

# 2023 EV DRIVER SURVEY

A STRONG YEAR FOR EVs,  
BUT CHARGING RELIABILITY  
NEEDS IMPROVEMENT

MAY 2023

PLUG IN AMERICA  
LOS ANGELES, CA  
[PLUGINAMERICA.ORG](https://pluginamerica.org)



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## EXECUTIVE SUMMARY

While there are several groups who perform surveys of EV drivers, Plug In America's database includes EV drivers with years, or even decades, of experience driving electric. From December 2022 through February 2023, Plug In America surveyed over 3,300 electric vehicle (EV) owners and nearly 600 individuals interested in purchasing an EV.<sup>1</sup> This survey builds on data collected from surveys conducted in 2020 and 2021.<sup>2</sup> The intent of this survey was to understand the current state of EV driving and consideration in the United States and in particular:

- What are the primary motivations for drivers and those considering EVs?
- What are the most valuable sources of information available to EV customers?
- What is the quality of the current EV buying experience for customers?
- Are EV owners content? Why or why not?
- What are the most significant concerns with existing fast-charging networks?

The year 2022 showed continued growth in the electric vehicle market, with 46% growth in new EV sales over 2021 (which itself was up nearly double over 2020). Electric vehicles made up approximately 6.7% of new vehicle sales nationwide in 2022, compared to about 4.3% in 2021.<sup>3</sup> Future growth is expected to be strong since many EV models continue to have wait lists and as new models become available, especially in the popular light truck segment. To support this continued growth, the EV industry must ensure that the buying, driving, and charging experiences continue to improve.

EV owners are generally satisfied with their purchases; 90% say that is it "likely" or "very likely" that their next vehicle purchase will be an EV. The primary motivation for EV owners to purchase the vehicle was the environment and air quality, with over 40% indicating this was their most important consideration, more than double the rate of the second most frequently listed motivation—cost savings, at 20%. A majority of respondents (57%) considered it "vital" or "very important" that EVs be charged with renewable energy, which further increases the environmental benefits of EVs.

With regard to available information about EVs, over 80% of owners indicated satisfaction with finding the information they needed to buy or lease an EV; the most common information lacking was cold-weather performance. Information on real-world EV range was also seen as lacking. Prospective EV buyers noted difficulty finding information on applying for incentives and rebates.

EV-specific websites such as PlugStar.com were rated as the most valuable source of EV information by both EV owners and those considering buying an EV. However, owners were

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<sup>1</sup> See "Survey Methodology and Response Summary" for more detail.

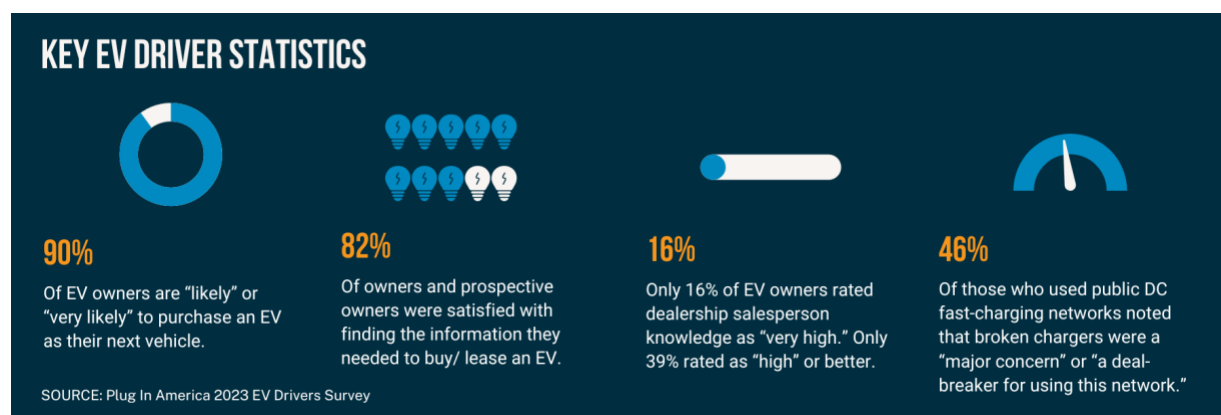
<sup>2</sup> See <https://pluginamerica.org/survey/>

<sup>3</sup> Argonne National Laboratory, "Light Duty Electric Drive Vehicles Monthly Sales Updates," <https://www.anl.gov/es/light-duty-electric-drive-vehicles-monthly-sales-updates>, accessed March 19, 2023.

generally dissatisfied with the experience they received at dealerships, with only 16% considering the salesperson “very high” in knowledge. While EV owners intend to continue driving electric, they voiced frustration with public charging infrastructure, with the most common issues being “broken or non-functional chargers” or “too few charging locations.”

There was significant variation by charging network, with the Tesla Supercharger Network scoring significantly better than its competitors on every metric. There was also some regional variation; California drivers expressed greater satisfaction with the number of charging stations but less satisfaction with the number of chargers or their operating status.

Overall, satisfaction with fast charging was down *significantly* compared to last year’s survey, with the public charging networks showing the greatest decline. There are several potential reasons for this year-over-year change, as detailed in this report.



Those who do not currently own an EV but are considering purchasing one within the next 12 months share some similarities with current owners, but there are some differences. Similar to current EV owners, these “intenders” are primarily motivated by environmental and clean air impacts to purchase the vehicle, but they are significantly more likely to name cost savings as their most important motivating factor (33% do so, versus 20% of EV drivers).

Intenders also find EV-specific websites to be the most valuable source of information on EVs but find less value in EV information resources overall, possibly because they have not yet completed their research. These intenders tended to be older and less likely to earn more than \$100,000 annually. They were approximately equally likely to live in a single-family home, with about 80% of respondents among both owners and intenders falling into this category.

The following report explores these findings in more detail and provides insight regarding what can be done to encourage further growth in EV adoption.

Since a significant motivating factor in EV adoption is improved air quality and environmental protection, we recommend that this benefit continue to be kept in mind when developing state

incentives. Incentives for EVs support a *public good* (cleaner air and a more liveable climate) and do not merely benefit the drivers or owners.

Improving the dealership experience is a key area of Plug In America expertise, which the report shows is an important area to continue to expand our work. We encourage regions and states to implement dealership engagement programs such as PlugStar, which supports, trains, and certifies dealers to sell EVs. This program has proven results in improving customer satisfaction and dealer success in regions where it is implemented.

The most significant problems noted for DC fast-charging (DCFC) networks were broken or non-functional chargers (a “major concern” or “deal-breaker” for 46% of users of public DCFC networks) and too sparse charging locations (a “major difficulty” or “deal-breaker” for 38% of such respondents). These concerns were far less severe among users of the Tesla Supercharger network, with only 8% finding broken chargers to be in the two most serious classifications of problems, and similarly only 8% of Tesla Supercharging users found insufficient charging locations to be of such severity. While satisfaction with the Supercharger network dropped slightly since the prior survey, satisfaction with public DCFC networks fell precipitously.

All charging networks need to reverse the trend of decreasing driver satisfaction; publicly-funded charging networks have a critical need to address this as soon as possible so that the National Electric Vehicle Infrastructure (NEVI) program results in chargers that meet drivers’ needs.

Aside from the concerning decrease in public charging satisfaction, the picture is encouraging. The continued growth of the EV market and the high satisfaction with the vehicles themselves offer hope for the future of the decarbonization of transportation.

# THE STATE OF EV OWNERSHIP

## *An Extraordinary Year*

The U.S. EV market, including both Battery Electric Vehicles (BEV) and Plug-In Hybrid Electric Vehicles (PHEV) grew from around 636,000 vehicles in 2021 to about 925,000 vehicles in 2022,<sup>4</sup> an increase of 46%. Market share increased from about 4.3% of light-duty vehicles in 2021 to about 6.7% in 2022.

The new models most reported by survey respondents included the Hyundai IONIQ 5 (78 responses), the Kia EV6 (72 responses), and the Ford F-150 Lightning (30 responses).

Notably, EV market share is significantly higher in the car segment, with over 10% of new car sales in 2022 being EVs. Fewer EV options exist in the much larger light truck segment (minivans, pickup trucks, and SUVs), but EVs are well represented in the compact and mid-sized crossover SUV segment.

The Ford F-150 Lightning was one of the most anticipated EVs in 2022 and scored very well in driver satisfaction; the Rivian R1T, released in 2021, was another pickup truck with outstanding reviews. With Ford's recently announced plans to increase F-150 Lightning production<sup>5</sup>, as well as the forthcoming release of the Chevy Silverado EV<sup>6</sup>, Plug In America expects to see a larger number of pickup trucks in next year's survey.

Automakers have made numerous commitments to electrification and unveiled plans to produce many new models of electric vehicles. While Plug In America welcomes commitments and plans, we look forward to seeing the actual vehicles on the road.

## *Motivation and Information*

Understanding what motivates EV drivers and where they found value in their EV-buying experience can help refine new offerings and move the market forward.

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<sup>4</sup> Argonne National Laboratory, Energy Systems Division, "Light Duty Electric Drive Vehicles Monthly Sales Updates," <https://www.anl.gov/es/light-duty-electric-drive-vehicles-monthly-sales-updates>, accessed March 19, 2023.

<sup>5</sup> Ford Motor Company (2023). "Ford Increasing Production of Popular Electric, Gas, Hybrid Vehicles in Response to Strong Customer Demand," press release, March 3. <https://media.ford.com/content/fordmedia/fna/us/en/news/2023/03/03/ford-increasing-production-of-popular-electric-gas-hybrid-vehi.html>

<sup>6</sup> General Motors Corporation (2023). "The First-Ever All-Electric Silverado." <https://www.chevrolet.com/electric/silverado-ev>. Website accessed March 27, 2023; notes Silverado EV to be available in Fall 2023.

The motivating factor for current EV owners in purchasing the vehicle is crystal clear – the environment and air quality. Over 40% indicated this was a “most important” consideration in buying an EV. Figure 1 displays the proportion of owners who indicated that a factor was “most important” to them when it came to considering the purchase of an EV.

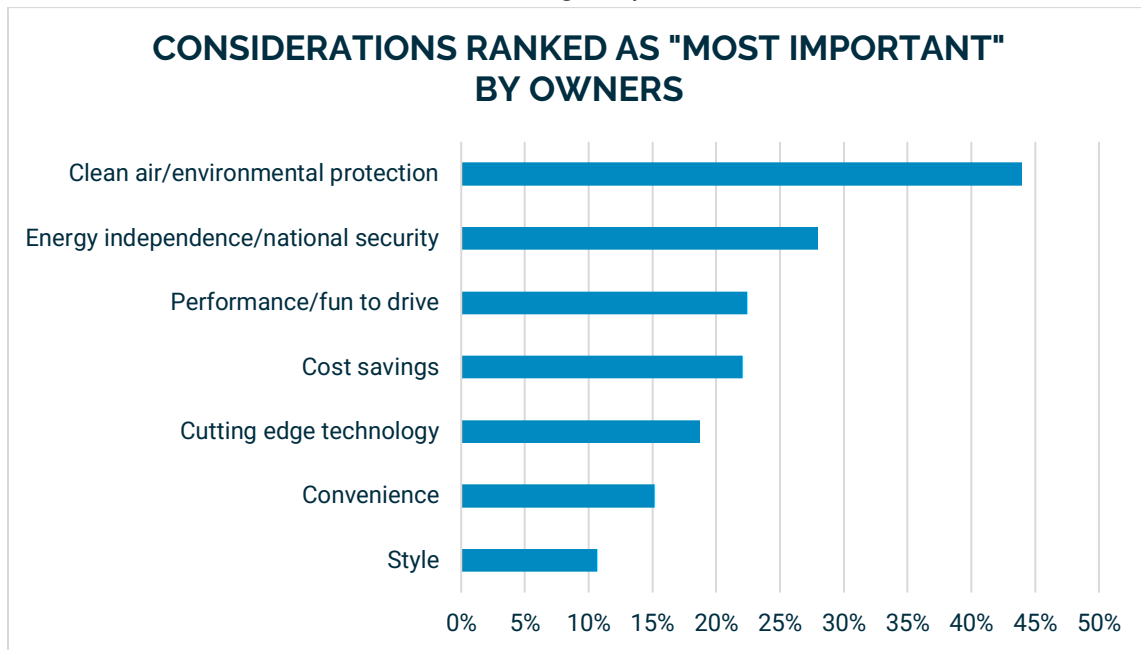


Figure 1: Percentage of EV owners indicating a factor is a “Most Important” purchase consideration

When asked to select the one single most important factor, clean air and environmental protection also came in first, with cost savings a distant second, as shown in Figure 2.

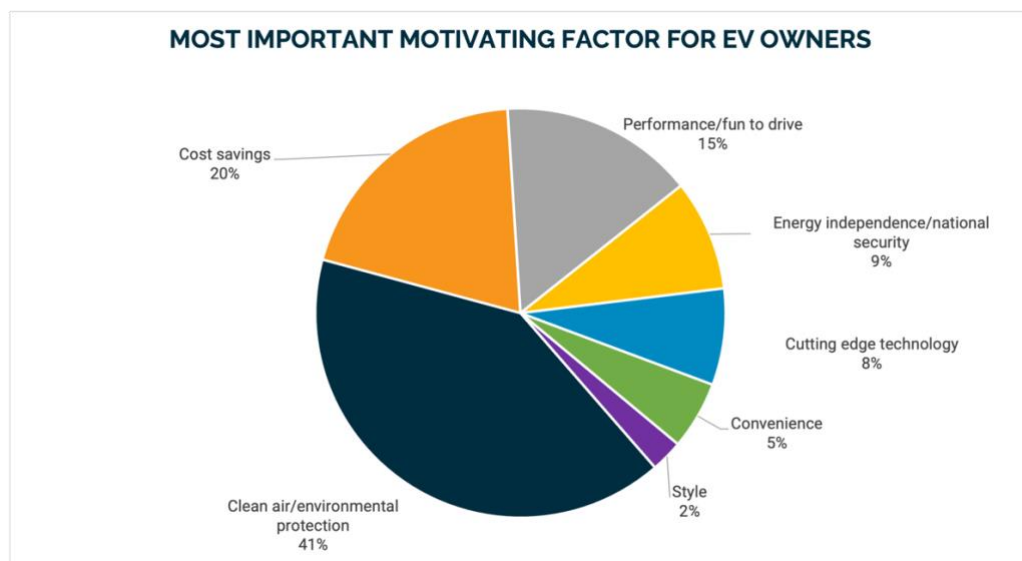


Figure 2: Most Important Motivating Factor for EV Owners

Over 57% of respondents indicated that it is “very important” or “vital” that the electricity used to power EVs comes from renewable energy sources, as seen in Figure 3.<sup>7</sup> This response further defines the environment as a primary driver of current EV owners and intenders.

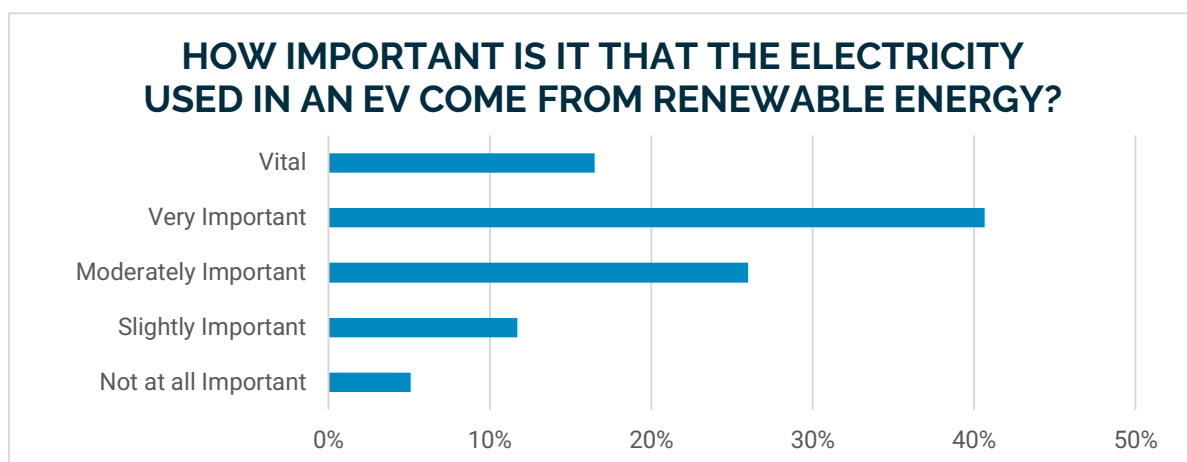


Figure 3: Responses to “How important is it that the electricity used in an EV comes from renewable energy?”

Economic factors were also significant considerations when deciding to purchase an EV; Figure 4 indicates the most influential of these.

<sup>7</sup> The average EV produces less than half the greenhouse gas emissions of the average gasoline vehicle, factoring in vehicle and battery manufacturing, and 90% of the U.S. population lives in regions where an average EV produces lower greenhouse gas emissions than the very *lowest-emission* gasoline vehicles (<https://www.ucsusa.org/resources/driving-cleaner>). Purchasing green power achieves even greater emission reductions.



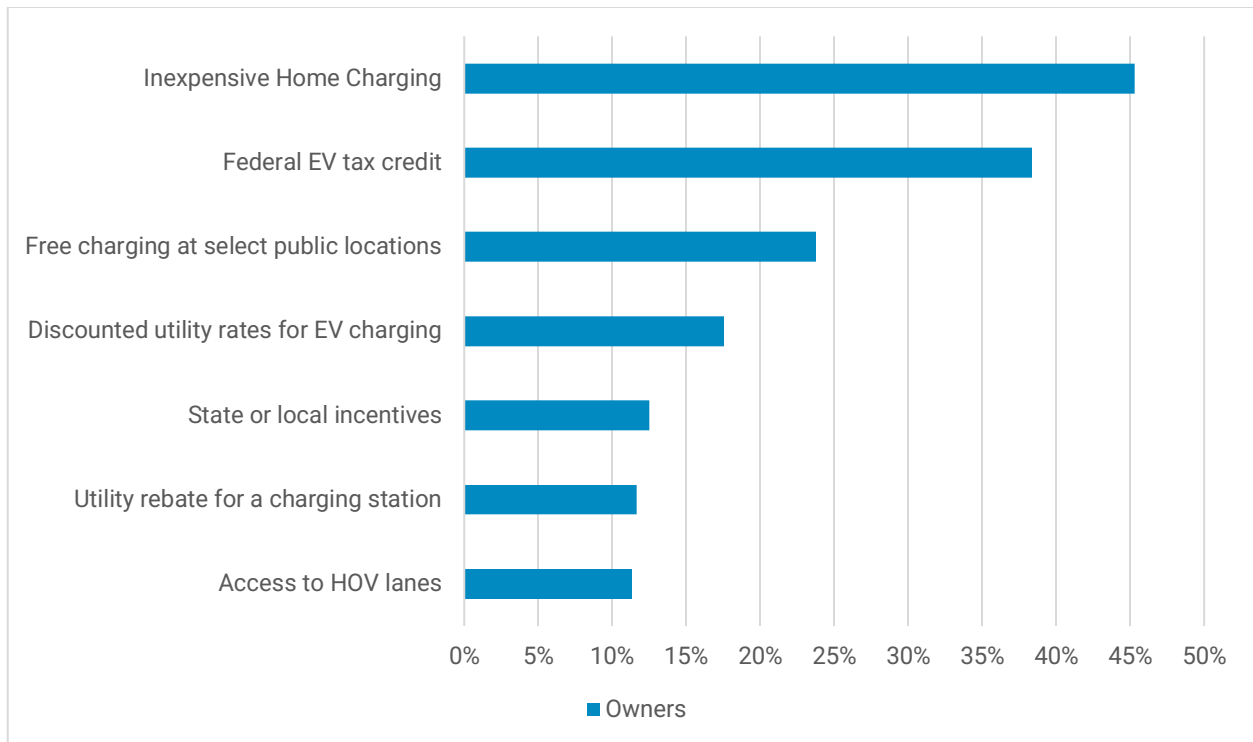


Figure 4: Percentage of EV owners indicating a factor is “Critical” or “Very Influential” on purchase decision

Access to low-cost home charging was the most significant economic factor in EV adoption. The federal tax credit was not available for many of the most popular EVs in 2022. However, this situation changed with the passage of the Inflation Reduction Act, restoring eligibility for many Tesla and GM vehicles. The federal tax credit is proving to be a strong driver of domestic supply chain development, with more than \$210 billion in recent vehicle and battery manufacturing investments committed in the United States.<sup>8</sup> While the federal clean vehicle tax credits are complex and change frequently, Plug In America expects vehicles eligible for the credits to enjoy increased sales in 2023.

In addition to motivations for purchasing the vehicle, owners were surveyed regarding the value of varying sources of EV information in making that purchase decision. Plug In America asked respondents to select the top three information resources that they considered most useful and trustworthy. Figure 5 displays the proportion of owners who listed a given information source in their top three. EV-specific websites were the top information source, with over 70% of respondents including them in their top three.

Ride-and-drive events were also significant sources of information, ahead of sources such as automakers, and friends and family. Plug In America and its national and local partners conduct

<sup>8</sup> [https://www.atlasevhub.com/data\\_story/210-billion-of-announced-investments-in-electric-vehicle-manufacturing-headed-for-the-u-s/](https://www.atlasevhub.com/data_story/210-billion-of-announced-investments-in-electric-vehicle-manufacturing-headed-for-the-u-s/)

hundreds of ride-and-drive events across the country during Drive Electric Earth Day and National Drive Electric Week.

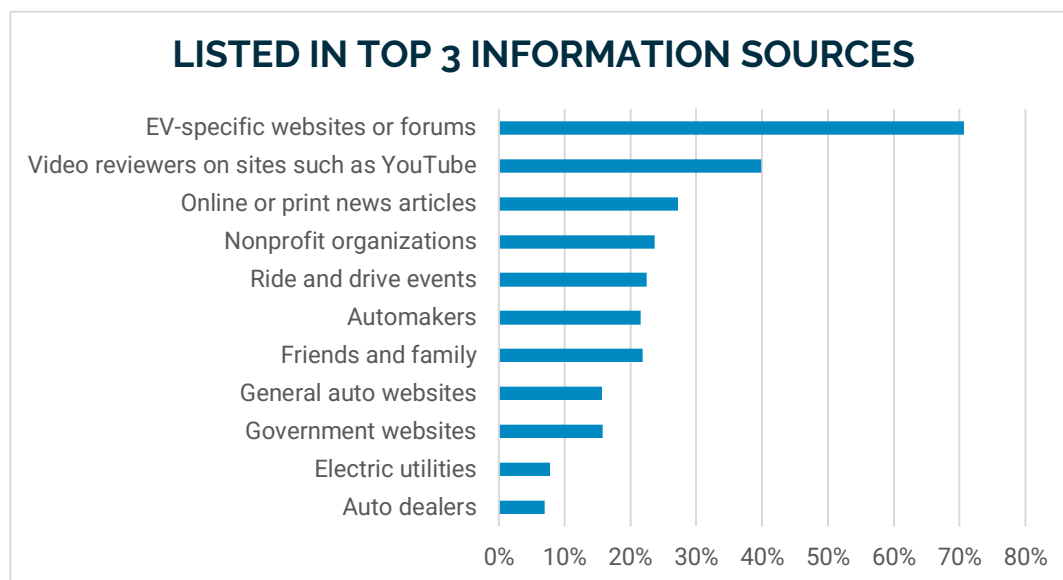


Figure 5: Percentage of EV owners listing information source in their top three most useful and trustworthy

Continuing analysis of what motivates EV buyers and what they consider the most valuable and trusted information source will be critical to creating and maintaining further momentum in the retail space. It is likely that value systems will continue to evolve as electric vehicles continue to become more mainstream, appealing to new demographics, and as the nature of information access continues to change.

Electric utilities were not highly cited as sources of information on electric vehicles, likely because such entities are only now becoming involved in significant education and outreach efforts.<sup>9</sup> Many states allow—or, in fact, require—electric utilities to provide information to their customers about energy-efficient technologies, such as high-efficiency air conditioners or water heaters. It is less common for utilities to promote EVs, even though EVs use highly efficient technology that can reduce greenhouse gas emissions and place downward pressure on electricity rates. As EV-specific websites were recognized as a valuable source of information, we note that Plug In America has developed white-labeled utility-specific versions of its PlugStar site to assist utilities in EV education and outreach.

Over 80% of EV owners indicated that they were *generally* satisfied with finding the information they needed to buy or lease an EV, but only 40% reported that they could find *all* the information they needed without difficulty, as seen in Figure 6. Among the others, the most common

<sup>9</sup> For more information on utility education and outreach programs,, see the Plug In America white paper, The Missing Piece on Meeting Transportation Electrification Goals: Utility Education and Outreach Programs, at <https://pluginamerica.org/wp-content/uploads/2020/12/EO-White-Paper.pdf>.

information lacking was cold-weather performance, with 25% of respondents noting that information was difficult to find.

Respondents generally found ample information on available vehicle models and characteristics; Plug In America offers that information through our PlugStar Shopping Assistant<sup>10</sup> and through our Electric Vehicle Guide flyer.<sup>11</sup> We do offer some general information on cold-weather EV driving<sup>12</sup> but do not have model-specific information for all EVs. Manufacturers should share information about expected range loss in cold temperatures, as this can vary significantly based on the battery and the vehicle heating system.

Information on real-world vehicle range was noted as lacking to a greater degree than it was in previous years, with 23% of EV buyers stating they had difficulty finding such information.

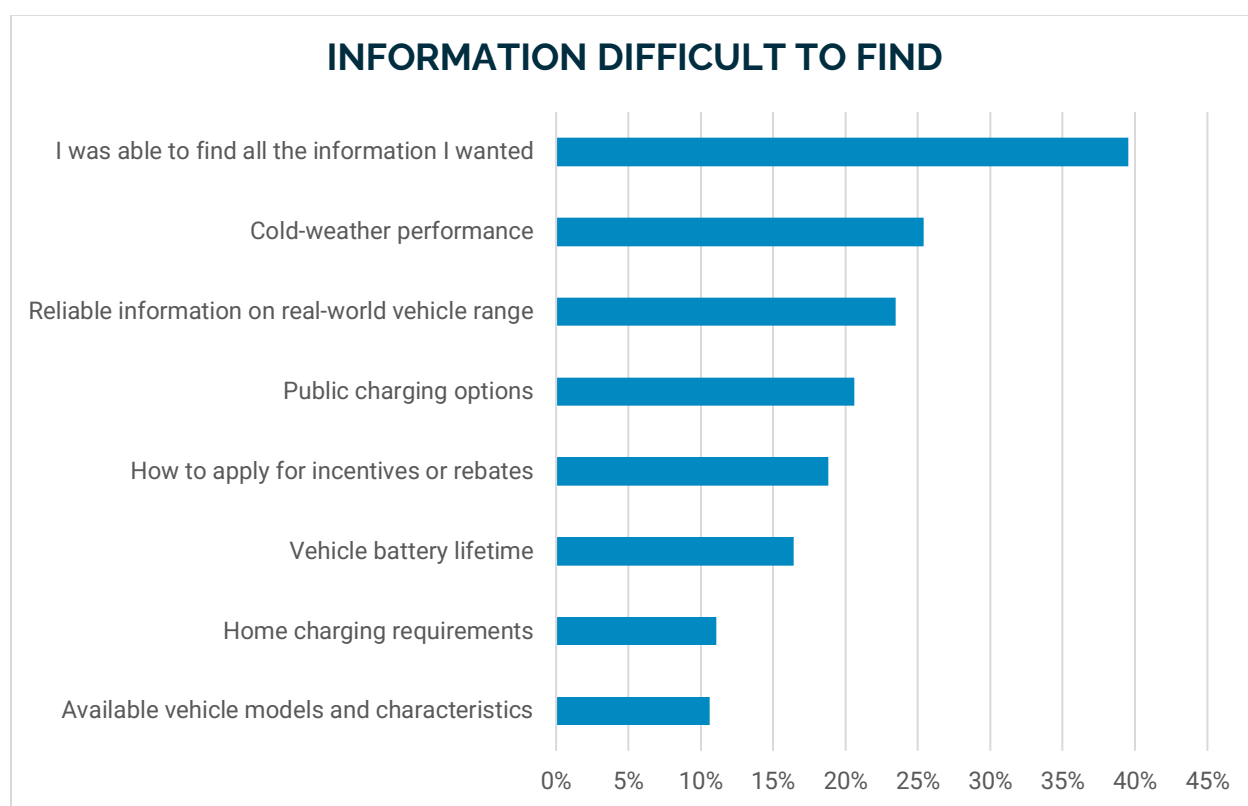


Figure 6: Responses to "What information, if any, did you have difficulty finding?"

We do note that our survey sample is not representative of a cross-section of the *entire* potential car-buying public; it still features many innovators and early adopters. This year, we asked how long respondents had been driving EVs.

<sup>10</sup> <https://plugstar.com/cars>.

<sup>11</sup> <https://pluginamerica.org/learn/guide/>

<sup>12</sup> See <https://pluginamerica.org/ev-tips-for-winter-weather/>.

The results were illuminating. Plug In America values its EV pioneer members, some of whom have been driving EVs for nearly 50 years. But as can be seen in Figure 7, the majority of respondents are very new EV drivers. The median respondent first had an EV in their household in 2018.

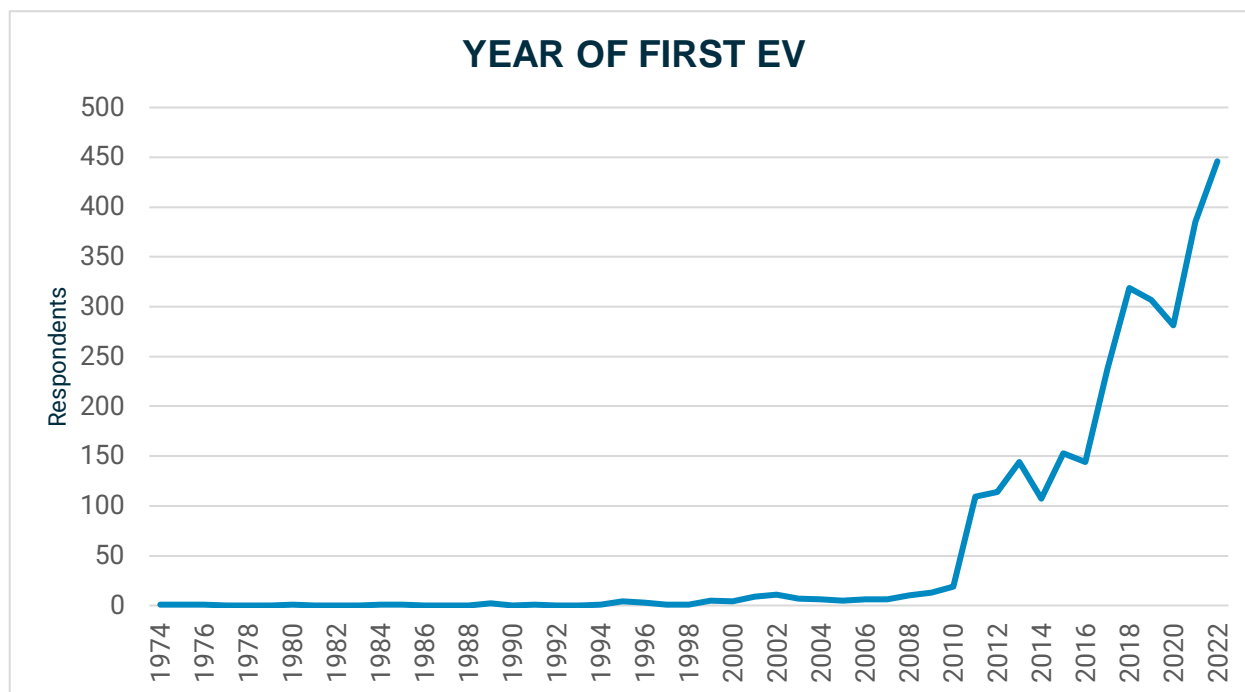


Figure 7: Responses to "In what year did you first have an EV in your household?"

### ***The Consumer Experience – Purchasing and Ownership***

The EV market is full of satisfied owners, with 90% stating that they were "very likely" (72%) or "likely" (17%) to purchase an EV as their next vehicle. BEVs were more common in our survey; 88% of EV owners had at least one BEV, while 28% had at least one PHEV. A full 33% of EV owners did *not* have a conventional internal combustion engine vehicle in their household.

EV owners were somewhat satisfied with the purchasing experience. Only 16% of customers who shopped at a dealership rated the knowledge of the salesperson about EVs as "very high." While manufacturers do provide informative model-specific training to dealerships, Plug In America has found that dealers often need more tools to answer questions about the entire EV ecosystem – including aspects like charging infrastructure, rebates, and policies. Figure 8 displays the proportion of survey responses by a rating of salesperson EV knowledge.

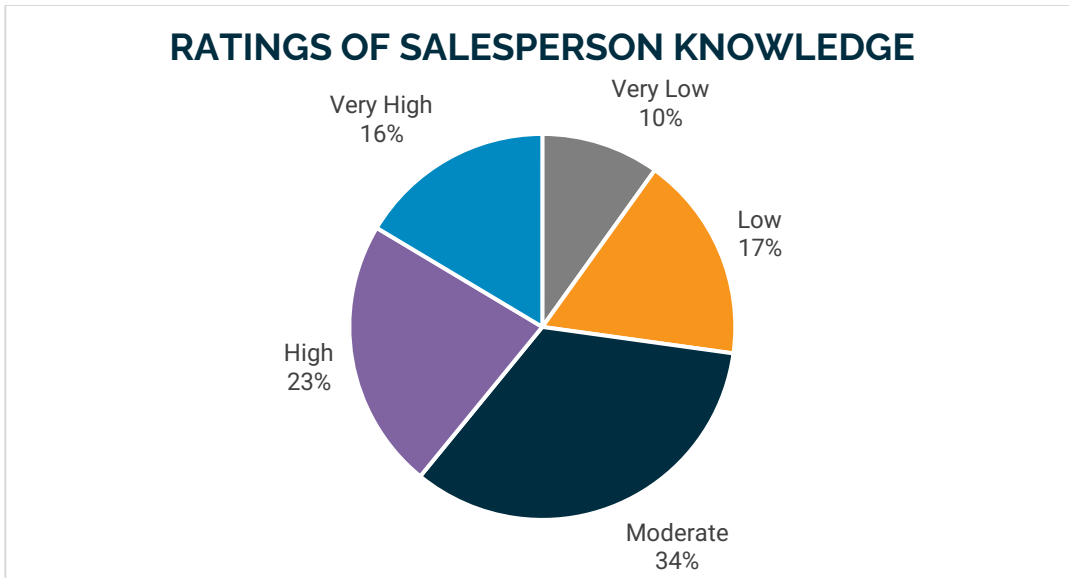


Figure 8: Ratings of salesperson EV knowledge for owners who shopped at dealerships or showrooms

Salesperson knowledge varied by brand. Of the six manufacturers with the highest number of vehicles in the responses, Tesla was the leader in salesperson knowledge, but BMW was not far behind, as seen in Figure 9.

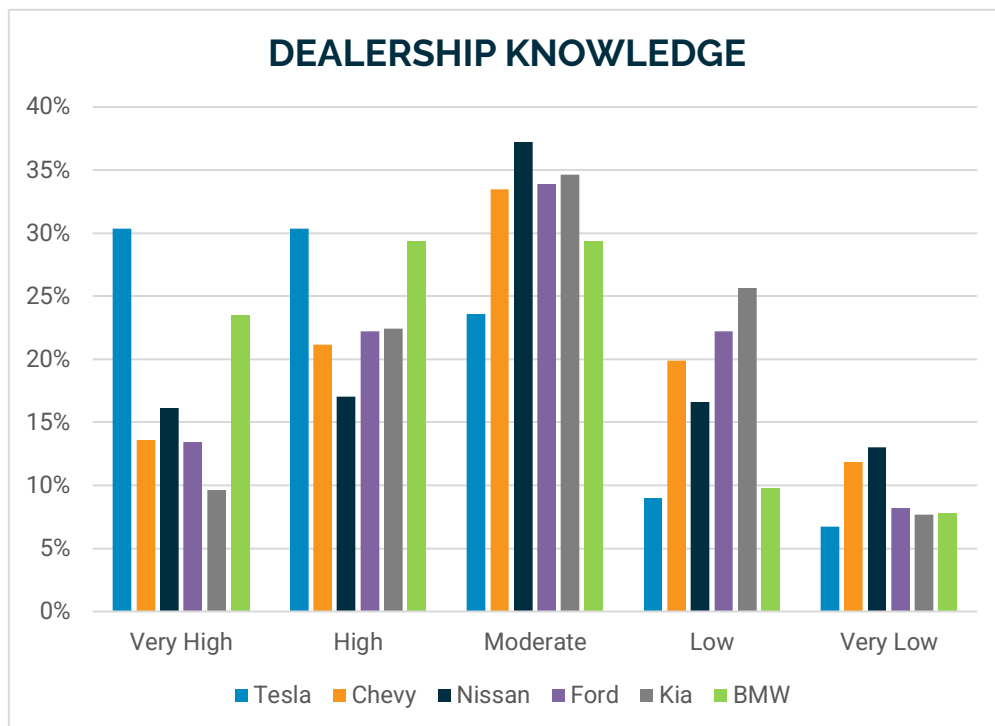


Figure 9: Dealership knowledge among top six manufacturers

Beyond salesperson knowledge, we also asked about satisfaction with the EV buying experience. Some EV-only manufacturers sell directly to customers rather than through franchised dealerships;

these direct manufacturers include Tesla, Rivian, and Lucid. Customers using the direct sale experience had a higher level of “very satisfied” responses for both the price negotiation component (notably, Tesla does *not* negotiate prices, a decision which appears to increase buyer satisfaction), as well as the post-delivery support and service component, as seen in Figure 10 and Figure 11.

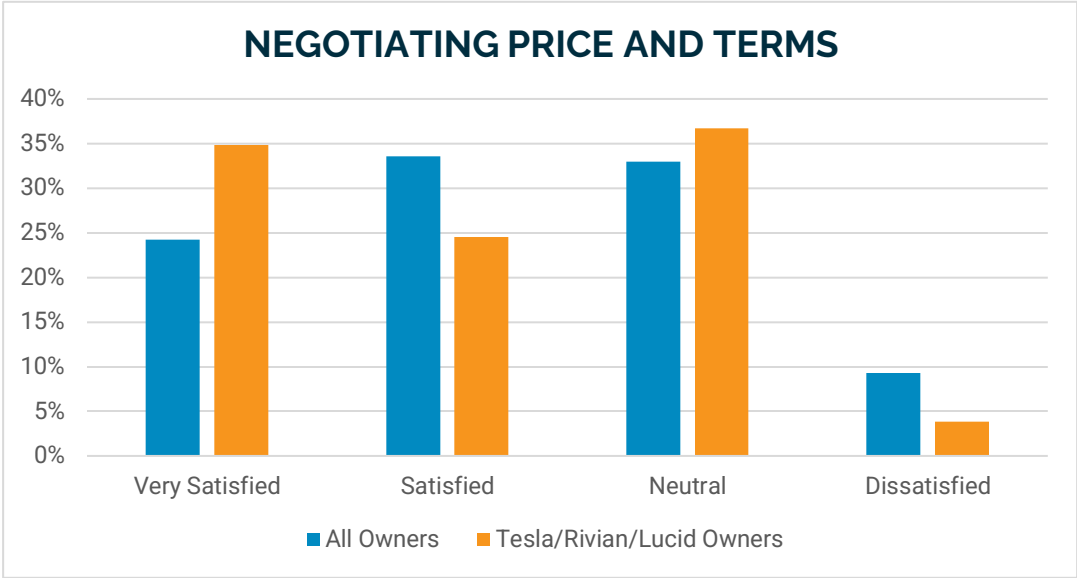


Figure 10: Satisfaction with EV Buying Experience (Price and Terms)

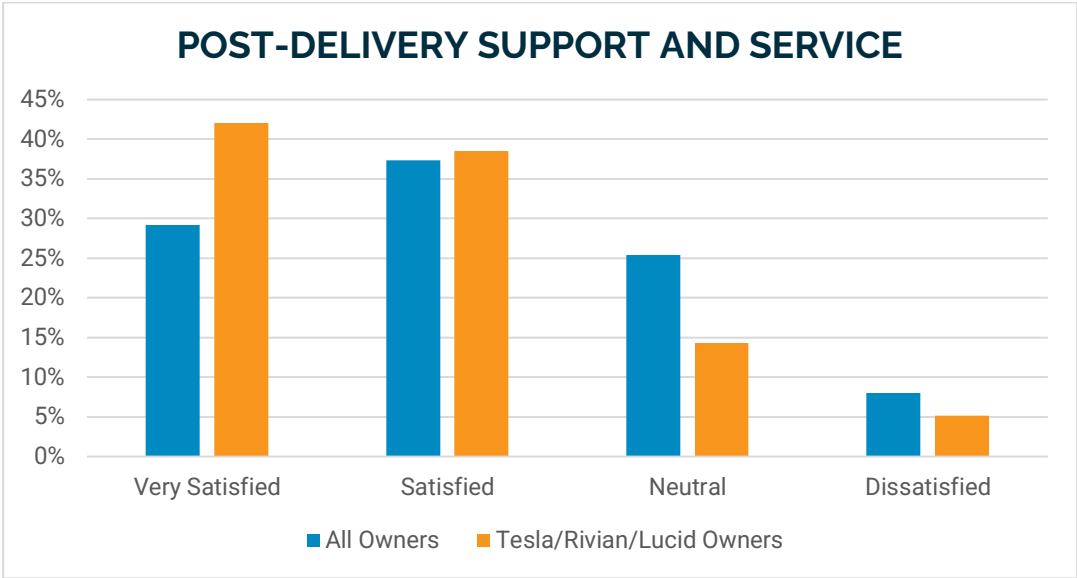


Figure 11: Satisfaction with EV Buying Experience (Support and Service)

Charging Patterns

More than 90% of EV owners have access to home charging, but the majority also charge in public, at least on occasion, as shown in Figure 12.

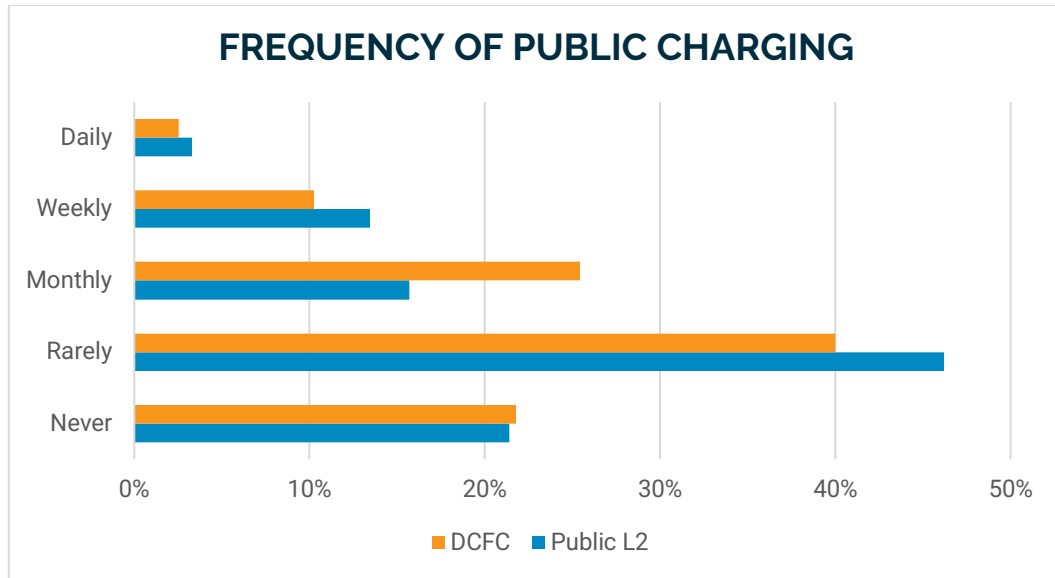


Figure 12: Frequency of Public Charging among EV Owners

Level 1 charging remained common for household charging, with about a quarter of EV owners using only 120-V outlets, as seen in Figure 13. These were not only drivers of PHEVs; the five most popular vehicles for drivers with only Level 1 charging were the Nissan LEAF, Chevy Bolt, Tesla Model 3, Chevy Volt, and BMW i3. About 28% of LEAF drivers reported using only Level 1 charging, as did about 18% of Bolt drivers and 10% of Model 3 drivers.

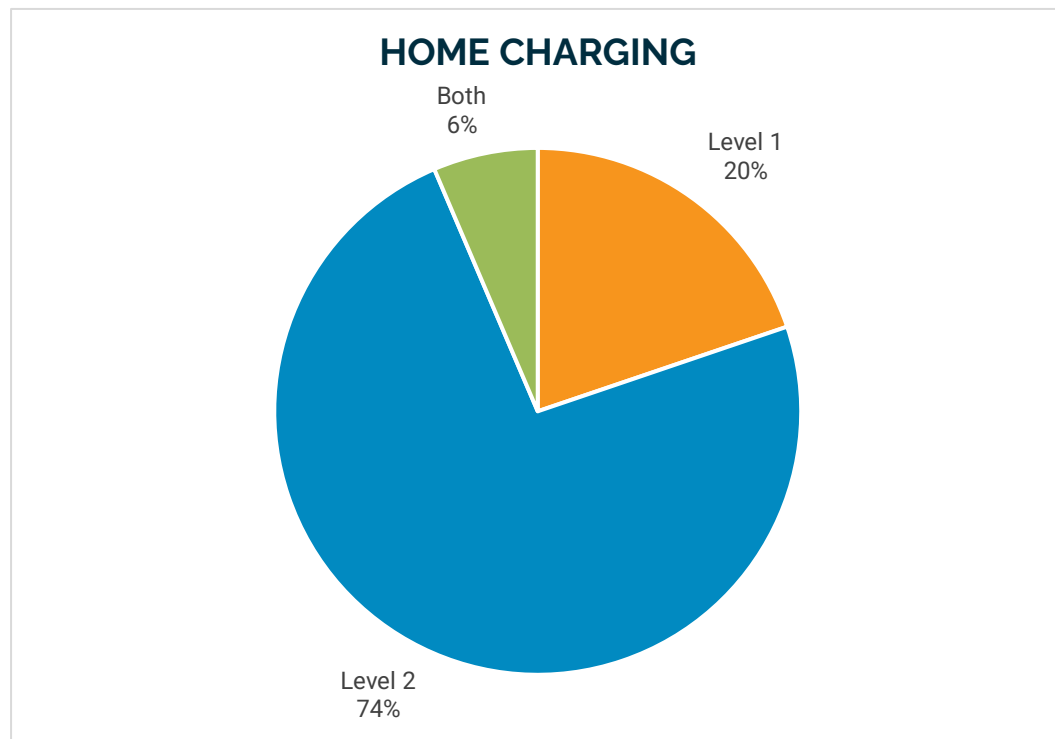


Figure 13: Home Charging Options

Workplace charging was frequently used by EV owners who have access to it. Over a quarter of respondents using workplace charging reported using it weekly, and nearly another quarter reported using it daily, as seen in Figure 14.

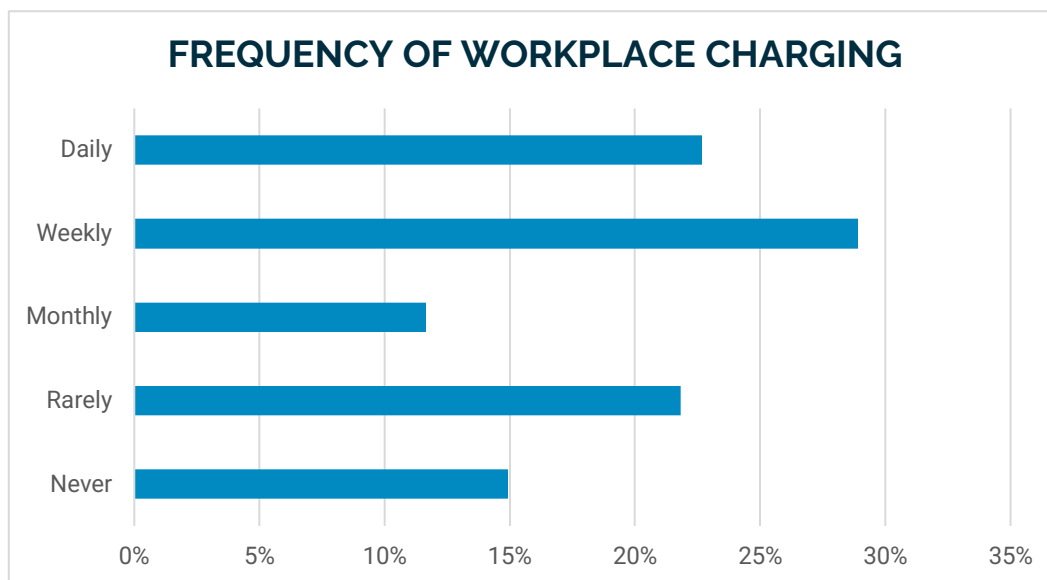


Figure 14: Frequency of workplace charging among EV owners with access to that option

### The Public Charging Experience

In prior surveys, we asked about difficulties with charging networks within the past year. This allows us to observe changes over time in the performance of such networks. Unfortunately, recent experience shows diminishing driver satisfaction with all fast-charging networks, most notably with the public charging networks. The relative importance of challenges remains unchanged—broken chargers are again the leading concern—but the magnitude of concerns overall has increased. The difficulties noted by drivers are shown in Figure 15 and Figure 16, comparing the 2023 survey to the 2022 survey.

The Tesla Supercharger Network is considered separately for several reasons. It is large enough to warrant such analysis (representing more than 40% of the ratings of fast-charger networks overall); it has a very different business model than the other networks; and, its satisfaction ratings are markedly different from the public charging networks. As Tesla opens up its Supercharger network to other EV drivers, we may need to separately consider the experience using this network for Tesla and non-Tesla drivers.



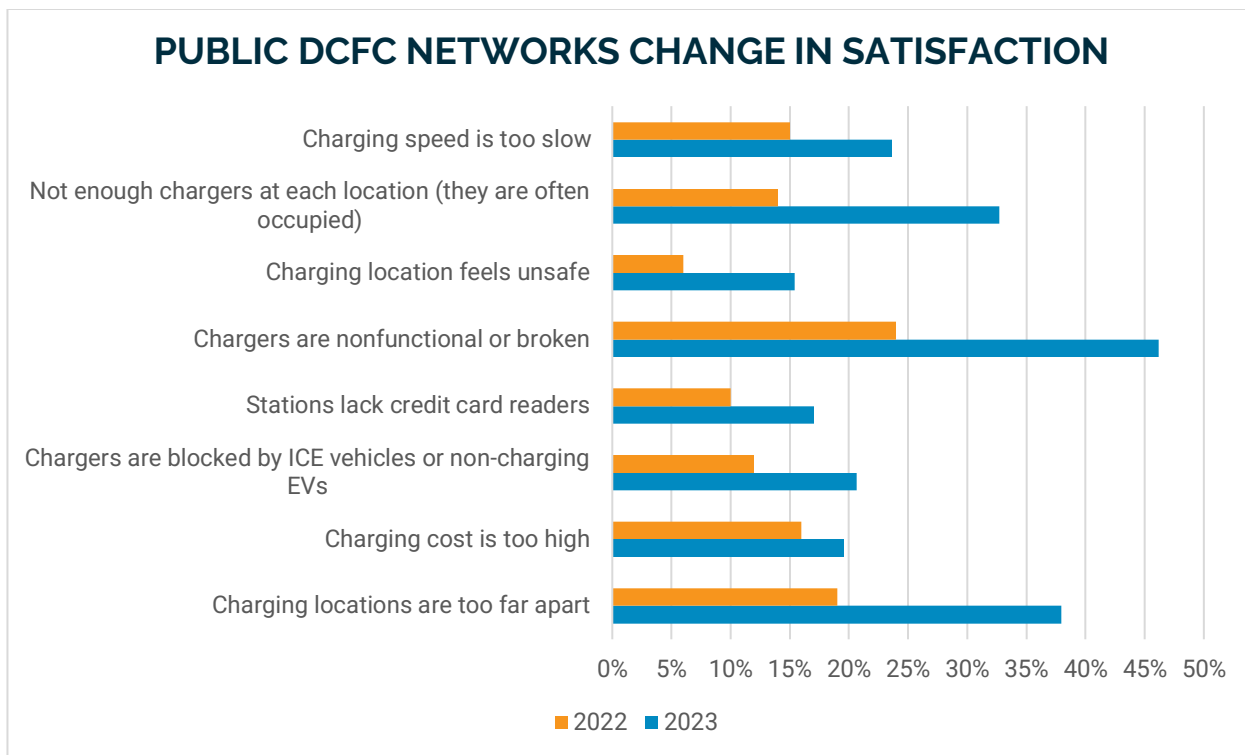


Figure 15: Public DCFC Networks Change in Satisfaction

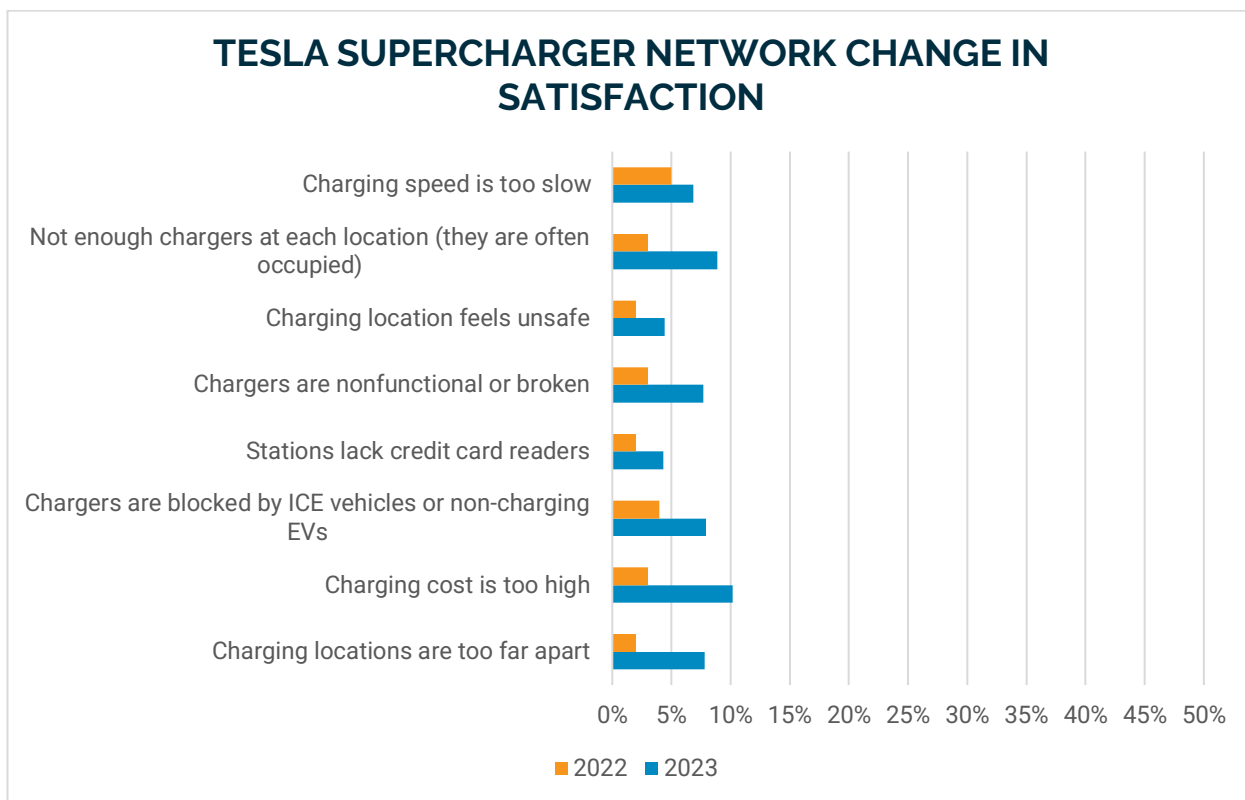


Figure 16: Tesla Supercharger Network Change in Satisfaction

The charging experience varies considerably by network. As can be seen from the above figures, users of the Tesla Supercharger Network reported far fewer problems than users of the public charging network—but even there, satisfaction decreased in 2022. For the Tesla Supercharger Network, the most significant concern was the cost of charging, with 9% rating it “a major concern” and 1% rating it “a deal-breaker for using this network.” The second-most prevalent concern was insufficient chargers at each location, with 7% considering it “a major concern” and 2% considering it “a deal-breaker.” Even though the Tesla Supercharger network typically has more chargers per site than other DCFC networks, the demand for these chargers is so great that there can be a wait to use them, especially during times of high travel demand.

For the major public charging networks (Blink, ChargePoint, Electrify America, and EVgo) taken as a group, the most prevalent concern was broken chargers. With 37% noting this “a major concern” and 9% noting it “a deal-breaker for using this network.” The second-most prevalent concern for public networks was the sparseness of charging stations (the stations being too far apart), which was in the top two ratings of concern for 38% of respondents (ranging from 36% to 42% across the four public charging networks considered).

At best, broken or non-functional chargers represent a nuisance or inconvenience. At worst, an EV driver could be stranded. Negative experiences caused by non-functional charging stations could adversely affect the EV market.

Table 1 shows the most common issues by fast-charging network. Most of the public charging networks had a similar prevalence of broken chargers.

*Table 1: Most prevalent issues with fast charging networks*

| <b>Network</b>             | <b>Most Significant Issue</b>         | <b>"A major concern" or "A deal-breaker for using this network"</b> |
|----------------------------|---------------------------------------|---|
| Blink                      | Chargers are non-functional or broken | 58%   |
| ChargePoint                | Charging locations are too far apart  | 38%   |
| Electrify America          | Chargers are non-functional or broken | 49%   |
| EVgo                       | Chargers are non-functional or broken | 47%   |
| Tesla Supercharger Network | Charging cost is too high             | 10%   |

In late 2021, Congress passed the Infrastructure Investment and Jobs Act, which committed \$7.5 billion to building a network of public EV charging infrastructure across the country. Government agencies have recently released comprehensive requirements for all EV charging stations built using this funding. Requirements include specifications on the number of chargers per charging plaza, charger power levels, uptime requirements, amenities, maintenance contracts, pricing transparency, and more. Plug In America expects that these investments and requirements will improve the quality and reliability of public charging over the next five years. We will continue to survey drivers about these issues and report our findings.

We do note certain caveats regarding this concern about public chargers. Our survey cannot isolate if the problem is increased *frequency* of DCFC malfunction, or increased *perception* of DCFC malfunction. In the weeks and months prior to the survey being fielded, a number of articles appeared in the press describing challenges with public charging networks.<sup>13141516</sup> It is possible that these articles raised the profile of reliability issues with chargers and prompted drivers to report on them.

Two additional factors could also drive increased reporting of public charging difficulties. One possibility is that the EV market is shifting from “early adopters,” who may be more tolerant of difficulties, to “early majority” who have different expectations. Another is that EV drivers took more road trips in 2022 than in 2021, as pandemic concerns partially eased, resulting in greater use of DCFC networks.

The second-most common concern of EV drivers about charging stations was the distance between the stations. This should improve as additional charging stations are built.

California accounted for over 20% of survey responses, nearly four times as many as the state with the next-highest number of responses. California is at the forefront of EV adoption in the United States, with a higher EV market share than any other state. We isolated California responses to see if there was geographic variation in concerns about fast-charging networks. California saw somewhat *lower* concern about how far apart charging stations are, but somewhat *higher* concern about the number of charging units at each location, as seen in Figure 17 and Figure 18. These were the two issues on which California respondents differed the most from other respondents. California has numerous EV charging locations; however, it also has a much greater demand for those chargers.

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<sup>13</sup> J.D. Power and Associates (2022), “J.D. Power Electric Vehicle Experience (EVX) Public Charging Study,” <https://www.jdpower.com/business/automotive/electric-vehicle-experience-evx-public-charging-study>, August 17.

<sup>14</sup> Deloitte (2023), “2023 Global Automotive Consumer Study,” <https://www2.deloitte.com/us/en/pages/consumer-business/articles/global-automotive-consumer-study.html>, January.

<sup>15</sup> Chokski, N. (2022), “A Frustrating Hassle Holding Electric Cars Back: Broken Chargers,” *New York Times*, August 16.

<sup>16</sup> Rempel, David and Cullen, Carleen and Bryan, Mary Matteson and Cezar, Gustavo Vianna (2022), Reliability of Open Public Electric Vehicle Direct Current Fast Chargers. April 7. Available at SSRN: <https://ssrn.com/abstract=4077554> or <http://dx.doi.org/10.2139/ssrn.4077554>

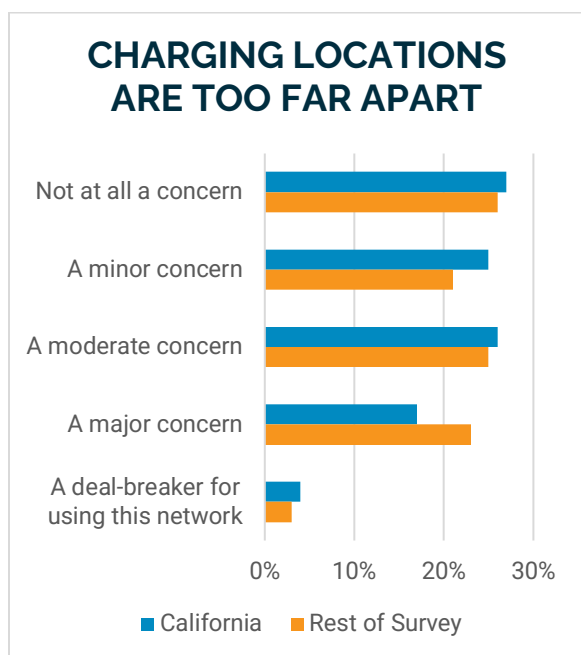


Figure 17: Charging locations, CA vs rest of survey

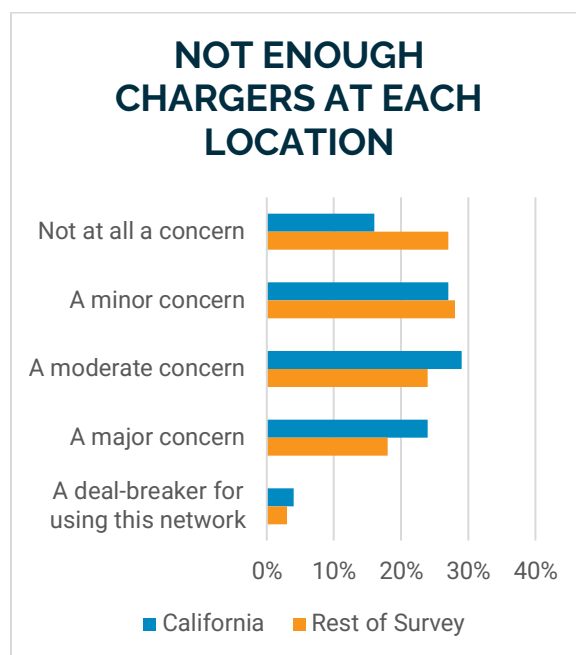


Figure 18: Chargers per location, CA vs rest of survey

A majority of respondents indicated that the charging speed of their usual network was either “not at all a concern” (33% of respondents) or only “a minor concern” (28%). And when asked about their vehicles, 90% of respondents reported that charging speed was “satisfactory” (70%) or “exceptional” (20%). While technological advances may enable faster EV charging in the future, the speed of charging at present should not be considered a barrier to EV adoption.

### Vehicle Characteristics

Acknowledging that many respondents had multiple EVs, respondents were asked about the EV that they drove *most often*. The Tesla Model 3 was the most frequently cited vehicle, accounting for 15% of responses, The next-most common EVs were the Chevy Bolt (including the Bolt EUV) and the Tesla Model Y. The responses are shown in Figure 19, noting all models with 50 responses or more.

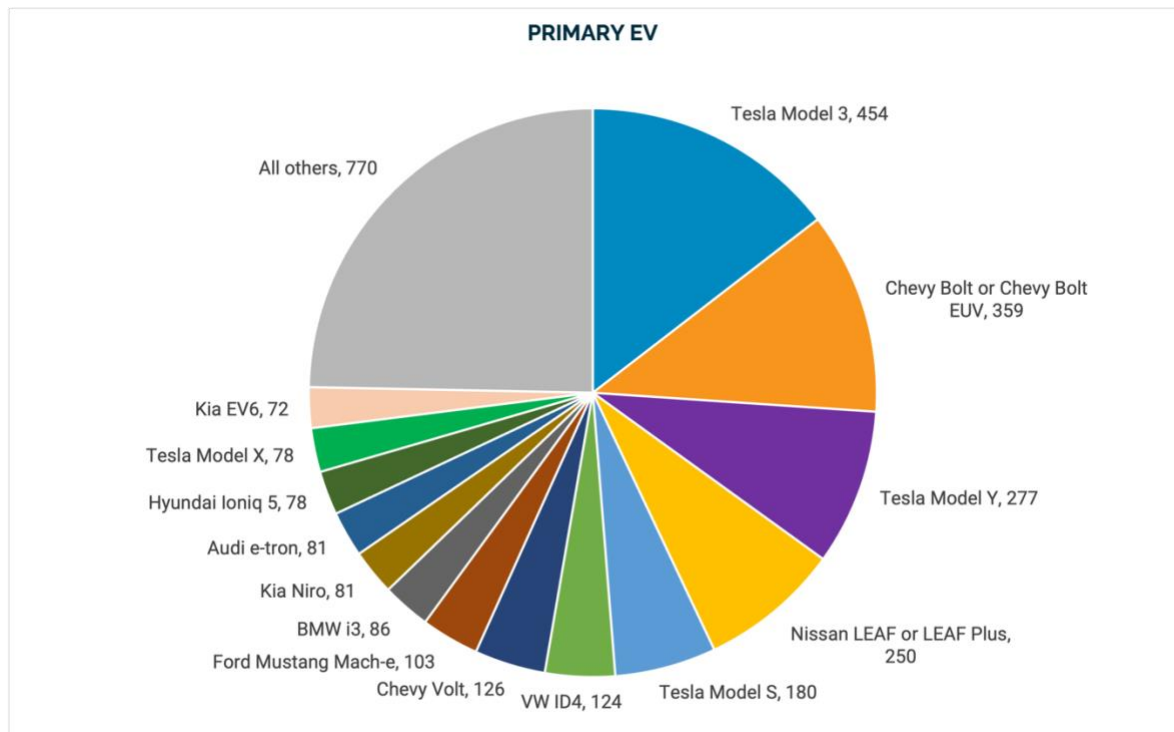


Figure 19: Primary EV of Survey Respondents

The Hyundai IONIQ 5 and the Kia EV6 both saw their first U.S. sales in the 2022 model year and represented the 12<sup>th</sup>-most and 14<sup>th</sup>-most common EVs in the survey.

A wide range of vehicles constituted the “All others” category, including electric motorcycles, conversions of internal combustion engine vehicles, and small-volume-production EVs. The Rivian R1T had 45 responses, and the Ford F-150 Lightning had 30.

Of those who purchased their EVs (as opposed to building or converting), 84% reported purchasing them new, while 16% purchased them used.

Overall, respondents were generally satisfied with their EV’s characteristics, as shown in Figure 20. Note that these are drivers’ perceptions and not objective quantifications. For example, the Tesla Model X has more cargo space than the smaller Model Y, but Model Y drivers reported greater satisfaction with their vehicle’s cargo space, perhaps due to different expectations.

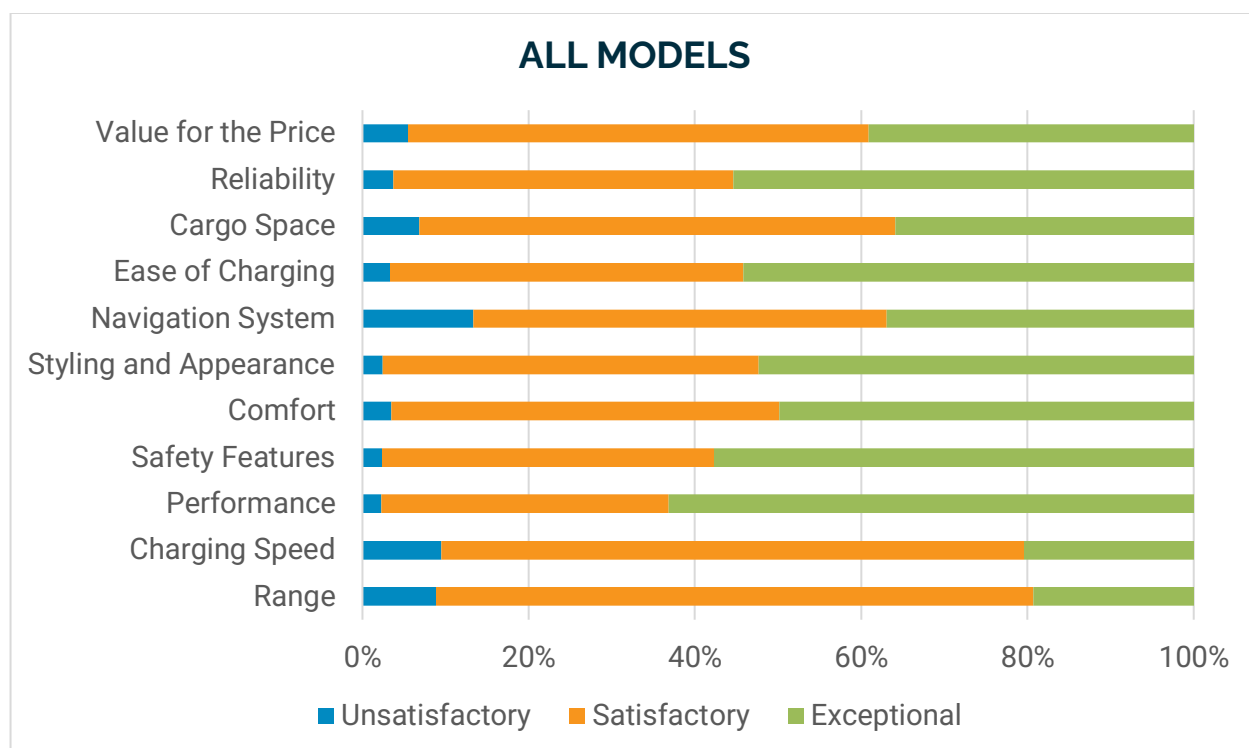


Figure 20: Overall Driver Satisfaction with EVs

The Tesla Model Y and Model 3 both had no less than 33% of respondents rate them as “Exceptional” in every category. The Model Y led all vehicles in the “Range” category, with 35% rating it “Exceptional.” The Kia EV6 led all models for “Charging Speed” with 71% “Exceptional”; the Model Y and Model 3 were nearly tied for “Ease of Charging” at 79% and 78%; the Toyota Rav4 Prime led for “Reliability” at 77%; and the Chevy Bolt led for “Value for the Price,” with 57% calling it “Exceptional.” The Rivian R1T led in Performance, Safety Features, Comfort, Styling/Appearance, and Cargo Space, but with only 45 responses, its ratings should be considered as having a wider range of uncertainty. Table 2 shows what EV drivers liked most about each vehicle, considering which characteristics were most often rated “Exceptional” for that model. It also notes which EVs led in any categories among those vehicles with 50 or more responses.

Table 2: Most "Exceptional" features of each EV with more than 50 responses, as rated by drivers

| Vehicle               | Count | Most Exceptional             | Led all EVs   |
|-----------------------|-------|------------------------------|---|
| Tesla Model 3         | 454   | Performance (83%)            | Performance (83%)   |
| Chevy Bolt/Bolt EUV   | 359   | Performance (64%)            | Value (57%)   |
| Tesla Model Y         | 277   | Performance (82%)            | Ease of Charging (79%)<br>Range (35%)<br>Safety Features (77%)<br>Cargo Space (72%) |
| Nissan LEAF/LEAF Plus | 250   | Reliability (60%)            |   |
| Tesla Model S         | 180   | Performance (81%)            | Styling/Appearance (77%)<br>Navigation System (71%)                                 |
| Chevy Volt            | 126   | Performance (48%)            |   |
| VW ID4                | 124   | Comfort (73%)                |   |
| Ford Mustang Mach-e   | 103   | Styling and Appearance (74%) |   |
| BMW i3                | 86    | Reliability (51%)            |   |
| Kia Niro              | 81    | Safety Features (67%)        |   |
| Audi e-tron           | 81    | Styling/Appearance (59%)     |   |
| Hyundai IONIQ 5       | 78    | Styling/Appearance (76%)     | Comfort (74%)   |
| Tesla Model X         | 78    | Ease of Charging (74%)       |   |
| Kia EV6               | 72    | Performance (78%)            | Charging Speed (71%)<br>Reliability (69%)   |

"Navigation System" had the most frequent ratings of "Unsatisfactory," with a survey-wide frequency of that rating at 13%; "Range" and "Charging Speed" both had 9% rated "Unsatisfactory." Some models had as few as 1% calling their range "Unsatisfactory," while other models had as high as 25% assigning that rating. We specifically asked about navigation systems due to the key role these can play in helping EV drivers find compatible and available charging stations. Drivers of gasoline vehicles may find gas stations by visible signs towering over highways or marking exit ramps; EV drivers, on the other hand, often rely on apps, whether on their phones or built into the vehicles. A well-designed navigation system can make an EV much more user-friendly.

Charging speed is sometimes portrayed as a barrier to EV adoption; however, only 9% of respondents felt that charging speed was "Unsatisfactory" for their vehicle, while 20% found it

“Exceptional”. In general, newer models were more likely to be rated “Exceptional” and less likely to be rated “Unsatisfactory,” although “Satisfactory” was the most common rating for all models.

We looked at the satisfaction with vehicle characteristics by model year. Not surprisingly, more recent model year vehicles were rated better on many characteristics due to technological improvement. For example, respondents generally perceived newer vehicles as being superior on range, charging speed, and performance, as seen in Figure 21 through Figure 23. However, older vehicles were equally well rated on reliability (Figure 24) and achieved superior ratings on value for the price (Figure 25).

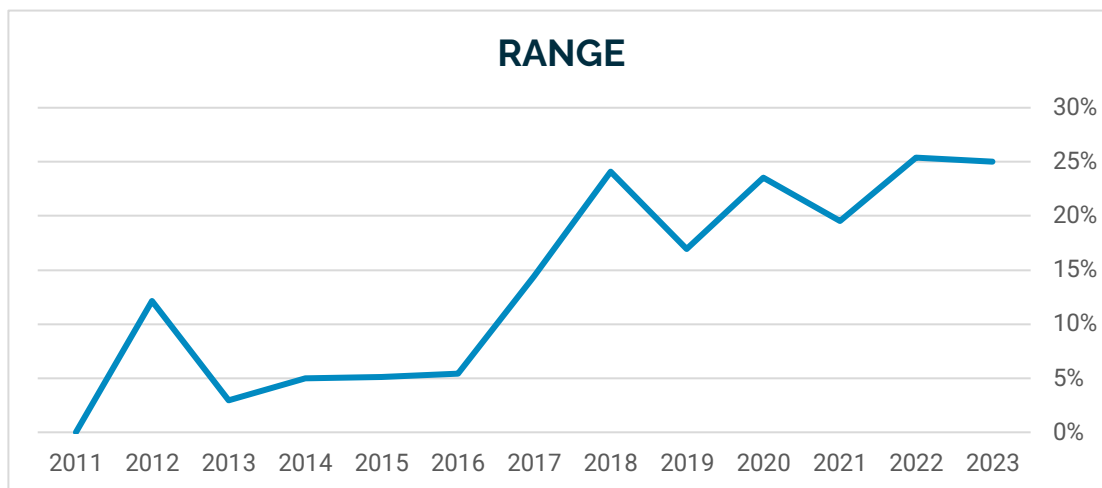


Figure 21: Rating of Range as "Exceptional" by Model Year

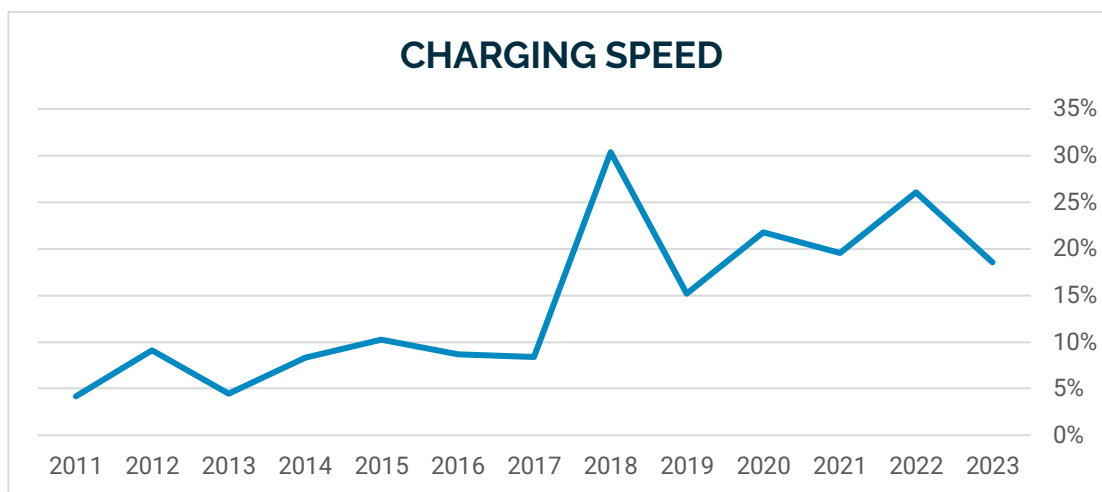


Figure 22: Rating of Charging Speed as "Exceptional" by Model Year



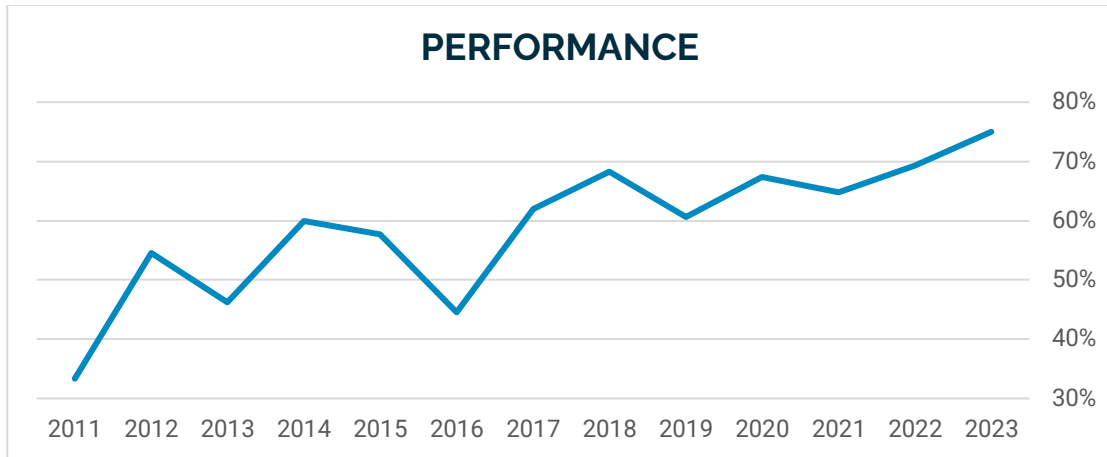


Figure 23: Rating of Performance as "Exceptional" by Model Year

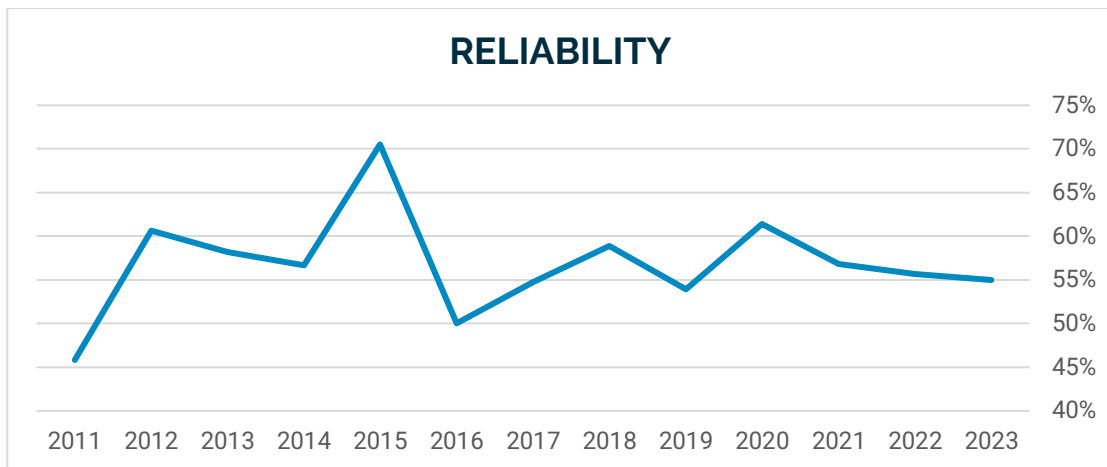


Figure 24: Rating of Reliability as "Exceptional" by Model Year

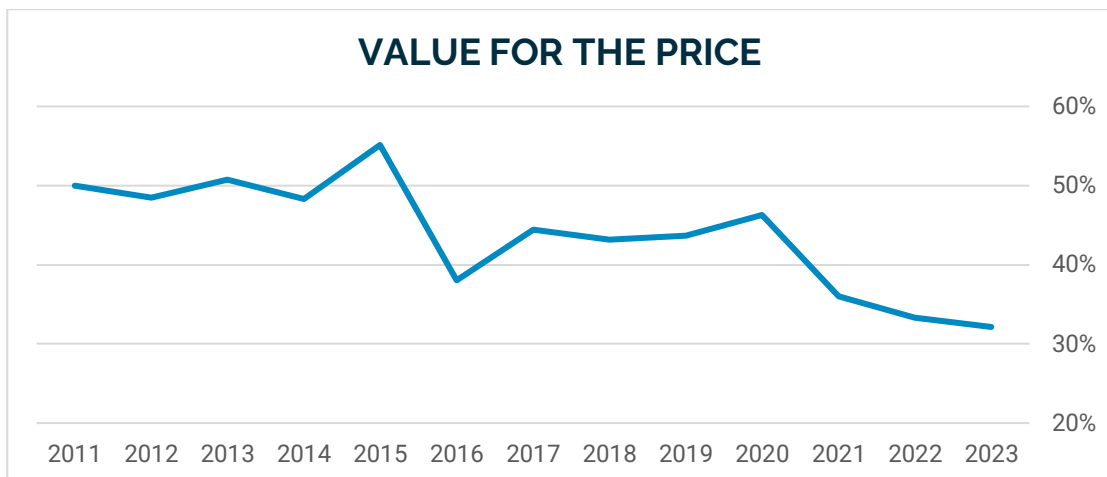


Figure 25: Rating of Value for the Price as "Exceptional" by Model Year

## Ridesharing and Delivery

While only a small fraction of respondents reported using their EVs for ridesharing or delivery services, this fraction still constituted 390 respondents. Those respondents were generally satisfied with the viability of the vehicle and of charging networks for such applications, as seen in Figure 26 and Figure 27, although there is definitely room for improvement.

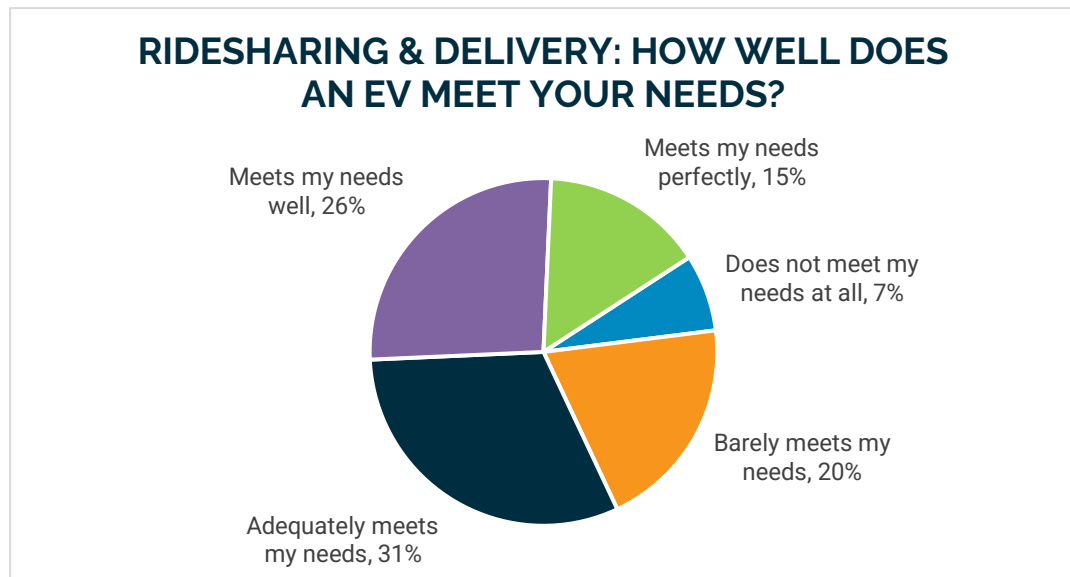


Figure 26: Responses to "How well does an EV meet your needs for ridesharing and/or delivery services?"

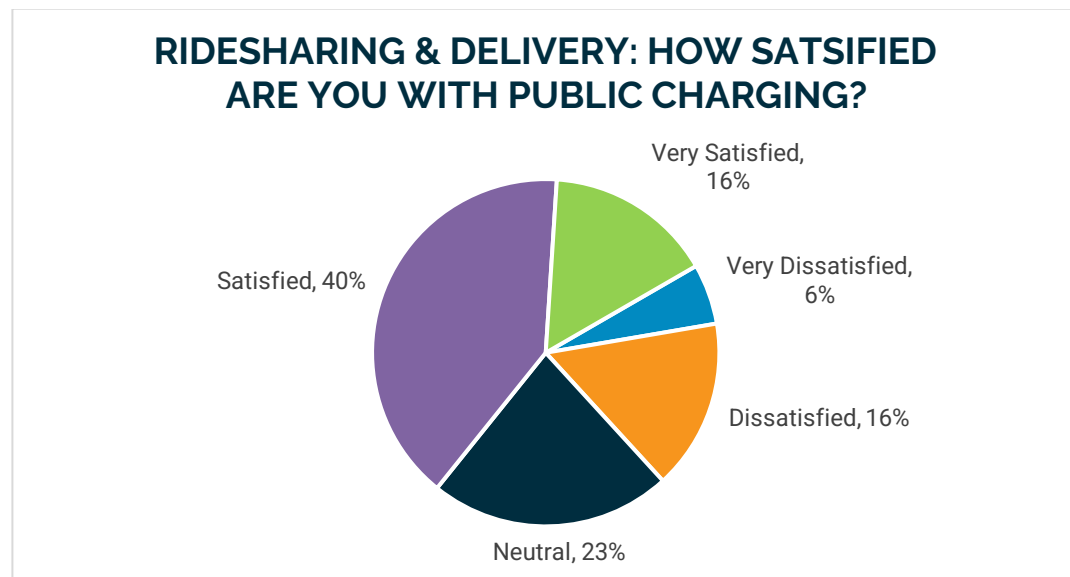
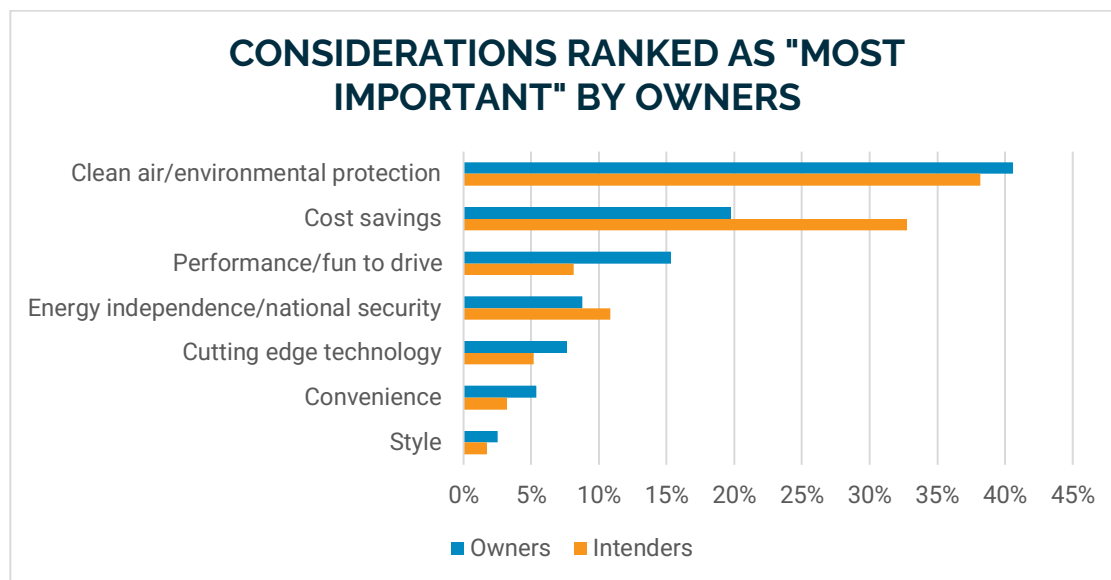


Figure 27: Responses to "How satisfied are you with public charging for ridesharing or delivery services?"

# EV INTENDERS – THE NEXT WAVE OF OWNERSHIP

## *Convergence and Divergence*

Those who do not currently own an EV but are considering purchasing one within the next 12 months share some similarities with current owners. Similar to current EV owners, these “intenders” are motivated by environmental and clean air impacts but are more interested in cost savings; the early adopters who are current EV owners have in many cases paid a premium that subsidized this developing technology and did not necessarily realize significant cost savings. **Figure 28** compares the proportion of intenders who indicated that a factor was “most important” to them when considering the purchase of an EV to that of owners.



*Figure 28: Percentage of respondents indicating a factor is the single most important purchase consideration*

Intenders had greater difficulty finding information on EVs in general, as shown in **Figure 29**. This may reflect the fact that they are not as far along in the EV purchasing process, although in some cases (such as understanding available incentives and rebates), it may be because the process has increased in complexity. Compared to an EV buyer of 2016, an EV buyer of 2023 in many cases faces greater uncertainty about their eligibility for various incentives.

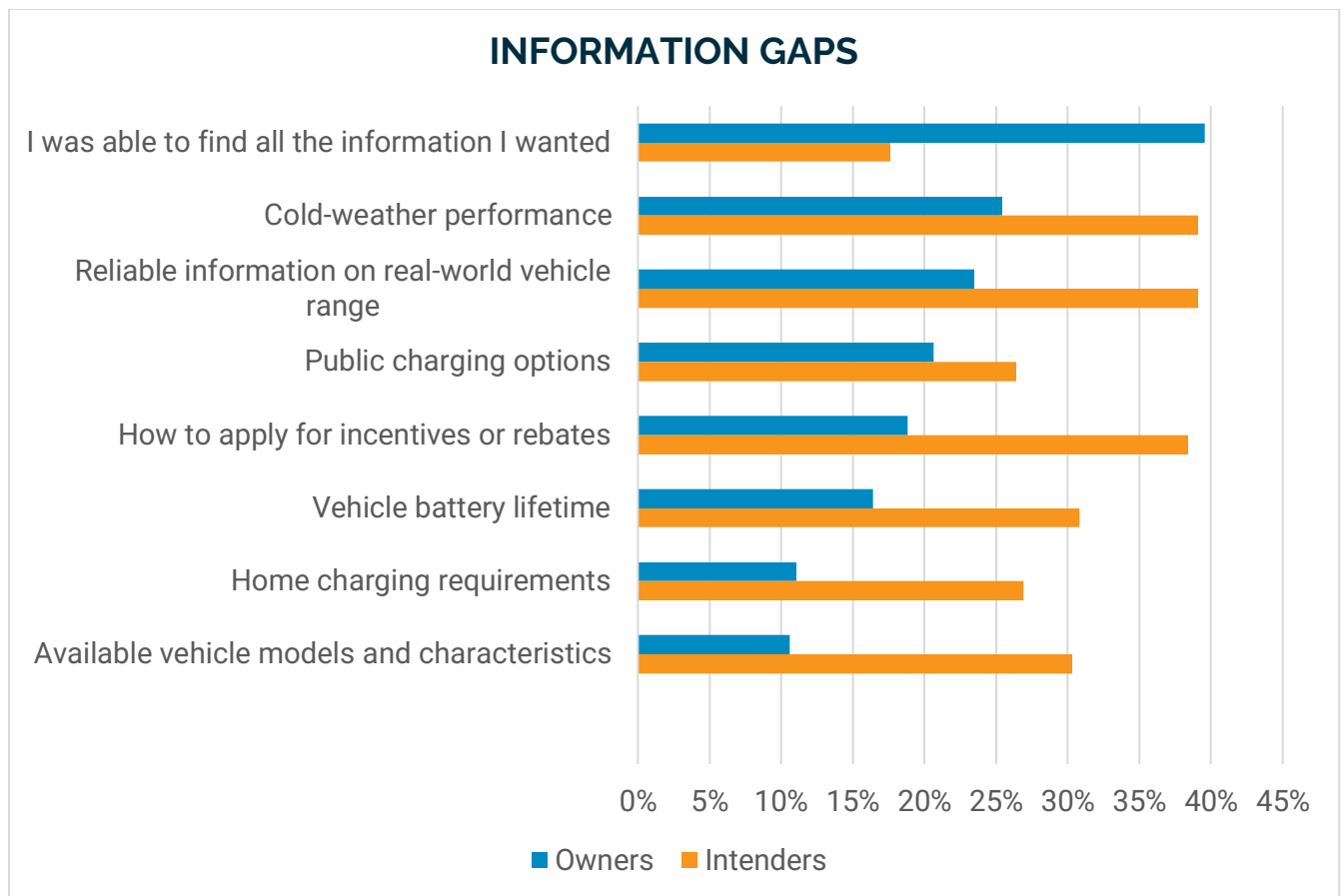


Figure 29: Information gaps faced by owners and intenders

The demographics of population groups also offer cases of similarity and divergence. Intenders are older, as they were in our previous survey. They are less likely to earn over \$100,000 per year. Figure 30 and Figure 31 display the demographic makeups of the two response groups.

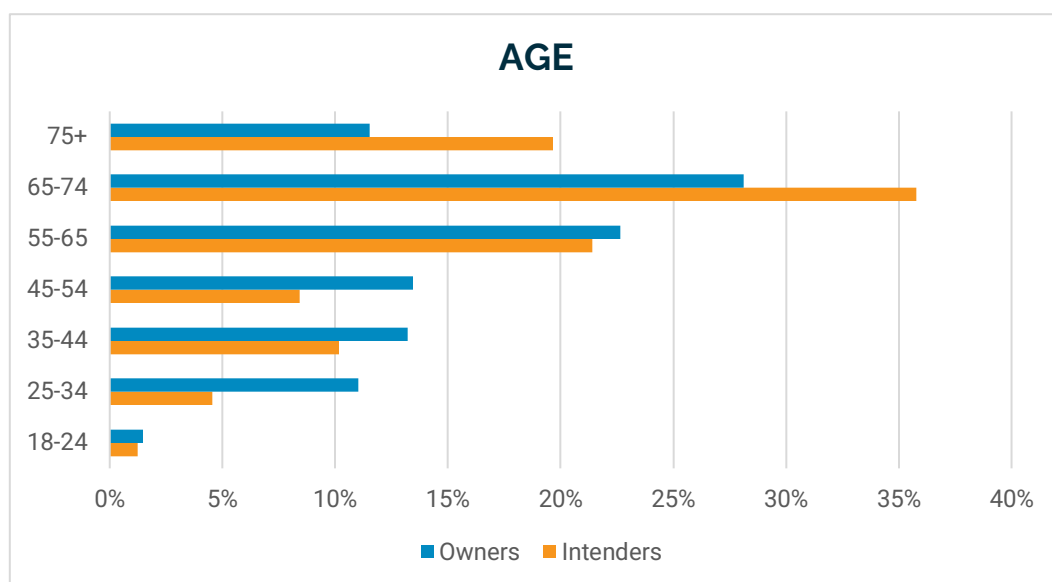


Figure 30: Age distribution of respondents

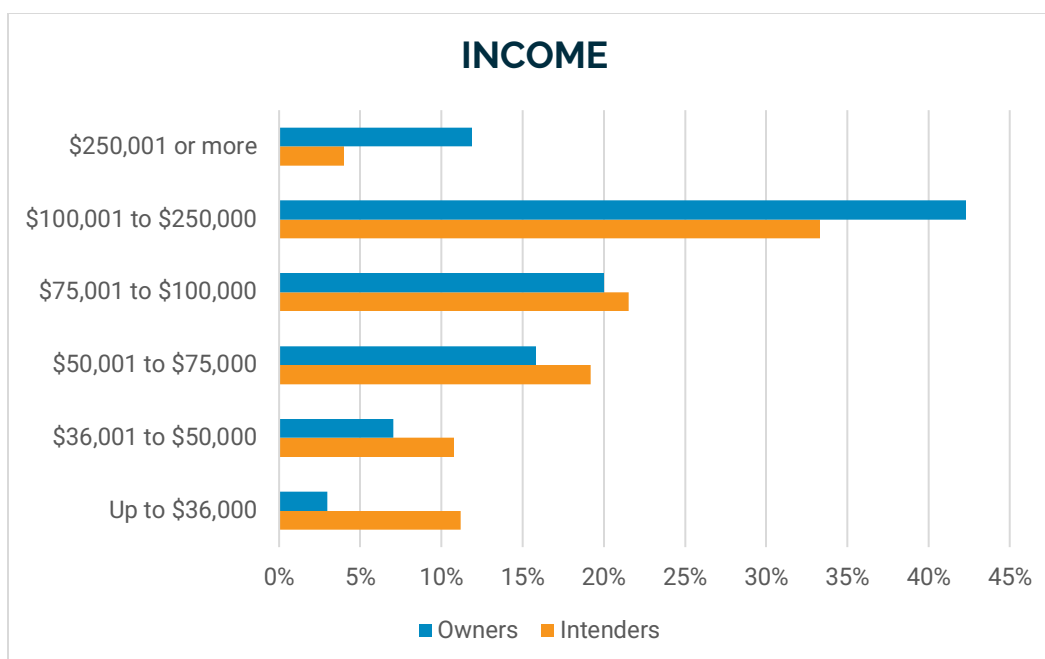


Figure 31: Income Distribution of Respondents

There are relatively few used EVs on the market, and EVs are still an emerging technology, so the profile of EV buyers does skew higher-income. About 16% of respondents did report buying their EV used, which is not an insignificant amount. This was down from 20% in our prior survey, but the 2021-2022 market saw significant price increases for all used vehicles, including used EVs, a situation that is only now beginning to reverse. In the U.S., about *two-thirds* of vehicle sales are used cars and trucks. The used EV proportion will increase as more used EVs come onto the market. As that occurs, buyers of used EVs should be supported with credible and reliable information on vehicle performance and battery condition.<sup>17</sup>

Single-family homes with garages offer a lower-cost charging solution than do most multi-unit dwellings, and single-family home residents represented 78% of EV owners and 82% of EV intenders. Access to low-cost home charging was one of the most significant economic factors in EV adoption, so it is not surprising that single-family home residents dominate our demographics.

Apartments and condominiums may have a garage or parking lot with dedicated parking spaces, or a parking lot with non-dedicated spaces, or may not have parking at all (requiring residents to rely on street parking). Installing charging infrastructure for such buildings does carry a higher capital cost, especially if done as a retrofit where trenching through concrete or asphalt is required. The cost of EV charging is much less if addressed during building construction.

Building codes requiring new construction to have adequate “EV-ready” parking spots will enable greater adoption of EVs by residents of multi-unit dwellings. The increase in EV ownership by residents of multi-unit dwellings (from 14% in the prior survey to 20% in this one) offers some cause

<sup>17</sup> Plug In America has developed a Used Electric Vehicle Buyer’s Guide, available online at <https://pluginamerica.org/learn/used-ev-buyers-guide/>

for hope that this seemingly intractable issue is finding solutions. There was no significant difference in the proportion of single-family residences among EV owners in California compared to the rest of the survey.

## CONCLUSIONS & FURTHER RESEARCH

Many of the findings of our previous surveys are again relevant in 2023. EV owners continue to be very positive about their experience, with 90% intending to purchase an EV as their next vehicle. EV owners continue to recognize that the vehicles provide a public benefit in improving air quality and reducing greenhouse gas emissions. This is *the single most* important motivating factor in EV adoption. EVs are becoming more mainstream, moving from early adopters to the early majority stage of the technology adoption curve. As they reach a broader market and price parity<sup>18</sup> with internal combustion vehicles, we expect that buyer motivations may shift away from environmental concerns being the leading motivational factor for EV drivers.

EV drivers were generally quite happy with the vehicles themselves. Newer vehicles scored some notable successes in driver satisfaction, as did pickup trucks—although in the latter case, the sample size was quite small.

Fast-charging infrastructure needs to improve. Lack of sufficient charging stations is the second-most prevalent concern about public fast charging networks, with over half of respondents noting that it was at least a moderate concern and over a quarter deeming it at least a major concern. Broken or non-functional chargers remain the most serious problem, increasing in severity in 2022 such that 31% regarded it as a major concern or a deal-breaker; this level was 46% among those relying on public fast-charging networks. Insufficient charging stations may deter an EV driver from taking a trip; broken charging stations may leave an EV driver stranded. The Bipartisan Infrastructure Law includes \$7 billion in EV infrastructure investments. One of the requirements of EV charging equipment installed using these funds is that it must meet at least 97% uptime. While this measure doesn't necessarily guarantee successful charging, it is a start.

The vast majority of EV drivers continue to charge at home; a slightly increased number are able to charge at home even when living in multi-unit dwellings, which is promising. Workplace charging is, as seen previously, commonly used by those who have access to it. Workplace charging provides a convenient solution for many EV drivers, including those without access to home charging.

Drivers noted that dealership knowledge is lacking; Plug In America's PlugStar dealer training program can resolve this. Beginning in 2023, Plug In America has launched an on-demand PlugStar dealer training program to reach even more dealers in a more convenient, affordable format. Customer-facing websites (also a component of PlugStar) were cited as the most valuable information sources. Drivers most commonly reported difficulty in finding information about cold-weather EV performance and real-world EV range. A growing body of research is available about cold-weather EV performance<sup>19</sup>, and we encourage automakers to make such information available about their specific vehicles.

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<sup>18</sup> <https://www.nytimes.com/2023/02/10/business/electric-vehicles-price-cost.html>

<sup>19</sup> <https://www.recurrentauto.com/research/winter-ev-range-loss>

The demographics of our respondents implicitly indicate a gap (though a diminishing one) in multi-unit dwelling charging availability. Building codes, grant programs, additional workplace charging, and focused work with multi-unit dwelling properties can help overcome this obstacle. We hope to see the \$1.25 billion in discretionary funds for community charging authorized in the Bipartisan Infrastructure Law focus on addressing this, particularly in low- to moderate-income communities with a high percentage of renters.

Future surveys will include questions about the length of EV ownership, to see if there are differences in perceptions or behavior between the earlier adopters and the more recent ones.

Plug In America looks forward to helping resolve the remaining barriers to EV adoption and to learning more about EV drivers through future surveys. In particular, we will look for signs of progress on the dealership experience, the public charging experience, and the availability of charging for multi-unit dwellings. We also are excited to see new EV models in our 2024 survey and an increase in used EV sales as the used market develops. We stand ready to provide consumer education through PlugStar and our ride-and-drive events, and remain committed to working with utilities, manufacturers, and other partners in these efforts.



# AUTHORS AND ACKNOWLEDGMENTS

## ***About Plug In America***

Plug In America is a non-profit, supporter-driven EV advocacy group. Our mission is to accelerate the shift to plug-in vehicles powered by clean, affordable, domestic electricity to reduce our nation's dependence on petroleum, improve air quality and reduce greenhouse gas emissions. Plug In America helps consumers, policymakers, auto manufacturers, and others to understand the powerful benefits of driving electric by providing practical, objective EV information.

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### **Gold Level Partners**



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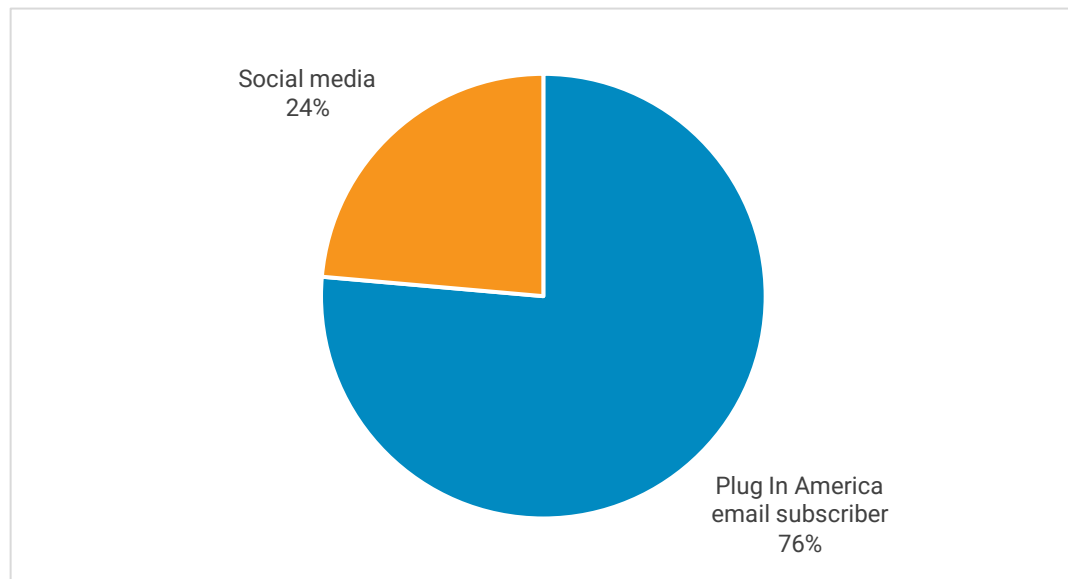


## ***Survey Methodology and Response Summary***

Plug-In America surveyed nearly 4,000 EV owners and those considering purchasing EVs December 2022 through February 2023. The survey was promoted in the Plug In America email

subscriber list and advertised on social media. In both cases, respondents were offered an opportunity to win a \$250 gift card. Below is a summary of data by source, including sample sizes.

### Responses By Data Source



### Responses By State

The figure below shows the responses from each the 20 states that had the most responses.

