles. The percentages of respondents stating PEVs are “better than” gas vehicles have fluctuated since 2015. The percentages of respondents stating PEVs are “not as good as” gas vehicles are the lowest they have been across the three years of studies. The percentage with the negative view of AEVs has dropped beyond the 3% margin of error for the study.

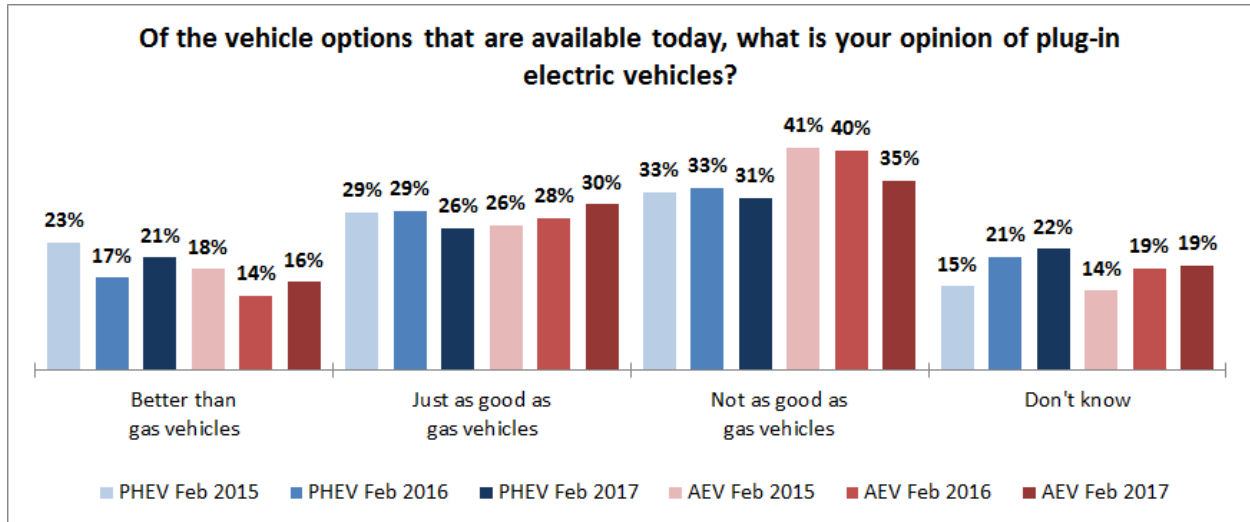


Figure 11. Questions 9 and 11: Comparison of PHEVs and AEVs to gasoline vehicles

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 PHEVs: ORC for NREL (2015), Study No. 724068, n=506. For 2015 AEVs: ORC for NREL (2015), Study No. 724068, n=509.

Note: Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: “Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries.” In the 2015 study, the respondent group was split. Roughly half of the respondents were asked about PHEV sentiments. The second half of respondents was asked about AEV sentiments.

2.5 Consumers Considering Plug-in Electric Vehicles and Why

Respondents showed a greater interest in PHEVs compared to AEVs when asked if they would consider purchasing the vehicles. Nearly a quarter of respondents (24%) stated they would consider or expect to purchase PHEVs; 21% stated they would consider or expect to purchase AEVs. A majority, 57% and 56%, stated they would not purchase or lease PHEVs or AEVs, respectively. Results were generally consistent with 2016 results. However, there was a decline in those stating they will not purchase an AEV beyond the 3% margin of error.

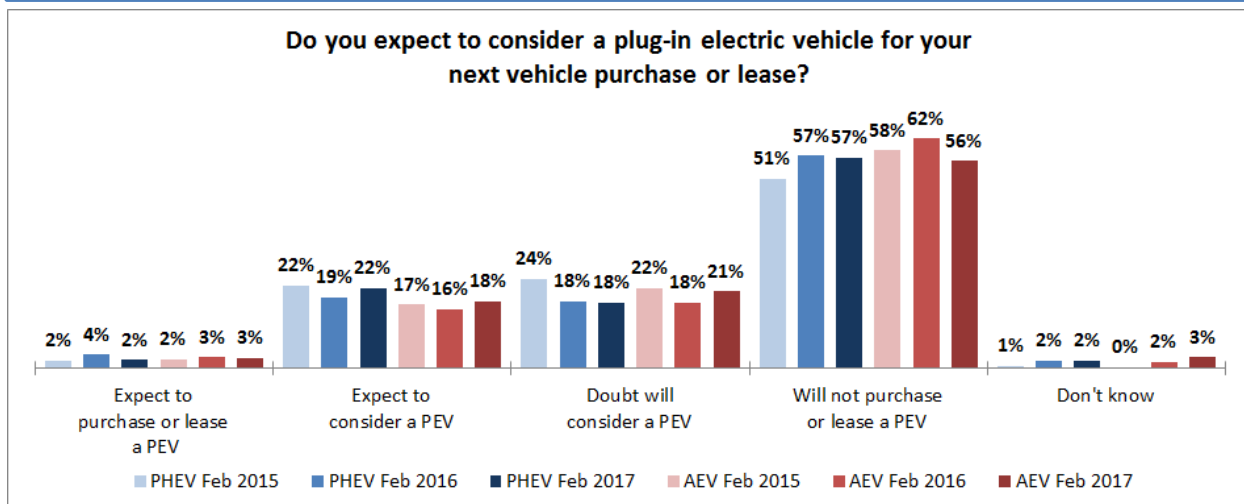


Figure 12. Questions 10 and 12: Willingness to consider purchasing PHEVs and AEVs

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 PHEVs: ORC for NREL (2015), Study No. 724068, n=506. For 2015 AEVs: ORC for NREL (2015), Study No. 724068, n=509.

Note: Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: “Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries.” In the 2015 study, the respondent group was split. Roughly half of the respondents were asked about PHEV sentiments. The second half of respondents was asked about AEV sentiments.

2.6 Reasons for Considering Plug-in Electric Vehicles

The top reasons for considering PEVs were that the vehicles were viewed as better for the environment and would provide fuel cost savings. In addition, majorities of respondents agreed the technology was better for national energy security, and they expressed interest in owning a cutting edge technology.

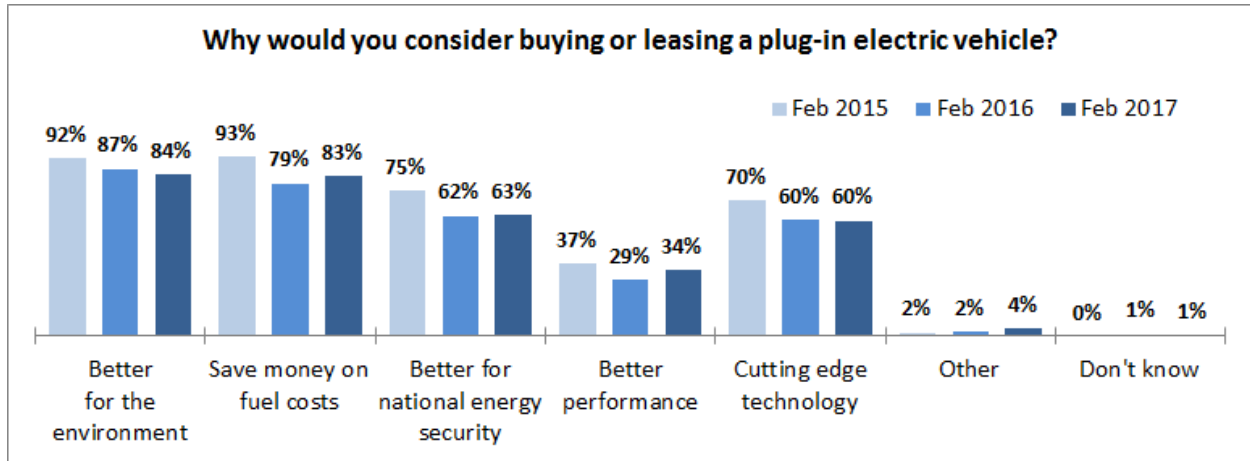


Figure 13. Question 13: Reasons for considering PEVs

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=274. For 2016: ORC for NREL (2016), Study No. 725068, n=256. For 2015: ORC for NREL (2015), Study No. 724068, n=223.

Notes: Respondents were able to select multiple reasons for why they would consider a PEV.

Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: "Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries." In the 2015 study, the respondent group was split. Roughly half of the respondents were asked about PHEV sentiments. The second half of respondents was asked about AEV sentiments.

2.7 Reasons for Not Considering Plug-in Electric Vehicles

The primary reason for not considering PEVs (given by 51%) was that the vehicles are too expensive. The inability to charge away from home was the next highest rated reason. Of the respondents who were not willing to consider PEVs, a significantly lower percentage than in 2015 agreed that any one of the reasons in Figure 15 would make them more likely to consider PEVs. These respondents rated environmental benefits and fuel cost savings as the top reasons to consider PEVs.

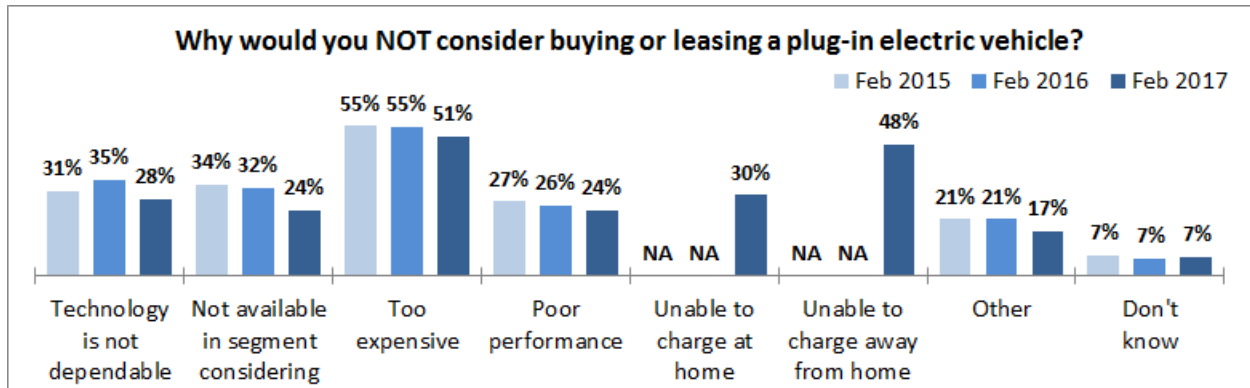


Figure 14. Question 14: Reasons for not considering PEVs

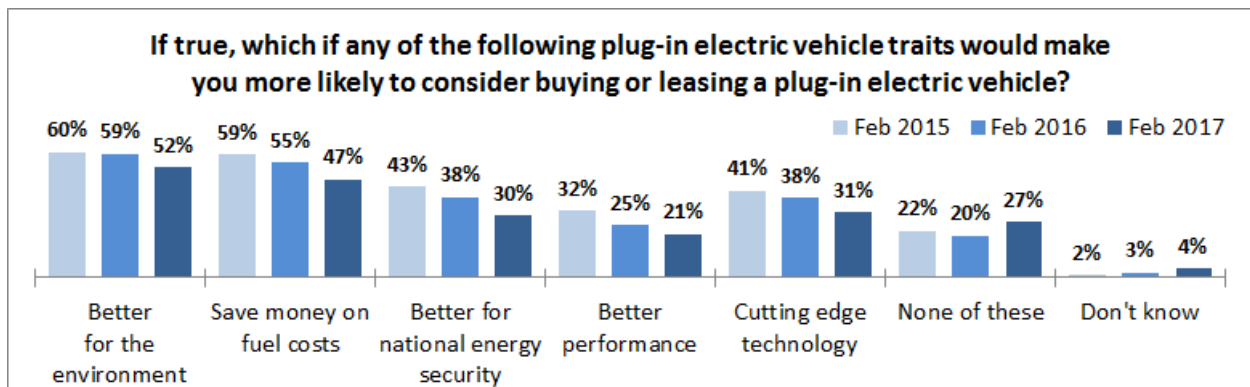


Figure 15. Question 15: PEV traits that could increase purchase consideration

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=712. For 2016: ORC for NREL (2016), Study No. 725068, n=728. For 2015: ORC for NREL (2015), Study No. 724068, n=787.

Notes Respondents were able to select multiple reasons for why they would consider a PEV. “Unable to charge at home” and “unable to charge away from home” were included as possible reasons for not considering PEVs for the first time in the 2017 study.

Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: “Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries.” In the 2015 study, the respondent group was split. Roughly half of the respondents were asked about PHEV sentiments. The second half of respondents was asked about AEV sentiments.

3 Barriers to Plug-in Electric Vehicle Acceptance

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3.1 Barriers to Plug-in Electric Vehicle Acceptance Overview

Advanced vehicle technologies have characteristics that require some familiarization by the market before they are considered by potential purchasers. Understanding barriers to broad acceptance helps to determine the market for those vehicles and their future potential.

The electric distance, or range, AEVs can travel on a single charge is limited by battery size or capacity. Depending on the size of the AEV battery and the type of charging equipment available, the vehicle may require considerable time to charge. A gasoline vehicle is limited by the distance the vehicle can travel on a single tank of gasoline, but gasoline stations are relatively prevalent, and gasoline vehicles are relatively quick to refuel.

This study asked respondents to provide the vehicle range they would require of an AEV in order to consider purchasing one. Results show that a broad set of vehicle ranges would be sufficient for different respondents. Vehicles would need to travel 100 miles on a single charge for 20% of respondents to consider purchasing, and 400 miles for a majority (57%) to consider purchasing. The median required vehicle range was 300 miles for respondents providing a range. These results track closely to the 2016 results.

Recharging opportunity may also influence PEV acceptance. This study found 26% of respondents are aware of charging stations they pass regularly, available at their places of work, or at the stores and places they frequent. This shows an increase compared to 20% in 2016 and 18% in 2015. More than half of respondents stated they could park their vehicles near electrical outlets at home (54%).

The purchase price of PEVs is a deterrent to some purchasers. PEVs are available in a range of prices, but as a new technology they are often more expensive than similar gasoline vehicles. Federal and state tax incentives can play a role in reducing the cost for the purchaser (AFDC 2017). This study found a range of vehicle prices respondents were expecting to pay for their next vehicles. A large majority (66%) stated they expect to pay \$30,000 or less for their next vehicle, and 42% expect to pay \$20,000 or less. Although price is a barrier, 32% of current top-selling, non-luxury PEV offerings fall within the respondents' reported expected price range, if they could all take advantage of the federal tax credit (IRS 2017). Expected purchase prices show little change from 2015 and 2016 results.

The percentage of respondents who would pay an incremental cost for a PEV compared to a comparable traditional gasoline vehicle has decreased from 51% in 2015 to 47% in 2017. An additional 20% would consider a PEV, but would not pay an increased cost.

3.2 Required Electric Vehicle Range

Respondents provided a wide array of mile ranges that would be necessary for them to consider purchasing AEVs. Respondents in 2017 responded with similar vehicle ranges as those in 2016. Of those respondents providing a range, the median provided range was 300 miles, consistent with 2016. A majority of all respondents (57%) provided a range of 400 miles or less. A range of 200 miles or less would be sufficient for 33%. A fifth of respondents (20%) stated a range of 100 miles or less. A smaller percentage of respondents (9%) would not consider purchasing an AEV, regardless of the vehicle range. To put these ranges in context, the median driving range for model year 2016 gasoline vehicles is 412 miles (EERE 2016).

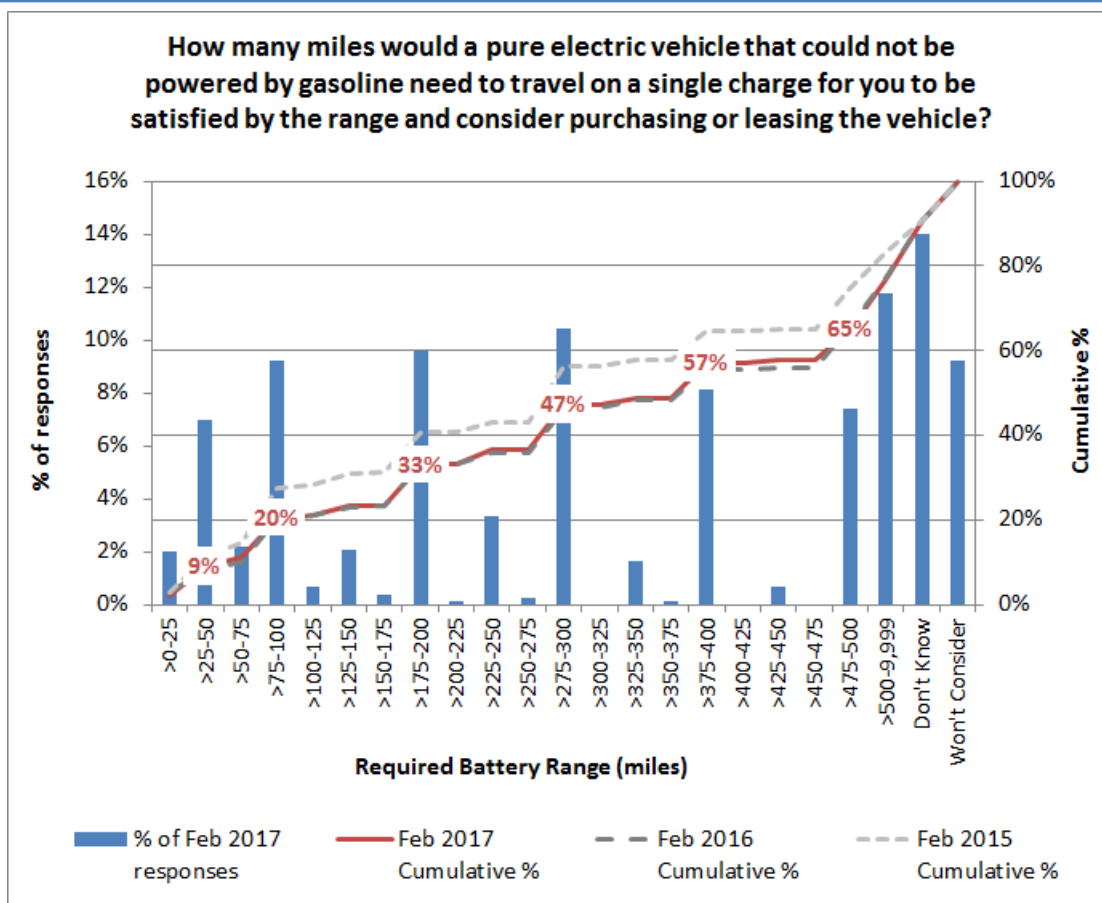


Figure 16. Question 16: Required AEV range for purchase consideration

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 ORC for NREL (2015), Study No. 724068, n=1,015.

Note: Respondents were given the following information before being asked about their exposure to, and opinion of, PEVs beginning with question 8: “Plug-in electric vehicles can be charged by being plugged into a household-type outlet or specially designed charging equipment. These can be defined as plug-in hybrids or all-electric vehicles. Not included in this definition are hybrids, such as the original Toyota Prius, that cannot be plugged in. The Chevy Volt is an example of a plug-in hybrid electric vehicle that can be powered by either the battery or the gasoline engine. The Tesla Model S or the Nissan Leaf are examples of all-electric vehicles powered only by their batteries.”

3.3 Perceived Ability to Charge a Plug-in Electric Vehicle

Respondents reported a low perceived availability of PEV charging stations. Overall, only 26% of respondents were aware of any charging stations that were on the routes they drove regularly, were at their places of work, or were at the stores and places they frequented. This percentage is up from 18% in 2015 and 20% in 2016. More than half (54%) stated they park their primary vehicles near electrical outlets at home. Thus, feasibly, these vehicles could be charged at the respondents' homes. Section 4 of this report investigates PEV acceptance by different respondent groups including those who are aware of charging stations and those who are able to plug in at home.

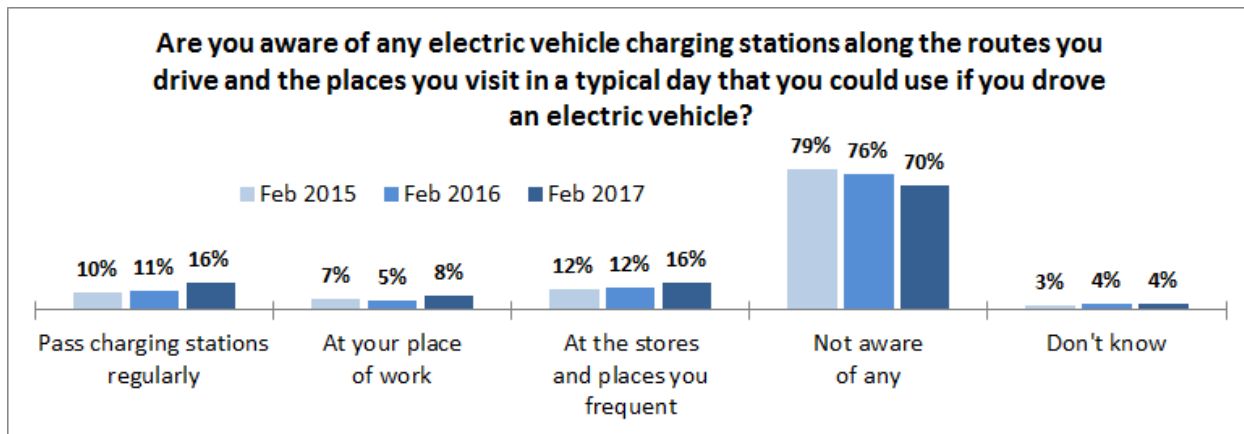


Figure 17. Question 17: Awareness of PEV charging stations

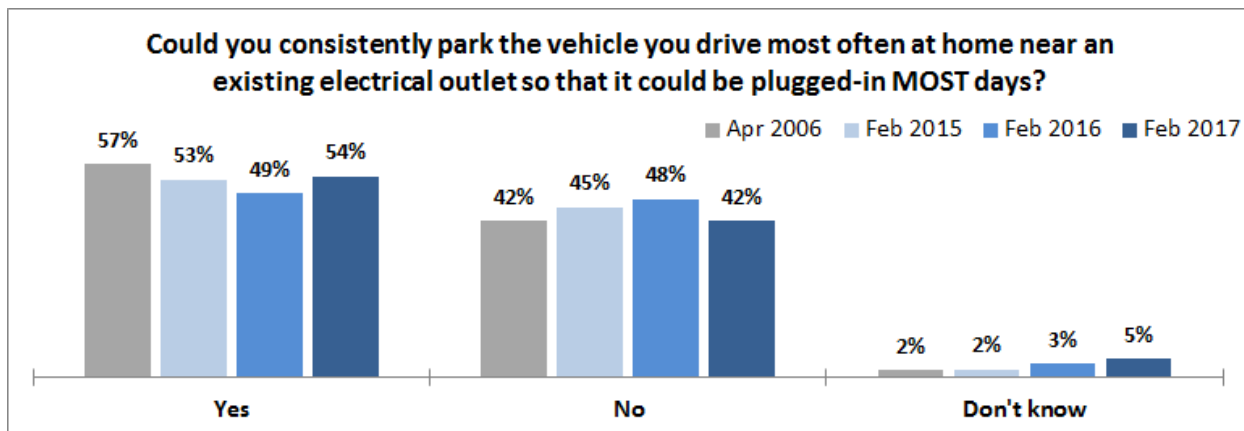


Figure 18. Question 18: Ability to charge a PEV at home

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015. For 2006: ORC for NREL (2006), Study No. 715168, n=480.

Note: In Section 4 of this report, the 26% segment of respondents who were aware of any charging stations that were on the routes they drove regularly, were at their places of work, or were at the stores and places they frequented were classified as “aware of PEV charging stations.”

3.4 Vehicle Purchase Price

Respondents provided a wide range of expected purchase prices for their next vehicles. A majority (66%) expected to spend \$30,000 or less, and 42% expected to pay \$20,000 or less. In January 2017, the top-selling PHEV was the Chevrolet Volt and the top-selling nonluxury AEV was the Chevrolet Bolt (ANL 2016). In August 2017, the Volt retail price was \$34,095 (Chevrolet 2017b) and the Bolt retail price was \$37,495 (Chevrolet 2017a). Both vehicles qualify for a federal tax credit of \$7,500 (IRS 2017). If these credits are subtracted from the vehicle prices, the Volt cost of \$26,595 would be in the range of 32% of respondents; the Bolt cost of \$29,995 would be in the price range of 31% of respondents. The distribution of expected purchase prices by respondents was consistent with prior years' results.

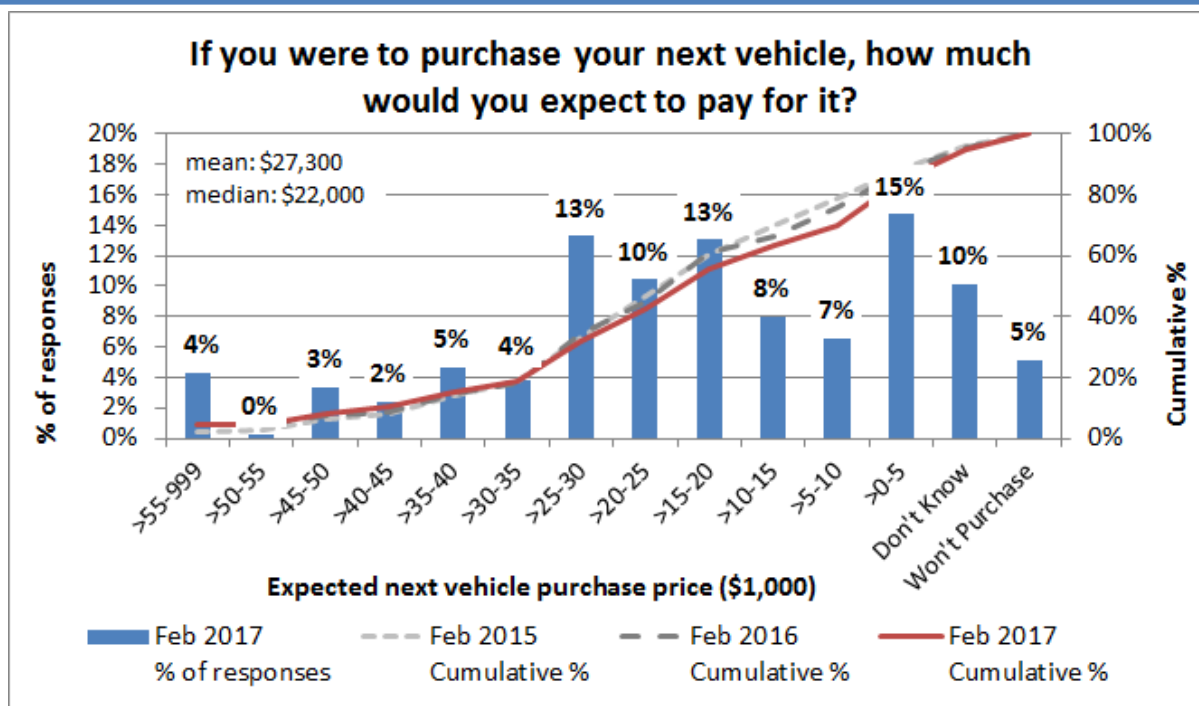


Figure 19. Question 19: Expected next vehicle purchase price

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

Notes: The results of this question are not intended to show what respondents have paid, or will actually pay, for their vehicles. The data are reflecting respondent current expectations, which may differ significantly from final purchase decisions.

The federal tax credit begins to phase out after a specific manufacturer sells 200,000 qualifying PEVs (IRS 2017). Chevrolet and Toyota are not expected to reach the cap in 2017. General Motors had sold nearly 150,000 PEVs and Toyota had sold nearly 60,000 PEVs by August 2017 (ANL 2017).

3.5 Willingness to Pay for a Plug-in Electric Vehicle

Respondents showed a diverse willingness to pay incremental costs for PEVs that would cut their fuel costs by one-third. Nearly half (47%) stated they would be willing to pay an incremental cost, and an additional 20% of respondents would not pay an incremental cost, but would consider the hypothetical PEV. Finally, 20% would not buy a PEV regardless of incremental costs. Respondent willingness to pay an incremental cost for a PEV was similar to prior years' results.

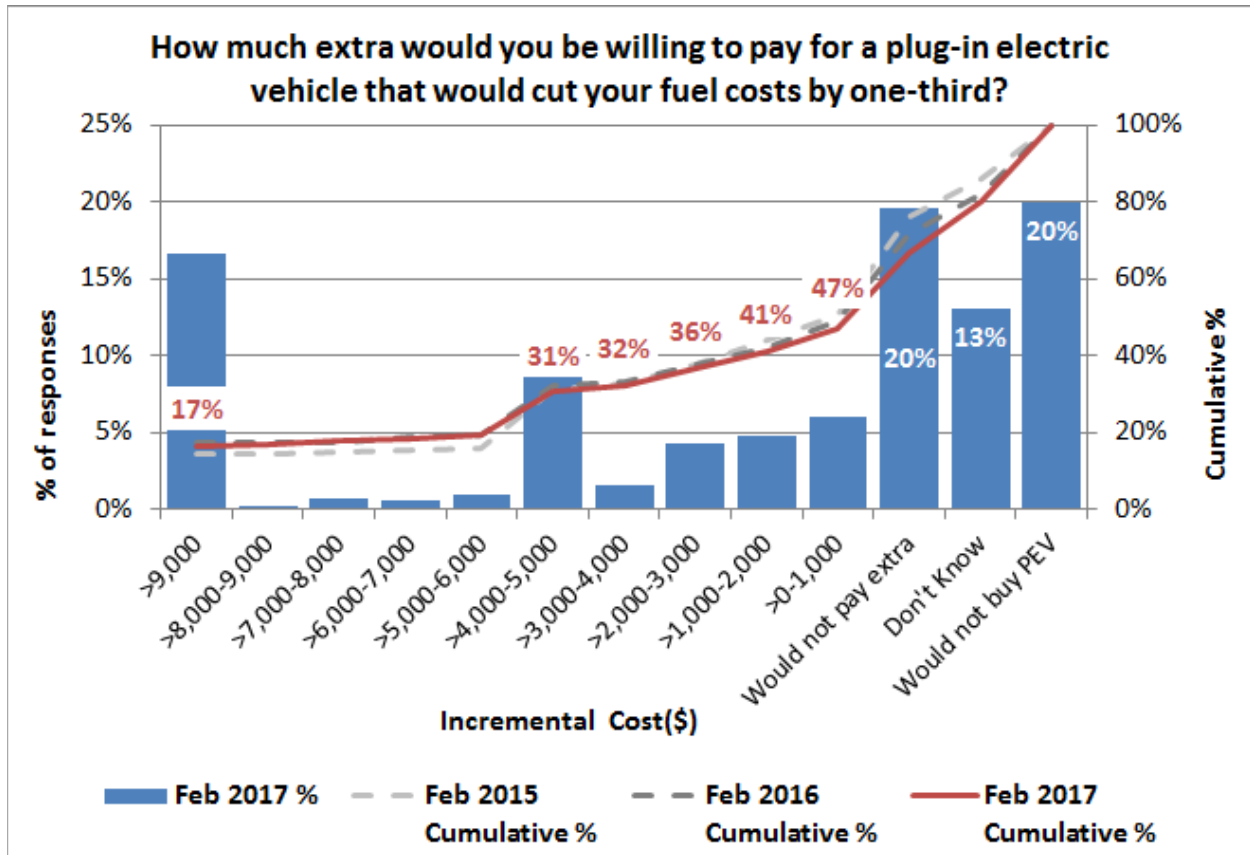


Figure 20. Question 20: Willingness to pay for a PEV

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015: ORC for NREL (2015), Study No. 724068, n=1,015.

4 Plug-in Electric Vehicle Acceptance

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4.1 Plug-in Electric Vehicle Acceptance Overview

A broad set of factors affect consumers' willingness to purchase vehicles. Even when considering established technologies, consumers' interest and purchase behavior varies to meet their transportation needs. For a new vehicle technology to succeed, consumers must know of the technology and understand how it can meet their needs.

Questions 9 and 11 (see Section 2.4) identified segments of respondents who believe that PEVs are “as good as” or “better than” traditional gasoline vehicles. Similarly, questions 10 and 12 (see Section 2.5) identified segments of respondents who either expect to purchase PEVs or expect to consider purchasing PEVs. These response sets were used as measures of PEV acceptance.

This section identifies additional respondent groups and compares their levels of PEV acceptance to each other and the overall respondent group. The sample sizes for these investigations, as noted in the coming pages for each graphic, are smaller than the study overall, but the comparisons highlight where stronger acceptance of PEVs originated in this study. Select segments of respondents are defined as follows:

- New or used vehicle purchasers (see Section 1.5)
- Vehicle purchasers who bought or plan to buy within one year (see Section 1.4)
- Single- or multivehicle households (see Section 1.2)
- Respondents able to name one of the top 10 best-selling PEVs (see Section 2.2)
- Respondents who have seen PEVs in parking lots (see Section 2.3)
- Respondents who have seen PEV advertisements (see Section 2.3)
- Respondents who have seen PEVs in social media (see Section 2.3)
- Respondents who are aware of PEV tax incentives (see Section 2.3)
- Respondents aware of PEV charging stations (see Section 3.3)
- Respondents able to plug in at home (see Section 3.3).

Additionally, the ORC study captured respondent demographics, allowing investigation of variations in PEV acceptance by respondent age, household income, education levels, and census region.

Respondents who were aware of existing PEV charging stations in their vicinity were most likely to report that PEVs were “as good as” or “better than” traditional gasoline vehicles compared to all other respondent segments. Similarly, those aware of charging stations were the second most likely group to expect to consider purchasing a PEV. Those respondents able to plug in at home were more likely to state PEVs were “as good as” or “better than” traditional gasoline vehicles.

Respondents aware of PEV tax incentives were most likely to consider purchasing a PEV. Those aware of PEV tax incentives were second most likely to view PEVs to be “as good as” or “better than” traditional gasoline vehicles. These relationships held true for both PHEVs and AEVs. More broadly, respondents with more exposure and awareness of PEVs reported the positive

PEV sentiments. Aside from tax incentive awareness, respondents who have seen PEVs in parking lots, PEV advertisements, or PEVs in social media, or who were able to name a specific PEV make and model consistently reported higher levels of PEV acceptance and willingness to consider purchasing PEVs.

Single-vehicle households reported that PEVs were “as good as” or “better than” traditional gasoline vehicles more often than multivehicle households. This relationship is consistent across PHEVs and AEVs. Single and multivehicle households did not report an elevated (or reduced) willingness to consider purchasing PEVs.

New vehicle purchasers stated PEVs were “as good as” or “better than” traditional gasoline vehicles more frequently than used vehicle purchasers. Similarly, new vehicle purchasers reported a higher likelihood of considering PEV purchases, but this difference was within the margin of error. These relationships held across PHEVs and AEVs.

Those respondents who had purchased a vehicle in the last year or expect to purchase in the next year (the group most recently active in the market) did not show a large difference in their PEV sentiments from the overall respondent group.

Overall, respondents are equally likely to view PHEVs and AEVs to be “as good as” or “better than” traditional gasoline vehicles. This is a change from prior years when PHEVs were more likely than AEVs to be viewed this way. AEV acceptance increased from the 2016 study by this measure, and the increase was found across all respondent groups studied. However, when asked about their willingness to consider purchasing PEVs, respondents still favor PHEVs over AEVs (24% and 21% respectively).

The percentages of respondents overall who are willing to consider purchasing PEVs increased from 2016 within the margin of error. The respondent group with the biggest increase in willingness to consider purchasing PEVs since the 2016 study is the respondents who are aware of PEV tax incentives.

Respondents aged 35 or younger are most likely to state that PEVs are “as good as” or “better than” traditional gasoline vehicles and are most likely to consider purchasing a PEV. Respondents over 55 years of age are least likely to have the positive PEV sentiments.

When investigating respondent income levels, those respondents with an annual household income less than \$50,000 are most likely to state PEVs were “as good as” or “better than” traditional gasoline vehicles. However, when asked about their willingness to consider purchasing a PEV, respondents with a household income over \$100,000 were most likely to state a willingness to consider purchasing a PEV.

Respondent views varied with education groupings. Respondents with some college education or college degrees are more likely to view PEVs to be “as good as” or “better than” traditional gasoline vehicles. Respondents with bachelor’s degrees are most likely to report a willingness to consider purchasing PEVs.

The increase in AEV acceptance from 2016 is seen across all demographic groups studied. Willingness to consider purchasing AEVs was similar to 2016 results for most demographic

groups, but there was a large increase in willingness to consider purchasing both PHEVs and AEVs by those between 36 and 55 years of age. Those with a bachelor's degree were more likely to be interested in purchasing a PHEV than in 2016. Finally those making over \$100,000 are more likely to consider purchasing an AEV than in 2016.

Respondents from the West census region are most likely to believe PEVs are “as good as” or “better than” traditional gasoline vehicles. The Northeast region reported the second highest level of acceptance. The Midwest and Southern regions in the U.S. reported similar, reduced levels of acceptance. PHEVs and AEVs are viewed similarly on this metric across all regions except the West, where respondents viewed PHEVs more positively.

Respondents from the West and Northeast regions reported the highest willingness to consider purchasing PEVs. Respondents from the Midwest and Southern regions were less likely to consider purchasing PEVs. PHEVs were favored over AEVs for purchase across all regions.

4.2 Perception of Plug-in Hybrid Electric vs. Conventional Vehicles

Overall, 46% of respondents, consistent with 2016, stated that PHEVs were “as good as” or “better than” gasoline vehicles. A sampling of respondent segments is shown in Figure 21. Respondents who reported being aware of charging stations had the highest percentage (65%) reporting a positive view. Similarly, respondents able to plug-in at home were more likely to report the positive view. Respondents reporting an awareness of PEVs (those who could name one of the top best-selling PEVs, who had seen PEVs in parking lots, seen PEV ads, seen PEVs in social media, or were aware of PEV tax incentives) were more likely to report a positive view. Those aware of tax incentives reported the second highest acceptance (62%) of all groups studied. PHEV acceptance was higher among new vehicle purchasers than used vehicle purchasers. Single vehicle households reported a higher PHEV acceptance than multivehicle households. Single vehicle households reported a higher PHEV acceptance than multivehicle households.

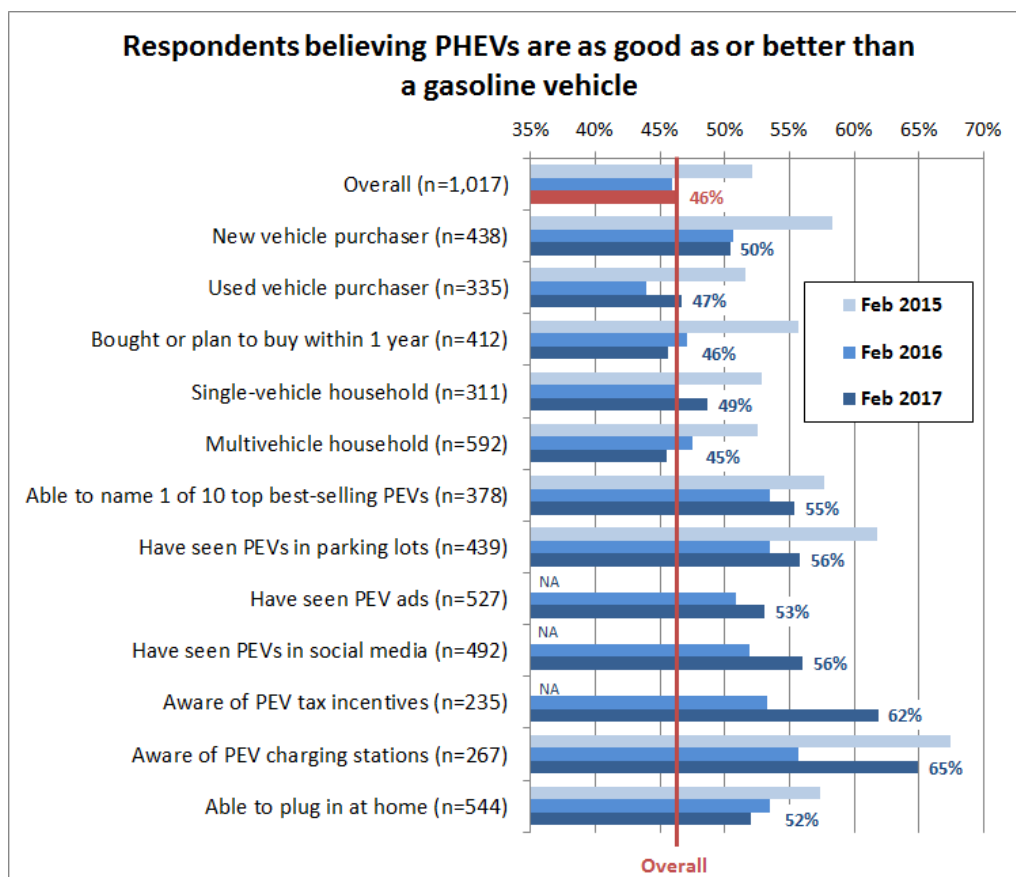


Figure 21. Segments of PHEV acceptance

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 PHEVs: ORC for NREL (2015), Study No. 724068, n=506.

Note: Respondents were not asked about PEV advertisements, PEVs in social media, or PEV tax incentives in 2015. The 2017 sample sizes are provided for each group in the figure. Prior year sample sizes for lower level groups are available in the prior reports (Singer 2016a and Singer 2016b).

4.3 Perception of All-Electric vs. Conventional Vehicles

Overall, 46% of respondents—up from 41% in 2016—stated that AEVs were “as good as” or “better than” gasoline vehicles. A sampling of respondent segments is shown in Figure 22. The increase in positive views of AEVs was seen across all groups studied. Respondents who reported being aware of charging stations had the highest percentage (65%) reporting a positive view. Respondents able to plug-in at home were also more likely to report the positive view. Respondents reporting an awareness of PEVs (those who could name one of the top best-selling PEVs, who had seen PEVs in parking lots, seen PEV ads, seen PEVs in social media, or were aware of PEV tax incentives) were more likely to report a positive view. Those aware of tax incentives reported the second highest acceptance (62%) of all groups studied. AEV acceptance was higher among new vehicle purchasers than used vehicle purchasers. Single vehicle households reported a higher AEV acceptance than multivehicle households. Single vehicle households reported a higher AEV acceptance than multivehicle households.

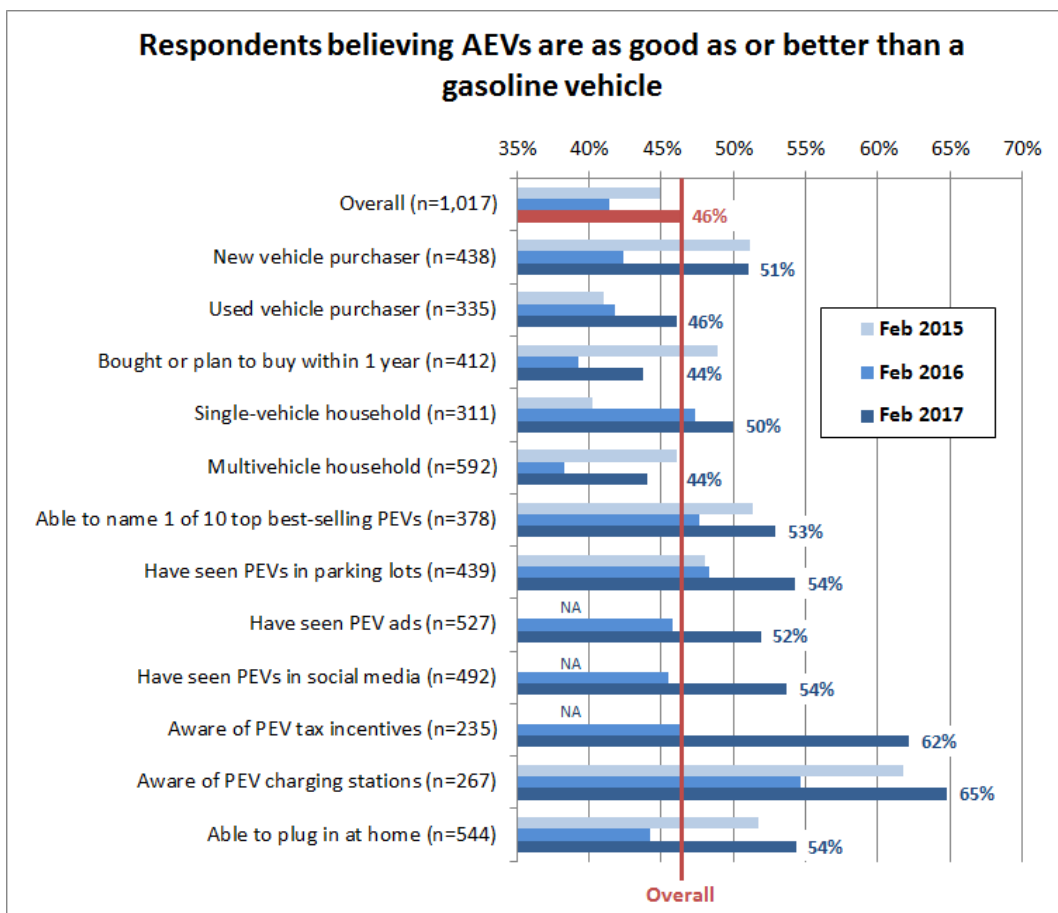


Figure 22. Segments of AEV acceptance

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 AEVs: ORC for NREL (2015), Study No. 724068, n=509.

Note: Respondents were not asked about PEV advertisements, PEVs in social media, or PEV tax incentives in 2015. The 2017 sample sizes are provided for each group in the figure. Prior year sample sizes for lower level groups are available in the prior reports (Singer 2016a and Singer 2016b).

4.4 Willingness to Consider Plug-in Hybrid Electric Vehicles by Segment

Overall, 24% of respondents, up (within the margin of error) from 23% in 2016, stated they would purchase or consider PHEVs for their next vehicle purchases or leases. A sampling of respondent segments is shown in Figure 23. Those aware of PEV tax incentives had the highest percentage (45%) of respondents who expected to consider a PHEV. Respondents who reported being aware of charging stations had the second highest percentage (40%). Similarly, those who were able to plug-in at home were more likely to report the positive view. Respondents reporting an awareness of PEVs (those who could name one of the top best-selling PEVs, who had seen PEVs in parking lots, seen PEV ads, seen PEVs in social media, or were aware of PEV tax incentives) were more likely to consider a PHEV. Willingness to consider a PHEV was slightly higher among new vehicle purchasers than used vehicle purchasers. Little difference in willingness to consider a PHEV was reported between single and multivehicle households. Respondents that bought a vehicle in the last year, or said they planned to purchase a vehicle in the next year, were neither more or less likely to consider purchasing a PHEV.

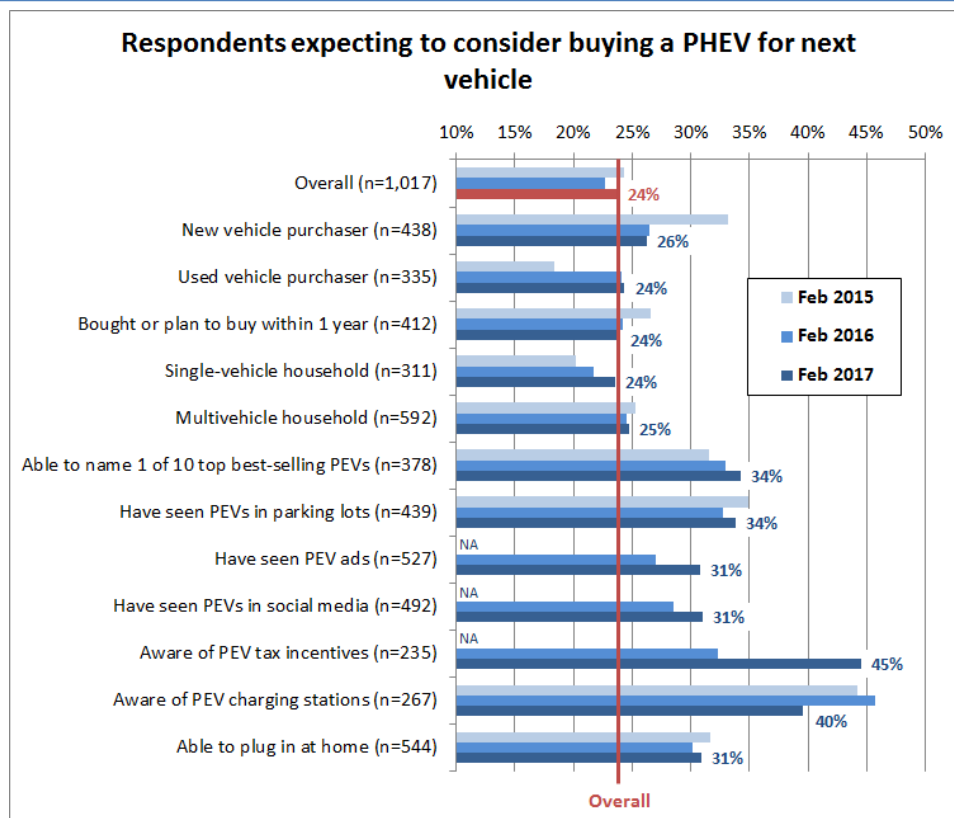


Figure 23. Willingness to consider PHEVs by segment

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 PHEVs: ORC for NREL (2015), Study No. 724068, n=506

Note: Respondents were not asked about PEV advertisements, PEVs in social media, or PEV tax incentives in 2015. The 2017 sample sizes are provided for each group in the figure. Prior year sample sizes for lower level groups are available in the prior reports (Singer 2016a and Singer 2016b).

4.5 Willingness to Consider All-Electric Vehicles by Segment

Overall, 21% of respondents, up within the margin of error from 19% in 2016, stated they would purchase or consider AEVs for their next vehicle purchases or leases. A sampling of respondent segments is shown in Figure 24. Those aware of PEV tax incentives had the highest percentage (40%) of respondents who expected to consider an AEV. Those who reported being aware of charging stations had the second highest percentage (38%). Similarly, those able to plug-in at home were more likely to report the positive view. Respondents reporting an awareness of PEVs (those who could name one of the top best-selling PEVs, who had seen PEVs in parking lots, seen PEV ads, seen PEVs in social media, or were aware of PEV tax incentives) were more likely to consider an AEV. New vehicle purchasers were slightly more likely than used purchasers to consider purchasing an AEV. Multivehicle households were slightly less likely to consider purchasing AEVs than single-vehicle households. Respondents that bought a vehicle in the last year, or said they planned to purchase a vehicle in the next year, were neither significantly more or less likely to consider an AEV.

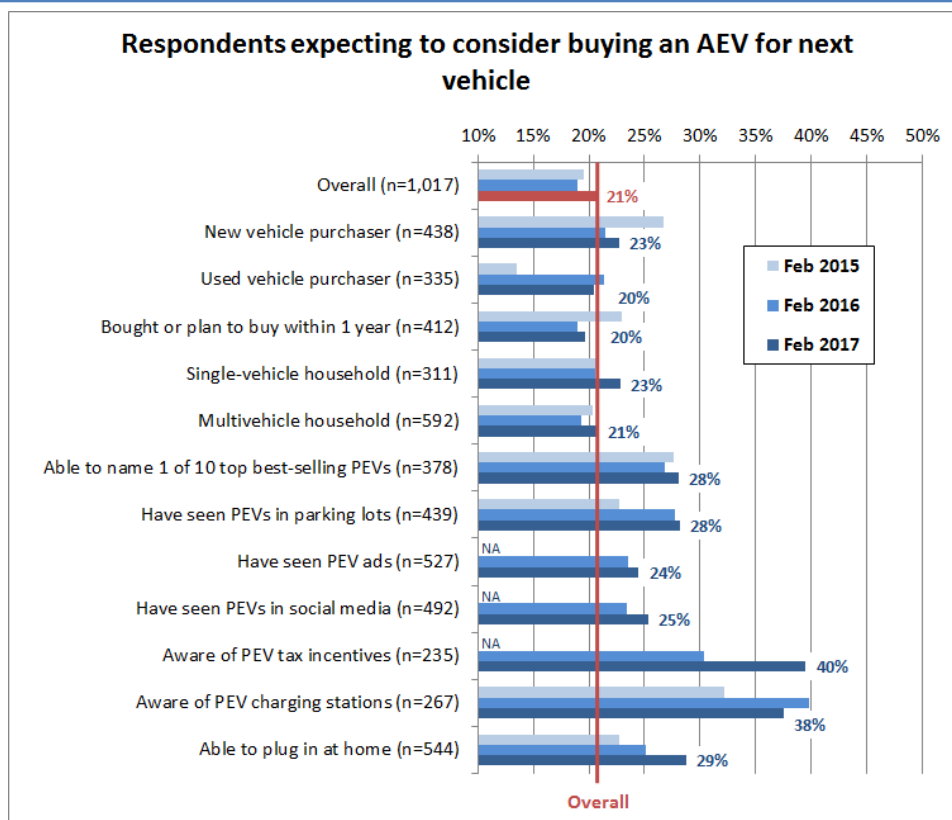


Figure 24. Willingness to consider AEVs by segment

Sources: For 2017: ORC for NREL (2017), Study No. 726058, n=1,017. For 2016: ORC for NREL (2016), Study No. 725068, n=1,008. For 2015 AEVs: ORC for NREL (2015), Study No. 724068, n=509.

Note: Respondents were not asked about PEV advertisements, PEVs in social media, or PEV tax incentives in 2015. The 2017 sample sizes are provided for each group in the figure. Prior year sample sizes for lower level groups are available in the prior reports (Singer 2016a and Singer 2016b).

4.6 Demographics of Plug-in Hybrid Electric Vehicle Perceptions

PHEV acceptance varied by respondent demographics captured in the study. A sampling of respondent segments is shown in Figure 25. Respondents age 35 or younger reported the highest levels of PHEV acceptance amongst the demographic groups studied. PHEV acceptance was highest across income levels among respondent households making less than \$50,000 a year in comparison to other income brackets. PHEV acceptance was highest among respondents with college degrees in comparison to other levels of education.

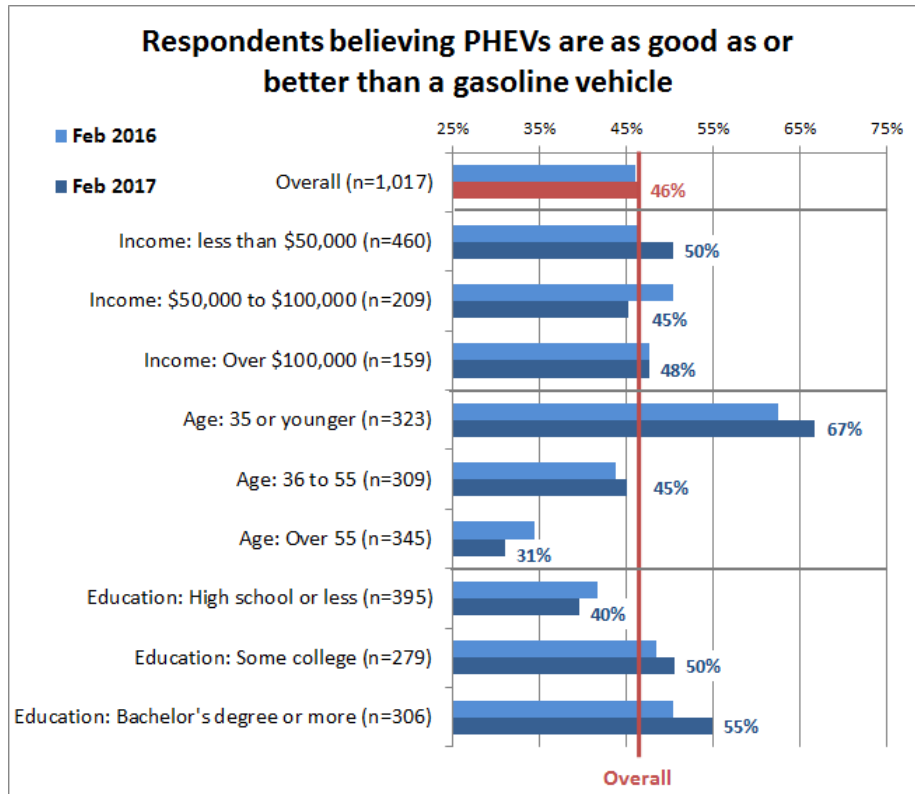


Figure 25. Demographics of PHEV acceptance

Sources: For 2016 (Singer 2016). For 2017: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The 2017 sample sizes are provided for each demographic group in the figure.

4.7 Demographics of All-Electric Vehicle Perceptions

AEV acceptance varied by respondent demographics captured in the study. A sampling of respondent segments is shown in Figure 26. Respondents age 35 or younger reported the highest levels of AEV acceptance amongst the demographic groups studied. AEV acceptance was highest across income levels among respondent households making less than \$50,000 a year in comparison to other income brackets. AEV acceptance was highest among respondents with college degrees in comparison to other levels of education.

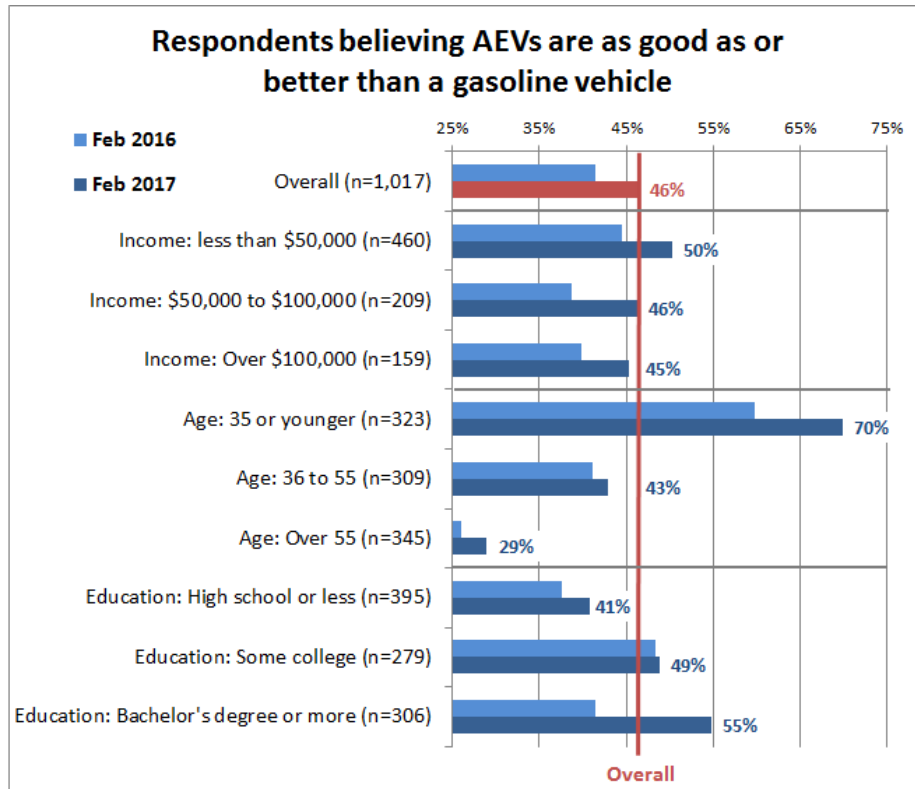


Figure 26. Demographics of AEV acceptance

Sources: For 2016 (Singer 2016). For 2017: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The 2017 sample sizes are provided for each demographic group in the figure.

4.8 Demographics of Willingness to Consider Plug-in Hybrid Electric Vehicles

Respondents from different demographic groups reported varied levels of willingness to consider purchasing PHEVs. A sampling of respondent segments is shown in Figure 27. Respondents age 35 or younger were most likely to consider purchasing PHEVs amongst the demographic groups studied. Willingness to consider PHEVs was higher for the two higher income segments, while those making less than \$50,000 were less likely to consider PHEVs. Respondents with a high school education or less were not as likely to consider PHEVs. Those with a Bachelor's degree reported an increased willingness to consider PEVs.

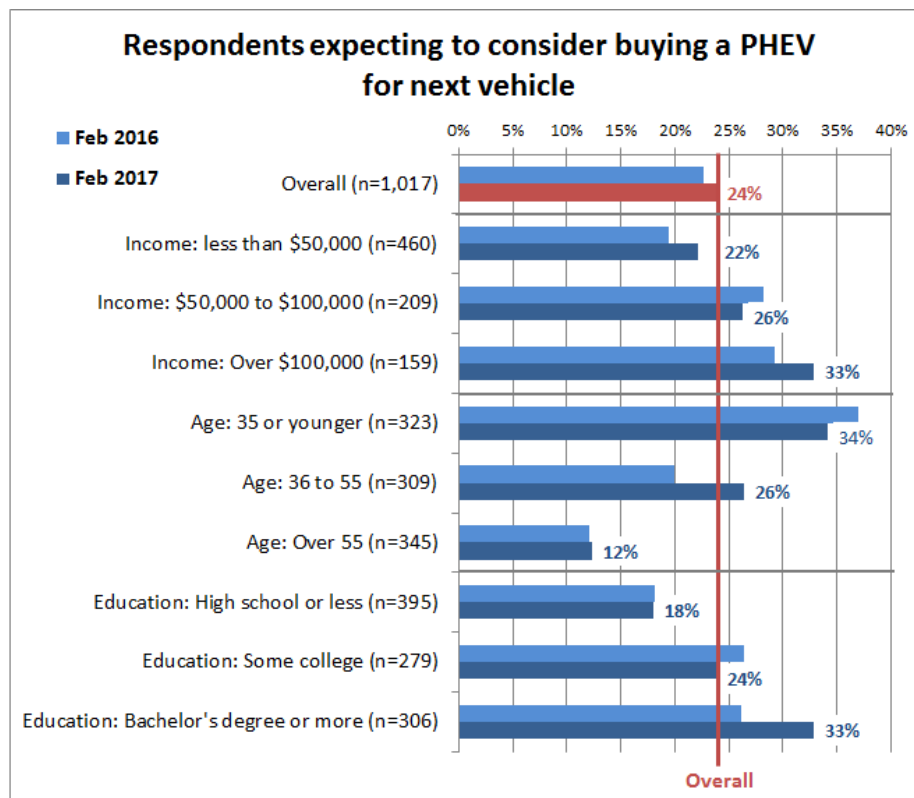


Figure 27. Demographics of willingness to consider PHEVs

Sources: For 2016 (Singer 2016). For 2017: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The 2017 sample sizes are provided for each demographic group in the figure.

4.9 Demographics of Willingness to Consider All-Electric Vehicles

Respondents from different demographic groups reported varied levels of willingness to consider purchasing AEVs. A sampling of respondent segments is shown in Figure 28. Respondents with an income over \$100,000 were most likely to consider purchasing an AEV among the demographic groups studied. Respondents age 35 or younger were most likely to consider purchasing AEVs amongst the age groups. Respondents with a high school education or less were not as likely to consider AEVs. The two respondent segments who reported having at least some college education reported an increased willingness to consider AEVs.

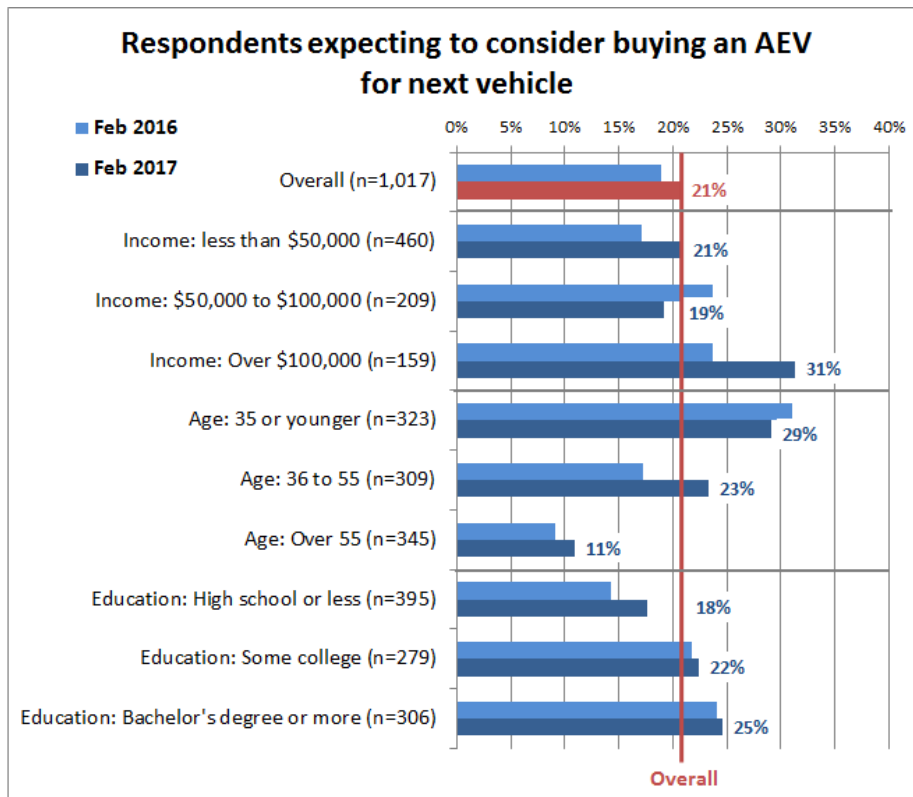


Figure 28. Demographics of willingness to consider AEVs

Sources: For 2016 (Singer 2016). For 2017: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The 2017 sample sizes are provided for each demographic group in the figure.

4.10 Geography of Plug-in Electric Vehicle Perceptions

Respondents from different census regions reported varying levels of PEV acceptance, as shown in Figure 29. Respondents from the Western region reported the highest acceptance of PEVs. The Northeast was the second highest. Respondents reported a similar acceptance of PHEVs and AEVs, although PHEVs were favored in the West.

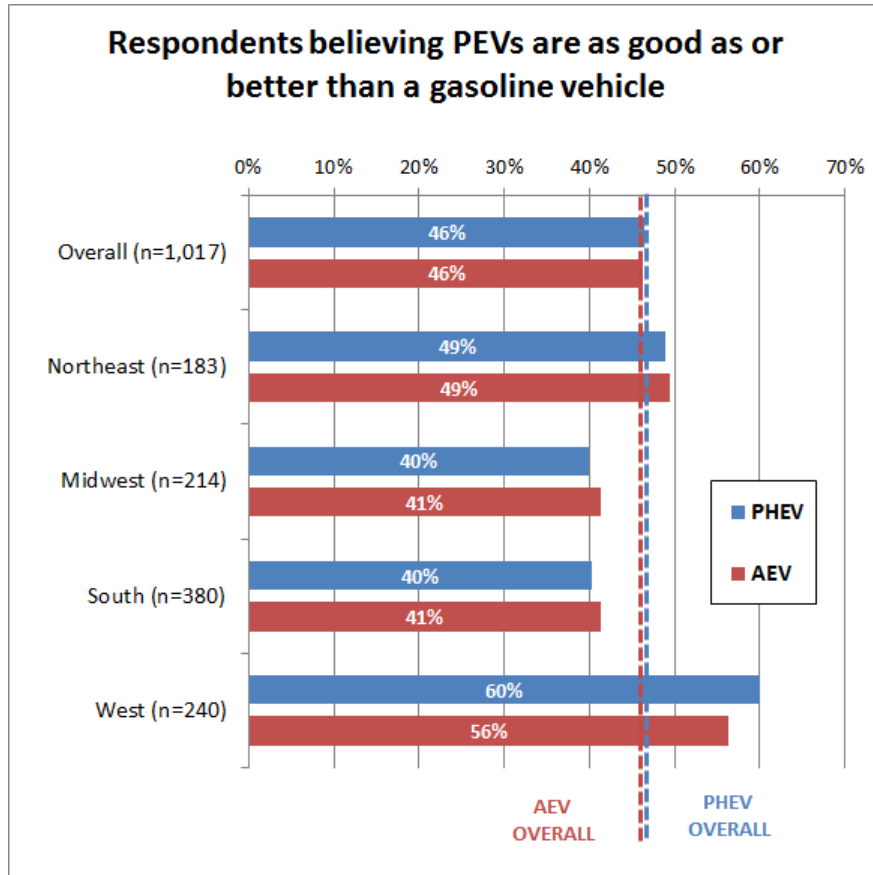


Figure 29. Geography of PEV Acceptance

Source: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The sample sizes are provided for each geographic group in the figure.

4.11 Geography of Willingness to Consider Plug-in Electric Vehicles

Respondents from different census regions reported varied levels of willingness to consider purchasing PEVs as shown in Figure 30. Respondents from the Western and Northeastern regions reported similarly increased levels of a willingness to purchase PEVs. PHEVs were favored in all regions.

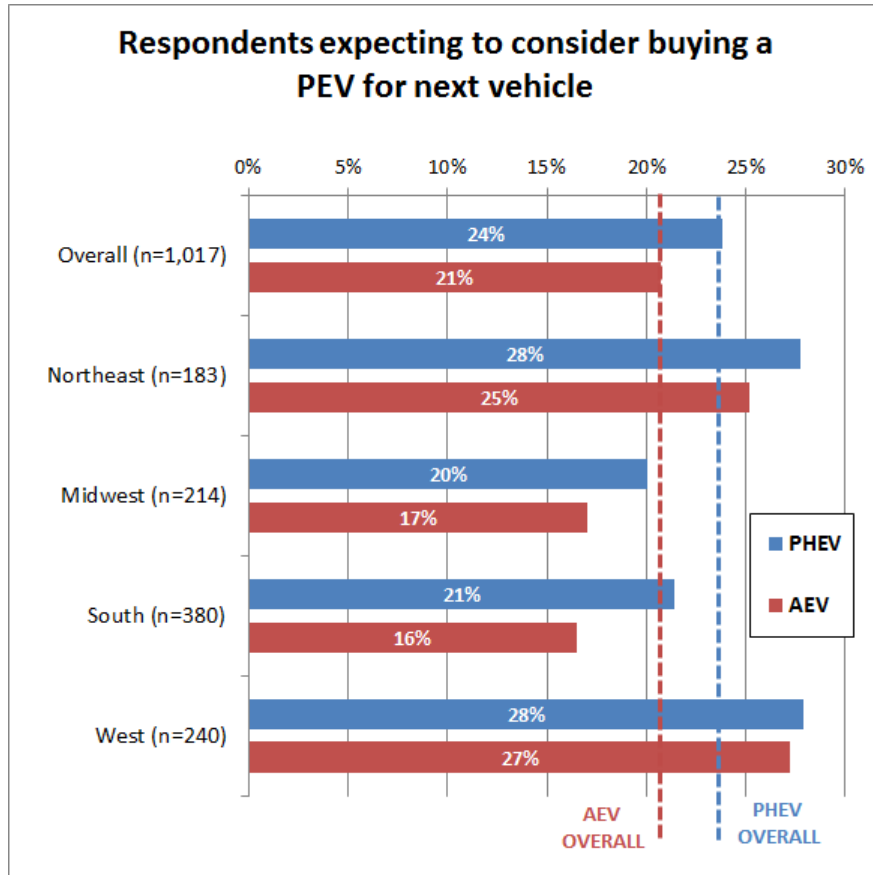


Figure 30. Geography of willingness to consider PEVs

Source: ORC for NREL (2017), Study No. 726058, n=1,017.

Note: The sample sizes are provided for each geographic group in the figure.

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Appendix A: Related Plug-in Electric Vehicle Studies

The following list of consumer studies is presented as context for this study.

| Date of Study ² | Title/ URL | Source | Sample Size |
|----------------------------|---|--|-----------------------------------|
| July 2017 | 3's Company | Autolist | 14,476 individuals |
| | Focus: Primary concerns for PEV buyers including AEV range. | | |
| | https://www.autolist.com/tesla#section=news&s=a | | |
| June 2017 | 30% of Motorists Likely to Opt for Electric Car | AA Ireland | 3,000 Ireland motorists |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | http://www.theaa.ie/blog/30-of-motorists-likely-to-opt-for-electric-car/ | | |
| April 2017 | Price, Access to Charging, Range the Barriers to Electric Vehicle Purchases – Survey | National Franchise Dealers Association | 1,419 United Kingdom car owners |
| | Focus: Primary concerns for considering PEVs. | | |
| | http://www.tyrepress.com/2017/04/price-access-to-charging-range-the-barriers-to-electric-vehicle-purchases-survey/ | | |
| April 2017 | Aspiring Drivers Weigh Automotive Revolution | Driving-tests.org | 158,000 website visitors |
| | Focus: Willingness to consider PEVs and views of automated vehicles. | | |
| | https://driving-tests.org/survey/2017/ | | |
| April 2017 | Public Attitudes Towards Electric Vehicles in Northern Ireland 2015/2016 | Northern Ireland Department for Infrastructure | 3,340 Northern Ireland adults |
| | Focus: Public awareness of PEVs and willingness to consider them. | | |
| | https://www.infrastructure-ni.gov.uk/articles/electric-cars-research | | |
| February 2017 | 40% Would Consider Buying an Electric Car, but Logistics Hold Them Back | Dalia Research | 43,034 people across 52 countries |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | https://daliaresearch.com/blog-40-would-consider-buying-an-electric-car-but-logistics-hold-people-back/ | | |
| February 2017 | Consumer Attitudes - Electric Vehicles | AAA | 1,004 U.S. adults |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | http://newsroom.aaa.com/2017/04/consumer-appetite-electric-vehicles-rivals-pickups/ | | |

² Date of publication if date range of study is uncertain.

| Date of Study² | Title/ URL | Source | Sample Size |
|----------------------------------|---|--------------------------------|---|
| January 2017 | Electrifying Insights: How Automakers Can Drive Electrified Vehicle Sales and Profitability | McKinsey and Company | 3,500 adults in U.S., Germany, and Norway; 3,500 adults in China |
| | Focus: Understanding of PEVs, willingness to consider PEVs, and primary PEV concerns. | | |
| | http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability | | |
| December 2016 | Survey: Lack of Awareness, High Costs Hamper EV Adoption | Altman Vilandrie and Company | 2,500 consumers |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | http://www.businesswire.com/news/home/20161208005809/en/ | | |
| September 2016 | UBS Evidence Lab: What Consumers Think about Electric Cars, and What it Means for Auto Profits | UBS | 1,503 U.S. consumers 9,400 global consumers |
| | Focus: Willingness to consider PEVs and primary PEV concerns including range and charging time. | | |
| | https://neo.ubs.com/shared/d1WrGBXf2R89khS/ | | |
| September 2016 | New Data Shows Consumer Interest in Electric Vehicles Is Growing | Consumer Federation of America | 1,007 U.S. adults |
| | Focus: Willingness to consider PEVs and knowledge of those vehicles. | | |
| | http://consumerfed.org/press_release/new-data-shows-consumer-interest-electric-vehicles-growing/ | | |
| April 2016 | California Drivers Give Electric Vehicles the Green Light | Union of Concerned Scientists | 1,213 drivers in California and 9 Northeast states |
| | Focus: Willingness to consider PEVs and awareness of PEV incentives. | | |
| | http://www.ucsusa.org/clean-vehicles/electric-vehicles/california-electric-cars | | |
| March 2016 | What Are the Barriers to Widespread Adoption of Battery Electric Vehicles? A Survey of Public Perception in Tianjin, China | She et al. | 476 adults in Tianjin, China |
| | Focus: Willingness to consider PEVs and the barriers to broader adoption. | | |
| | http://www.sciencedirect.com/science/article/pii/S0967070X1630395X | | |

| Date of Study² | Title/ URL | Source | Sample Size |
|----------------------------------|---|--------------------------------|---|
| March 2016 | PEV Marketing to Consumers: What's Missing? | Edwards, Turrentine & White | 1,000s of PEV drivers |
| | Focus: PEV owners' willingness to pay for the vehicles, and considerations for purchase. | | |
| | http://www.pevcollaborative.org/pevc_meeting_march_8_2016 | | |
| February 2016 | Consumer Views on Plug-in Electric Vehicles – National Benchmark Report (Second Edition) | NREL | 1,008 U.S. households |
| | Focus: PEV awareness, willingness to consider purchasing, barriers to acceptance, and willingness to pay. | | |
| | https://www.nrel.gov/docs/fy17osti/67107.pdf | | |
| August 2015 | Knowledge Affects Consumer Interest in EVs, New EVs Guide to Address Info Gap | Consumer Federation of America | 1,009 adult Americans |
| | Focus: Willingness to consider PEVs and knowledge of those vehicles. | | |
| | http://consumerfed.org/press_release/knowledge-affects-consumer-interest-in-evs-new-evs-guide-to-address-info-gap/ | | |
| May 2015 | Interest in Electric and Hybrid Vehicles Shows Little Change Since 2013 | The Harris Poll | 2,225 U.S. adults |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | http://www.theharrispoll.com/business/Interest-in-Electric-and-Hybrid-Vehicles.html | | |
| September 2012 – May 2015 | EV Consumer Characteristics, Awareness, Information Channels & Motivations | Williams and Johnson | 19,460 PEV buyers in California |
| | Focus: PEV owners' demographics and considerations for purchase. | | |
| | https://energycenter.org/sites/default/files/docs/ext/transportation/2016-07-20%20EVR9-CSE-PEVmarkets%20handout.pdf | | |
| March 2015 | New Car Buyers' Valuation of Zero-emission Vehicles: California | Kurani et al. | 5,654 adult new car buyers across 13 states |
| | Focus: PEV awareness, willingness to consider purchasing, and considerations for purchase. | | |
| | https://www.arb.ca.gov/research/single-project.php?row_id=65166 | | |

| Date of Study² | Title/ URL | Source | Sample Size |
|----------------------------------|---|---------------------|-----------------------------------|
| February 2015 | Consumer Views on Plug-in Electric Vehicles – National Benchmark Report | NREL | 1,015 U.S. households |
| | Focus: PEV awareness, willingness to consider purchasing, barriers to acceptance, and willingness to pay. | | |
| | https://www.nrel.gov/docs/fy16osti/65279.pdf | | |
| September 2014 | Transportation rEvolution: Electric Vehicle Status Update 2014 | World Wildlife Fund | 1,002 adult Canadians |
| | Focus: Willingness to consider PEVs and views of PEV costs and incentives. | | |
| | http://www.ryerson.ca/content/dam/cue/pdfs/wwf_ev_progress_update_report_2014.pdf | | |
| October 2013 | Is Awareness of Public Charging Associated with Consumer Interest in Plug-In Electric Vehicles? | Bailey et al. | 1,739 Canadian new vehicle buyers |
| | Focus: Awareness of PEV charging stations and willingness to consider PEVs. | | |
| | http://www.sciencedirect.com/science/article/pii/S1361920915000103 | | |
| July 2013 | New Car Dealers and Retail Innovation in California's Plug-In Electric Vehicle Market | Cahill et al. | >7,000 California PEV owners |
| | Focus: PEV owners' requirements of car dealers. | | |
| | https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2353 | | |
| Multiple 2007 - 2013 | Consumer Views on Transportation and Advanced Vehicle Technologies | NREL | ~1,000 U.S. households |
| | Focus: PEV awareness, PEV acceptance, and ability to charge a PEV. | | |
| | https://www.nrel.gov/docs/fy15osti/64840.pdf | | |
| Fall 2012 | Electric Vehicle Consumer Survey: Consumer Attitudes, Opinions, Preferences, and Price Sensitivity for Plug-In Electric Vehicles and EV Charging Stations | Vyas and Hurst | 1,001 U.S. consumers |
| | Focus: Willingness to consider PEVs and primary PEV concerns. | | |
| | https://www.navigantresearch.com/wp-content/uploads/2012/10/EVCS-12-Executive-Summary.pdf | | |
| September 2012 | Barriers to Widespread Adoption of Electric Vehicles: An Analysis of Consumer Attitudes and perceptions | Egbue & Long | 481 technology enthusiasts |
| | Focus: PEV interest, importance of PEV attributes, and PEV concerns. | | |
| | http://www.sciencedirect.com/science/article/pii/S0301421512005162 | | |

| Date of Study² | Title/ URL | Source | Sample Size |
|----------------------------------|---|-------------------------|--|
| Early 2012 | Consumer Attitudes about Electric Cars: Pricing Analysis and Policy Implications | Larson et al. | 240 Manitoba consumers |
| | Focus: Willingness to pay for PEVs. | | |
| | http://www.sciencedirect.com/science/article/pii/S0965856414002134 | | |
| October 2011 | Perception and Reality: Public Knowledge of Plug-In Electric Vehicles in 21 U.S. Cities | Krause et al. | 2,302 individuals in 21 large U.S. cities |
| | Focus: Measuring the public's understanding of PEVs. | | |
| | http://www.sciencedirect.com/science/article/pii/S0301421513009427 | | |
| July 2011 | Analysis of a Consumer Survey on Plug-In Hybrid Electric Vehicles | Krupa et al. | 911 U.S. adults |
| | Focus: Willingness to consider PEVs, considerations for purchase, and willingness to pay. | | |
| | http://www.sciencedirect.com/science/article/pii/S0965856414000500 | | |
| 2011 | The Shift to Electric Vehicles: Putting Consumers in the Driver's Seat | Gyimesi and Viswanathan | 125 automotive industry executives; 1,716 U.S. drivers |
| | Focus: Awareness of PEVs and considerations for purchase. | | |
| | http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=XB&infotype=PM&appname=GBSE_GB_TI_USEN&htmlfid=GBE03454USEN&attachment=GBE03454USEN.PDF | | |
| June 2009 | Learning from Consumers: Plug-In Hybrid Electric Vehicle (PHEV) Demonstration and Consumer Education, Outreach, and Market Research Program | Kurani et al. | 34 PHEV households |
| | Focus: Observing consumers' PHEV charging habits. | | |
| | https://ideas.repec.org/p/cdl/itsdav/qt9361r9h7.html | | |