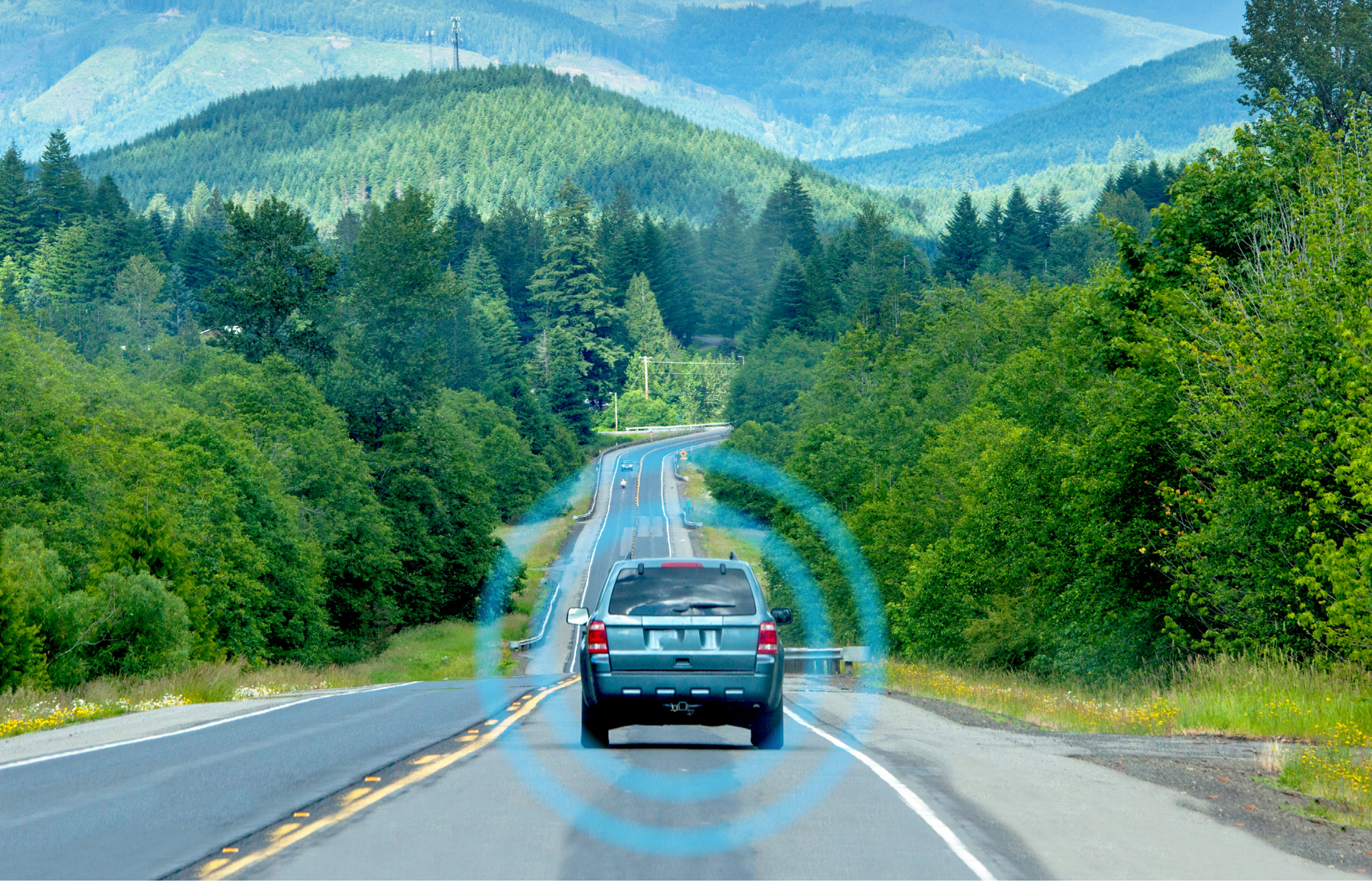
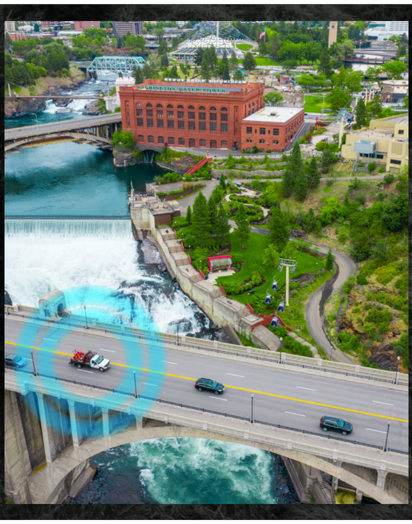


ENCOURAGING HIGH-CONSUMPTION FUEL USERS TO USE ELECTRIC VEHICLES

WASHINGTON STATE JOINT TRANSPORTATION COMMITTEE



REPORT | JUNE 2023

Acknowledgements

Washington Legislative and Public Agencies

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Consulting Team

CDM Smith
Ipsos

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EXECUTIVE SUMMARY

Overview of Study Purpose, Findings, and Policy options

Purpose

Electric vehicles (EVs) account for nearly 20 percent (%) of new light-duty vehicles sold in Washington. Recent, rapid growth in adoption rates has lifted EVs to 2% of the light-duty fleet overall, with these vehicles creating no tailpipe greenhouse gases (GHG) emissions. On the other end of the spectrum, 10% of light-duty vehicles in Washington account for over a quarter of gasoline consumption and GHG emissions.

In 2022, the legislature directed the Joint Transportation Committee (JTC) to study those vehicles that consume the most fuel and emit the most GHG emissions, understand their driving behavior and vehicle purchasing decision factors, and assess the potential to encourage these so-called high-consumption fuel users (HCFUs) to switch to EVs. Advocates have hypothesized that policy interventions can persuade HCFUs to adopt EVs faster than the general population, resulting in swifter displacement of GHG emissions.

Summary of Findings

This study confirms that encouraging HCFUs to adopt EVs faster than the general population would result in faster displacement of GHG emissions. However, achieving higher rates of EV adoption among HCFUs must overcome several market barriers, including EV supply constraints, a relative shortage of EV model diversity with the requisite performance characteristics to serve as HCFU replacements, and persistently higher prices for EVs among some key HCFU market segments. In addition, many of the policy interventions that motivate HCFUs to purchase EVs likewise would increase the motivation of non-HCFUs to purchase EVs. As a result, successfully encouraging HCFUs to adopt EVs requires more targeted policy interventions.

Policy Options

Based on analysis of EV market conditions and consumer sentiments among HCFUs and non-HCFUs, this report proposes four targeted policy interventions to motivate faster EV adoption among HCFUs:

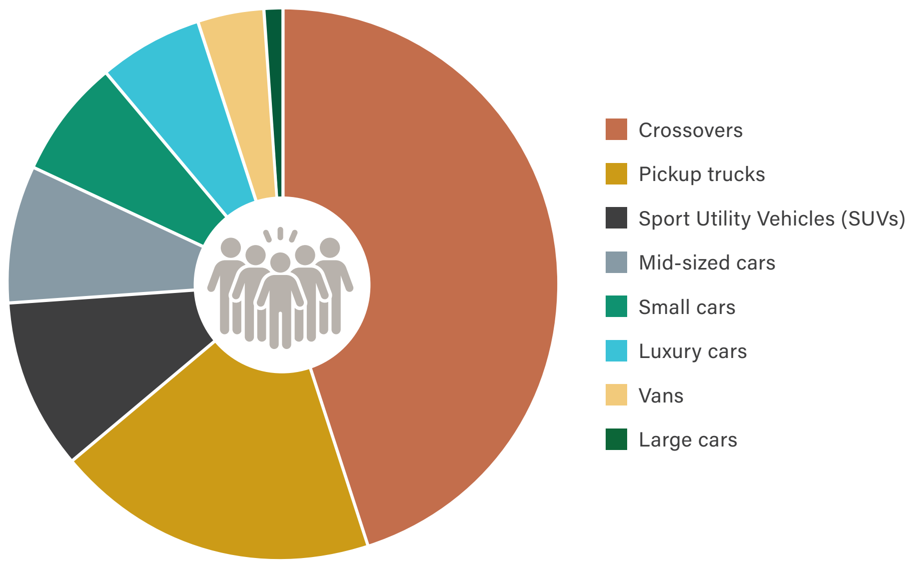
- **Lease incentive.** An EV lease incentive for HCFUs could be provided, where rebates would be provided to dealers for every electric mile driven by an EV above 12,000 miles per year. This encourages HCFUs to shift their daily driving to EVs and offers both dealers and HCFU drivers access to financial benefits if their high-mileage driving is shifted to a leased EV.
- **EV purchase incentive for HCFUs.** Providing an EV purchase incentive for trading in low-mile-per-gallon (mpg)/high-mileage vehicles (i.e., those drivers would qualify as HCFUs) is another policy option. By providing direct rebates or sales tax credits based on the displaced fuel consumption of a traded-in vehicle, this incentive program differentiates between HCFUs and non-HCFUs, and targets the former. This approach optimizes emissions reductions by encouraging HCFUs to purchase EVs that displace more GHG emissions.
- **Vehicle loaner program for HCFUs.** A vehicle loaner program that allows HCFUs to use gas-powered towing/hauling vehicles for occasional trips that require capabilities beyond what current EVs offer is a third policy concept. This program would provide vouchers or reimburse HCFUs for renting gas-powered vehicles when needed, while they continue to use their new EVs for everyday driving. By addressing the performance limitations of EVs for certain driving needs (e.g., towing a boat), this program aims to incentivize those HCFUs who rely occasionally on pickups and larger sport utility vehicles (SUVs).
- **Free home charger incentives.** A final policy option is to create a free home charger incentive program for HCFUs. This program would provide free Level 2 home chargers and rebates for installation costs. It is intended to address the concerns of HCFUs regarding home charging capabilities and minimize reliance on public charging stations. The California Air Resources Board created a similar state-level program as their Clean Vehicle Assistance Program. While the State of Washington already offers a sales tax exemption on the purchase and installation of a home-based charger, the value of this exemption (about $192) is far less than the value of a free home charger with subsidized installation costs (about $2,000).

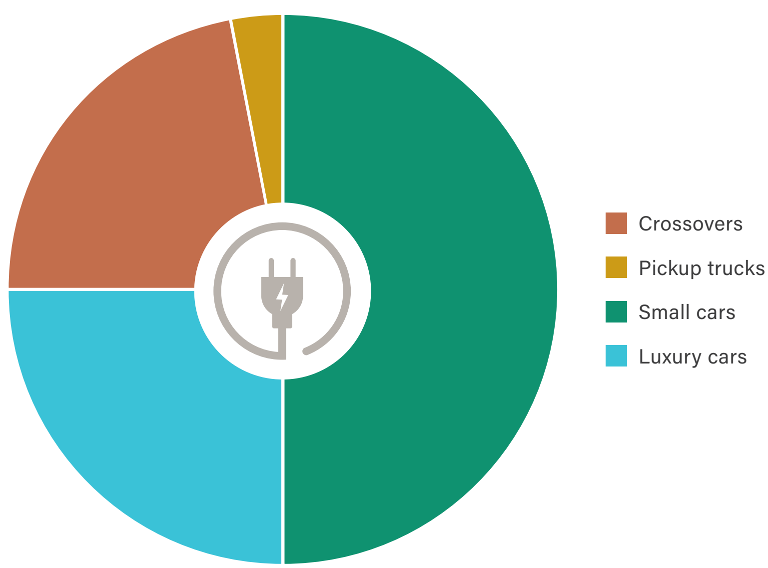
Each of these policy concepts targets HCFUs directly and/or appeals to HCFUs' vehicle feature preferences in consumer sentiment surveys. Nevertheless, each of these policy concepts could benefit from a trial or pilot period to test its effectiveness at encouraging EV adoption among HCFUs, its cost and complexity to administer, and its overall cost-effectiveness at achieving faster GHG reductions than broad EV adoption incentives.

Background on Electric Vehicle Incentives

Numerous factors influence consumers' vehicle purchasing decisions and, specifically, their consideration of EVs. On the supply side, vehicle availability continues to be a constraint, with the global supply chain, automotive production capacity, and competition for raw materials and components limiting the number of EVs produced each year. Meanwhile, macroeconomic forces impact overall vehicle sales, including EV sales, such as gasoline and electricity prices as well as broader price inflation for core durable goods in the United States.

On the demand side, consumers appear to have a growing appetite for EVs, with most EV purchasers facing wait lists for their preferred purchase. Aside from price, perhaps the most significant barrier for EV adoption is model availability. Crossovers, pickup trucks, and SUVs now constitute three-quarters of new vehicle sales in the United States; yet, these same three categories represent only one-quarter of EV production.





Almost all EV policy interventions reviewed in the United States and globally address the demand side. The most prominent policy intervention is purchase price incentives, including federal income tax credits up to $7,500 for new EV purchases and sales tax credits at the point of purchase in Washington for new EVs up to $45,000 manufacturer's suggested retail price (MSRP) and used EVs valued below $30,000. In Washington, sales tax exemptions also apply to the purchase and installation of EV infrastructure, including home charging equipment. The second most prominent incentive is government investment in public EV charging stations, designed to ease range anxiety among prospective EV buyers. Washington was the first in the nation to develop a network of DC fast-charging stations along major highways through a public–private partnership that included free charging for EVs for three years. Washington continues to lead in developing EV charging networks with the support of federal funding through the National Electric Vehicle Infrastructure (NEVI) program, created under the Infrastructure Investment and Jobs Act of 2021.

EV incentives offered in other states include free or preferred parking, legal access to high-occupancy vehicle lanes (HOVs), and reduced or discounted tolling. The private sector also can offer incentives such as discounts and rebates from automakers, dealers, and utilities. These are less common; however, in Washington, several utilities offer rebates for installation of home EV charging equipment.

All policy interventions reviewed in Washington aim to incentivize the purchase of cleaner light-duty vehicles without regard for the usage profile of the vehicles being replaced. Washington is one of the first states to consider incentives targeting HCFUs specifically. By driving a disproportionate number of miles with relatively lower fuel economy, these drivers emit a disproportionate amount of GHG. Policies that successfully encourage these drivers to transition to EVs will make more progress toward the emission goals codified in the Climate Commitment Act, Revised Code of Washington (RCW) 70a.65.

Identifying and Quantifying High-Consumption Fuel Users in Washington

Identifying HCFUs

As of 2022, the nearly 7 million light-duty vehicles owners in Washington drove an average of 9,992 miles per year, with a fuel economy of 23.4 mpg, using an average of 427 gallons of gasoline per year.

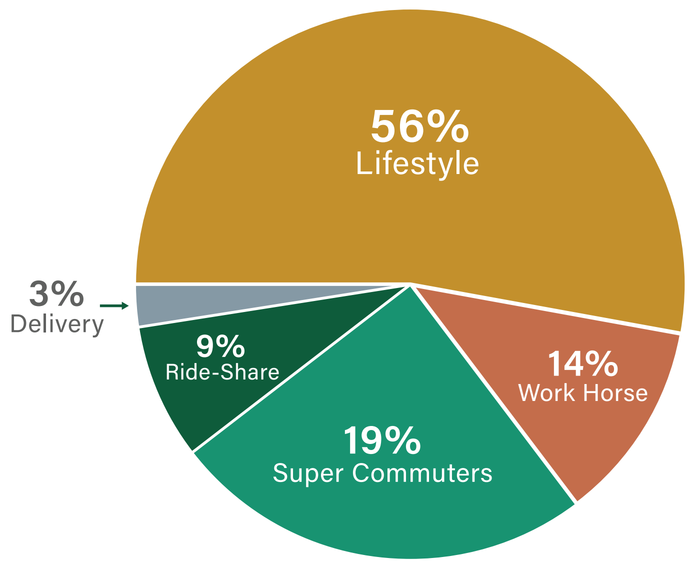
The CDM Smith consultant team chose 1,000 gallons as the threshold to define an HCFU. Based on data collected from the Washington Department of Licensing (DOL), the National Household Travel Survey (NHTS), the American Community Survey (ACS), and private data sources, analysis revealed a variety of performance characteristics corresponding to HCFUs. There are 434,270 HCFU vehicles in Washington, representing 6.3% of the state's total vehicle fleet. HCFUs travel an average of 25,375 miles per year, two and a half times as many miles as the average vehicle driver. They do so with a fuel economy of 19.1 mpg, more than 4 mpg lower than average. These vehicles consume an average of 1,328 gallons of gasoline per year, more than triple the average. HCFU vehicles tend to be larger than the average vehicle, with the majority being SUVs and pickup trucks.

The Central Puget Sound region has the highest number of HCFUs because it is the most populous region of the state and home to more than half of all registered vehicles. However, the prevalence of HCFU vehicles as a percentage of vehicles is lowest in Central Puget Sound at just 4.9%. Central Washington has the highest per-capita prevalence of HCFU vehicles— at 8.8% of all registered vehicles. Pickup trucks and SUVs account for 78% of HCFU vehicles—higher than the overall fleet percentage. Vans make up another 8%, and only 14% of

HCFU vehicles are cars (sedans, coupes, etc.). Of the top 10 most common HCFU models, three are SUVs and seven are pickups. The top four HCFU models in Washington are the Ford F-150, Chevrolet Silverado, Dodge Ram, and Toyota Tundra.

Market Segments

Qualitative market segmentation based on vehicle usage and characteristics can help to identify which types of HCFUs are best suited to switch to EVs. Five segments developed for this analysis include Work Horses, Lifestyle, Super-Commuters, Ride-Sharers, and Delivery Vehicles. Fleets constitute a sixth category, but this category was not analyzed because of the lack of available data to identify commercial fleets and their constituent vehicle characteristics. Each of the five analyzed segment has distinct functional requirements and varying suitability for EV transition. For example, Super-Commuters and Ride-Sharers are currently better-suited to transition to EVs, while the other three segments face challenges because of the current limited EV model variety and relatively high pricing.



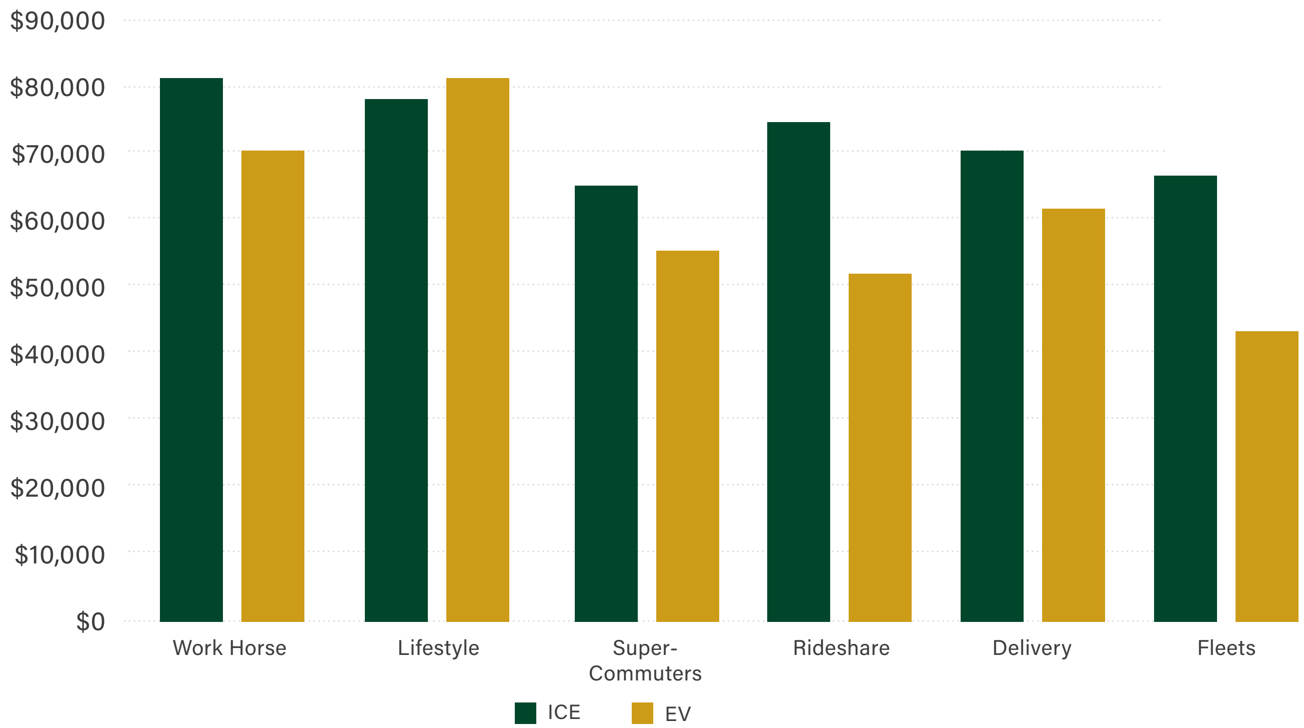
Total Cost of Ownership calcuations

Total cost of ownership (TCO) is a crucial metric for decision-making, particularly for fleet managers. TCO covers all costs of owning and operating a vehicle, including fuel, maintenance, insurance, and depreciation. However, the effectiveness of TCO as a decision-making tool varies among segments because of diverse functional requirements of drivers and the economic feasibility of EVs within the various market segments.

TCO analysis reveals that EV models are less costly than comparable internal combustion engine (ICE) models over a five-year time frame in all market segments except the Lifestyle category. This analysis is based on comparison of single models within each market segment. For example, the Lifestyle category compares TCO between a Toyota 4Runner (ICE) and a Rivian R1S (EV).

Model Availability

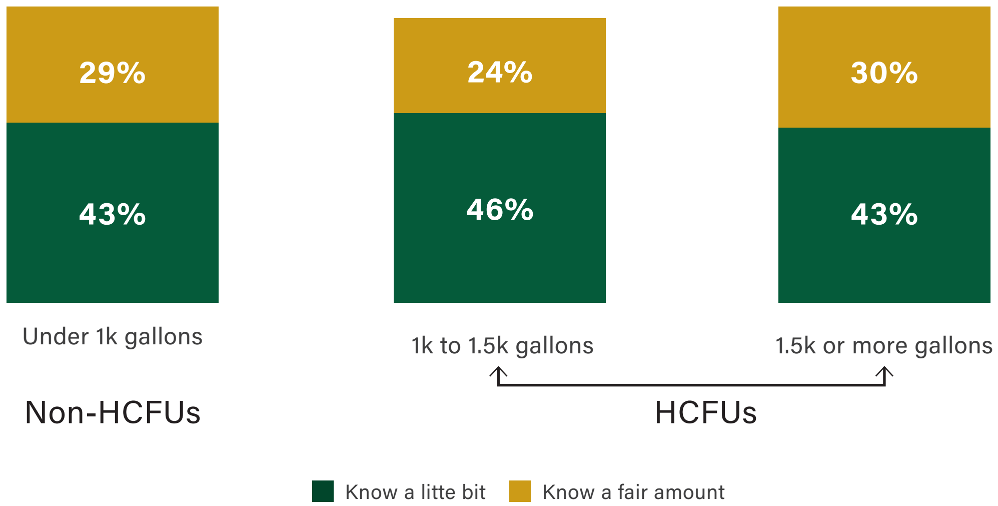
Although the TCO analysis reveals compelling prospective savings for EVs in nearly every category, the full story of the prospects of EVs to displace HCFU vehicles requires consideration of model availability. Currently, limited variety and availability of specific models, such as pickup trucks, SUVs, and vans, poses a significant challenge. There are seven ICE vehicle models to choose from for every one EV model. Within the SUV and pickup categories, the ratios are even higher (8-to-1 and 9-to-1, respectively). Production increases and new model introductions expected by 2030 should help address these issues. However, until then, longer wait times and comparatively higher prices may continue to hamper the economic viability of HCFUs to switch to EVs.



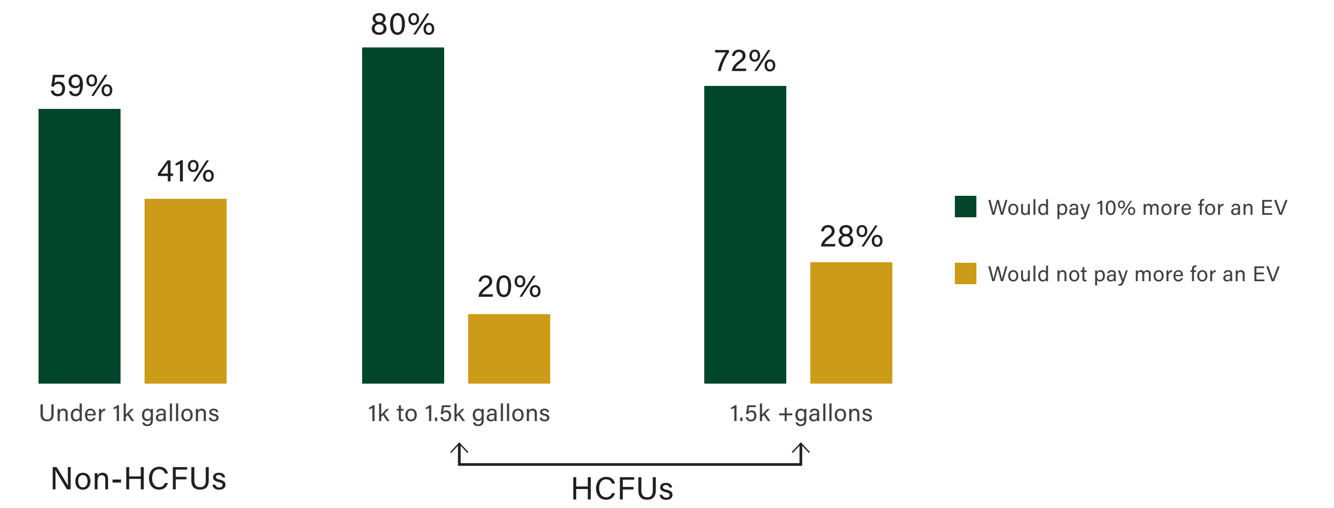
Market Research

In-depth market research of HCFUs and non-HCFUs alike identified the most salient factors among Washington drivers that influence their relative willingness to purchase EVs. An online engagement queried more than 400 drivers with in-depth questions about their existing vehicle, driving habits, functional needs, and preferences. The engagement also tested a wide range of policy interventions, with a goal to understand factors that motivate HCFUs compared to the general driving population in Washington.

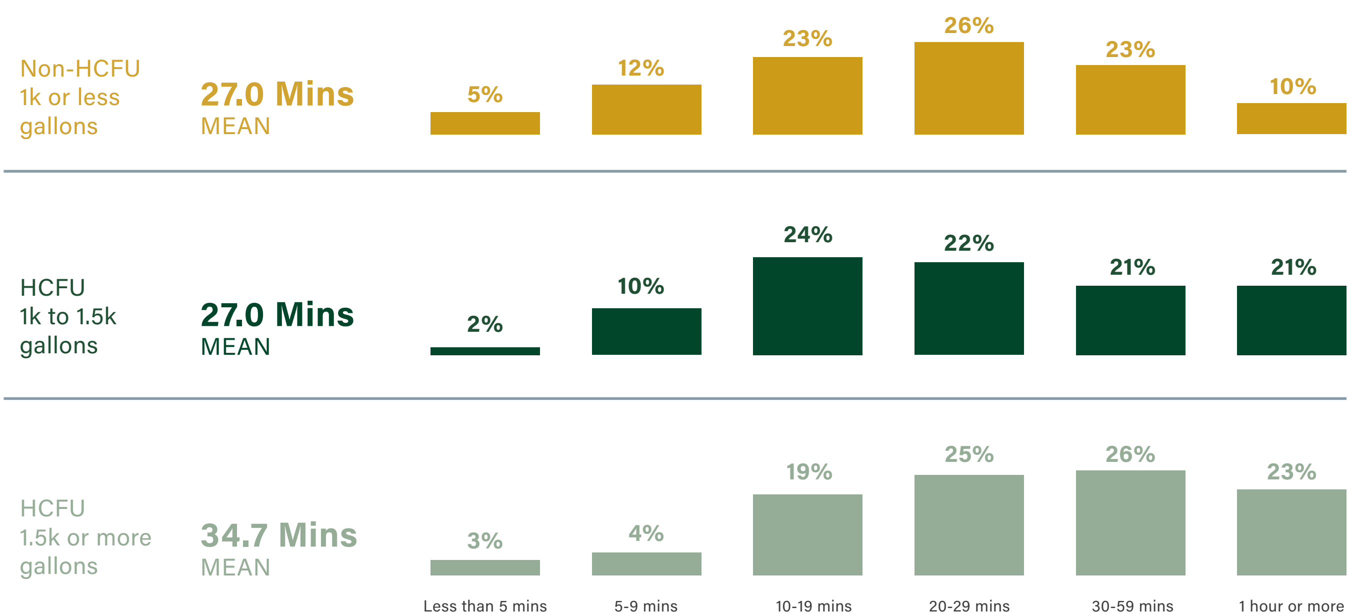
The market research revealed that HCFUs and non-HCFUs broadly share similar attitudes and preferences with regard to EVs. Some key points stand out. First, HCFUs have equivalent knowledge of EVs as non-HCFUs, meaning education is not a significant relative barrier hampering HCFUs' adoption of EVs.



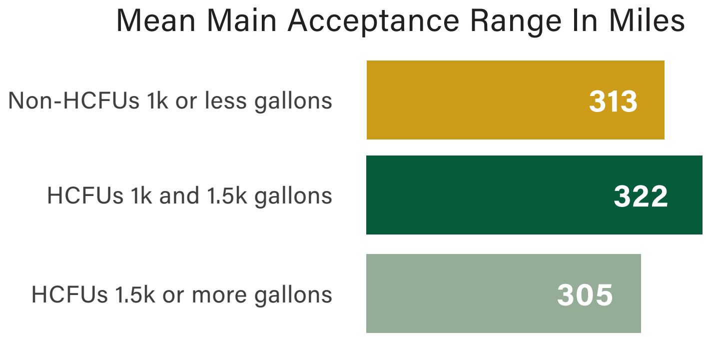
Encouragingly, perhaps because of their higher fuel costs, HCFUs are much more likely than non-HCFUs to pay a premium for an EV over a conventional vehicle. Nearly four in five HCFUs would pay 10% more for an EV.



In addition, HCFUs are willing to wait at least as long as non-HCFUs for an EV to charge at a fast-charging station. Those HCFUs in the highest fuel consumption category (1,500 or more gallons per year) are willing to wait 26% longer (34 minutes versus 27 minutes for non-HCFUs).



HCFUs have approximately equal expectations regarding EV battery range as non-HCFUs, at just over 300 miles. In fact, most EV models today are approaching the range expectation of most HCFUs



Among the key differences between HCFUs and non-HCFUs, market research revealed that HCFUs are much more likely to purchase new vehicles than non-HCFUs. Given their heavier usage patterns, this makes sense. In addition, although majorities of both HCFUs and non-HCFUs prefer to own rather than lease, HCFUs are much more likely to lease their new vehicle.

Public Policy Interventions to Encourage High-Consumption Fuel Users to Purchase Electric Vehicles

Drawing on knowledge of EVs' characteristics, existing incentives, and deep market research into HCFUs, the study concludes that a number of messaging and policy interventions can help to encourage HCFUs to acquire EVs faster.

Messaging

Most of the prospective policy interventions impacting HCFUs would appeal equally to non-HCFUs, such as fast chargers at gas stations, sales tax exemptions for EV purchases, and free Level 2 public charging stations. While these incentives already exist in Washington, they are not uniformly available or well-known to consumers. An opportunity exists to improve communication about these existing incentives and programs that support EV adoption. This can be achieved through enhanced web portals and online tools that provide comprehensive information about EVs, including benefits, available models, costs, incentives, and charging infrastructure. The design of these platforms should allow users to customize their EV purchaser profile by sharing their driving habits and preferences so that the sites tailor the content they receive. Additionally, financial and operational incentives based on the area in which they live, and real-time fuel prices (both gasoline and electricity), could be compiled for consumers' convenience.

The complexity of current EV purchase incentives, especially tax incentives, has been identified as a barrier to consumer understanding and confidence in purchases. Simplifying the design of these incentives can only help to enhance consumer comprehension. The most recent federal tax incentives, in particular, are reported to be confusing, leading to a wait-and-see approach among potential EV purchasers, as evidenced by slowing EV adoption rates the first quarter of 2023. Streamlining these incentives at the federal level and providing clearer information about state-level incentives, such as the sales and use tax exemption in Washington, is an opportunity to improve EV adoption more broadly.

Incentives

For direct incentives to be effective in motivating HCFUs to purchase EVs, they must be targeted, almost to the exclusion of non-HCFUs. The study proposes four such targeted interventions that aim to appeal to HCFUs financially:

1. Deploy an EV lease incentive program for HCFUs, where rebates would be provided to dealers for every electric mile driven by an EV above 12,000 miles per year.
2. Provide an EV purchase incentive for trading in low-mpg/high-mileage vehicles (i.e., those vehicles that qualify as HCFU vehicles).
3. Offer a vehicle loaner program that allows HCFUs to use gas-powered towing/hauling vehicles for occasional trips that require capabilities beyond what current EVs offer.
4. Create a free home charger incentive program for HCFUs.

Each of these policy interventions comes with a cost. These programs could be deployed in addition to existing Washington incentives (sales tax credits) or as an adjustment or redeployment of existing public investment in EV adoption incentives. Given the potentially high cost of these incentives, including the higher administration costs than incentives that are agnostic to vehicle usage, each of these programs may benefit from a brief trial period to confirm the benefits, cost-effectiveness, and administrative feasibility before deploying on a larger scale.

CHAPTER 1

Current and Future Conditions for Consumer Adoption of Electric Vehicles

Overview

The State of Washington's 2022 supplemental transportation budget included a budget proviso commissioning a study by the Joint Transportation Committee (JTC) to "... significantly advance policymakers' understanding of the dynamics impacting consumer decisions to transition from a fossil fueled vehicle to an electric vehicle, and to evaluate potential policies to help encourage this transition." The study focuses on encouraging this transition for "high consumption fuel users" (HCFUs).

To date, almost all policy interventions reviewed in the U.S. and globally involve incentivizing the purchase of cleaner passenger vehicles without regard for the usage profile of the vehicles replaced. Washington is the first state to consider incentives targeting HCFUs By driving a disproportionate number of miles, these drivers emit a disproportionate amount of greenhouse gases. Policies that successfully encourage these drivers to transition to electric vehicles (EVs) will make more progress toward the emission goals codified in the Climate Commitment Act, Revised Code of Washington (RCW) 70a.65.

This chapter describes the current state of play for adoption of zero-emissions vehicles and, more narrowly, EVs in the U.S., including availability of EVs, government incentives for encouraging their adoption, and projections of future consumer demand for these vehicles. This context will help policymakers understand the dynamics impacting vehicle purchase decisions and the policy interventions that can facilitate the transition to zero-emission vehicles.

Chapter One contains four primary sections:

1. Forces that influence the current market for EVs
2. Summary of current Washington EV goals and incentives
3. Summary of EV goals and incentives in other states and nations
4. EV adoption goals and forecasts of potential for meeting those goals

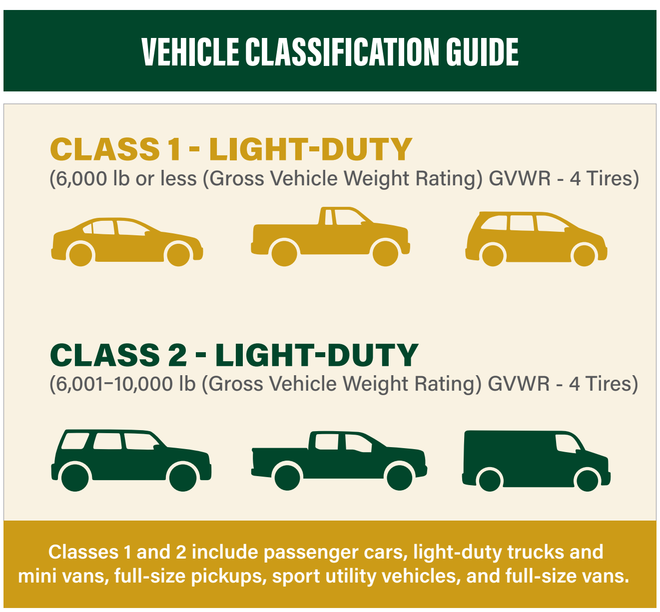
The chapter concludes with key takeaways for legislative consideration.

Working Definitions: Light-Duty Vehicles, Zero-Emission Vehicles, and Electric Vehicles

Light-Duty Vehicles

The term "light-duty vehicles" has a specific meaning within the automotive industry that is not necessarily shared by the general public. Many vehicles commonly used in construction and the trades, while heavier duty than a family car, still qualify as "light-duty,". Consider the examples in (Figure 1) below and to the right:

Figure 1: Vehicle Classification Guide



"Medium-duty" vehicles include larger service and delivery vehicles. These larger vehicles, if used in commerce, require a commercial driver's license to operate.

Most electric trucks and vans currently in commercial production are light duty. Some EV manufacturers are bringing medium-duty vehicles into production in the next few years, though it will be some time before they are widely available. For instance, Amazon has a contract with Rivian for 100,000 medium-duty EV delivery vans, but these are all spoken for by Amazon.[1]

Given current market realities and the scope of the JTC study, this report focuses on HCFUs driving driving light-duty vehicles (10,000 GVW or less).

CLASS 3 - MEDIUM-DUTY
(10,001 lb–14,000 lb GVWR - 6 tires or more)

CLASS 4 - MEDIUM-DUTY
(14,001–16,000 lb GVWR - 6 tires or more)

CLASS 5 - MEDIUM-DUTY
(16,001–19,500 lbs GVWR - 6 tires or more)

CLASS 6 - MEDIUM-DUTY
(19,501–26,000 lb GVWR - 6 tires or more)

Classes 3 through 6 include a range of mid-sized to larger vehicles, including delivery trucks, utility vehicles, motor homes, packaged parcels trucks, ambulances, small dump trucks, landscape vehicles, small flatbed and stake-type trucks, refrigerated and box trucks, small- and medium-duty buses (schools and local transit buses).

Electric Vehicles and Zero Emission Vehicles

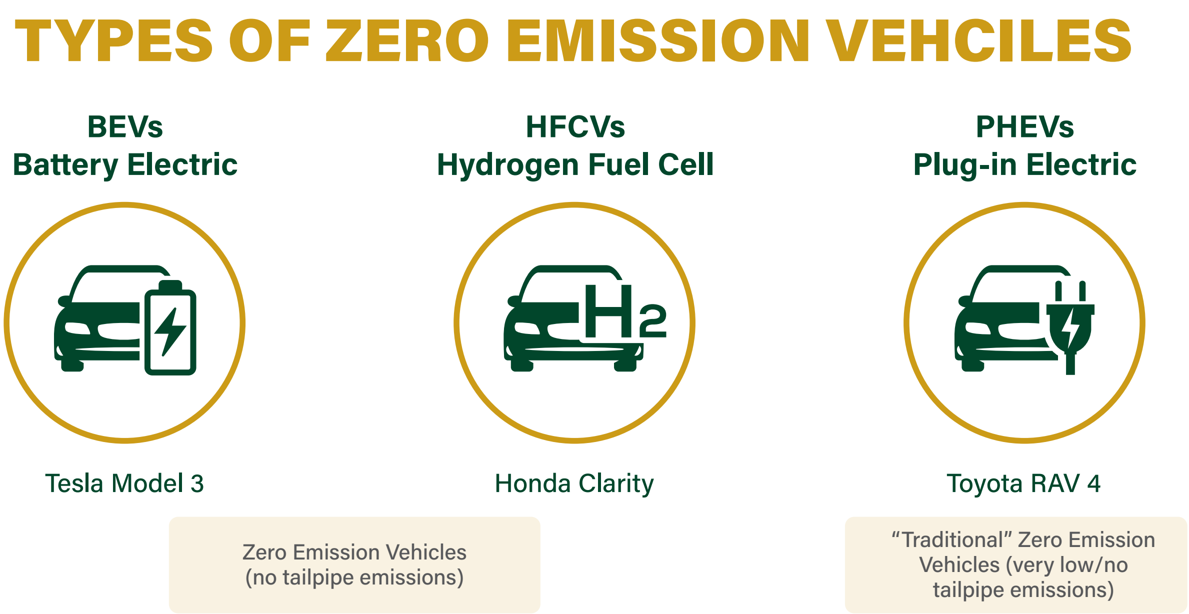
For this report, the definition of "electric vehicle" found in RCW 46.17.323 is adopted. Under that definition, an EV is a fully battery-electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV) with a range of at least 30 miles.

The definition of zero-emission vehicles (ZEVs) is slightly broader, because it includes EVs and hydrogen fuel cell vehicles (HFCVs). For example, the relevant section of RCW 70A.30.010, codifying Washington's legal adoption of California's motor vehicle emission standards defines ZEVs to include both EVs and HFCVs (WAC 173-423-040).[3]

The legislature requires analyses of all ZEVs, including HFCVs. Where relevant distinctions exist between EVs and ZEVs, these are treated separately. For example, when considering barriers to consumer adoption, HFCVs are at a much earlier stage of the technology adoption curve and, as a result, must overcome more barriers before they are a commercially viable, mass-market substitute for gas-powered passenger vehicles.

Given the early stages of HFCV development and the impending emissions reduction goal deadline (2030), transitioning HCFUs to EVs to meet those goals, in the short-term, requires reliance on BEVs and PHEVs. The strategies, policies, and messages that prove effective for EVs should perform equally well for HFCVs once they reach a similar stage of technology and market maturity.

Figure 2: Passenger Vehicle Technologies Subject to California Zero-Emissions Regulations



Section 1: Forces Influencing Electric Vehicle Adoption

This section identifies the dynamics, or market forces, that influence EV adoption rates in the U.S. Identifying and understanding these forces will inform policy development focusing on HCFUs. Several forces affect the pace of EV sales:

- **Supply-side forces** refer to factors that affect the manufacturers' ability to produce and sell EVs in quantities sufficient to meet demand at competitive prices. A rational policy encouraging people to switch to EVs depends on the availability of those vehicles. The global supply chain, automotive production capacity, and competition for raw materials and components all affect the supply of price-competitive EVs.
- **Demand-side forces** refer to factors related to the suitability of the vehicle for the driver and the various trade-offs consumers must make when deciding to purchase a car. Many (but not all) of these factors are being addressed by public policy. This section will identify those factors influencing the EV market. Subsequent chapters will address how these factors impact HCFUs in Washington.
- **Macroeconomic forces** refer to economic factors beyond the automotive industry that can affect EV adoption. These include the wholesale and retail price of vehicle fuels—gasoline and residential electricity—as well as broader price inflation for core durable goods in the U.S.

1.1 Supply

Effective policy incentives encouraging HCFUs to switch to EVs require an adequate supply of EVs available for purchase. As discussed in more detail below, while there is adequate supply of certain models of EVs, delivery has been delayed for some of the most sough-after body types. Current analysis predicts that supply constraints on EVs will ease sometime in late 2023 or 2024.[4]

A host of factors can (and currently are) impact the availability of EV units for sale in the U.S. These include:

- Ramp-up time needed for automakers' assembly lines
- Availability of component parts, particularly semiconductors and battery packs
- Availability of used EVs
- Labor disruptions due to the global pandemic
- Transportation bottlenecks such as delays at ports

This section discusses the first three of these constraints. Some are short-term barriers while others are expected to take longer to resolve.

1.1.1 Short-Term Barrier: Original Equipment Manufacturer Manufacturing Constraints

Analysts are optimistic that major automakers will be ready to produce the number of EVs required to meet global demand and policy goals within this decade. In the shorter run, manufacturing capabilities remain constrained. New vehicle production is currently hampered by a semiconductor shortage. This is true for all light-duty vehicles, not just EVs.

For EVs, original equipment manufacturer (OEM) manufacturing constraints are also attributed to the need to construct new production facilities or retool older plants to produce EVs. S&P Global projects that sales of EVs will be limited in 2022 and into 2023 because of the limited OEM production capacity.[5] They also forecast that supply will not be capable of meeting demand for EVs until sometime in 2024.

In many instances, EV manufacturing constraints are preventing auto dealerships from meeting consumer demand. Consumers who place an order now (April 2023) can expect to wait an average of 35 weeks for their new EV, an increase of 3.1% since August 2022.[6] A recent article explored wait times for popular EV brands in the U.S., with results shown in (Figure 3) to the right.

Figure 3: Estimated Wait Times for New Electric Cars, as of November 19, 2022 (Source: Electrifying.com)

EV Make/Model	Reported Wait Times for Retailer (Dealer) Availability
Audi E-Tron	12+ months
BMW i4	6+ months
Fiat 500e	4–6 months
Ford Mustang Mach-E	12–18 months
Hyundai IONIQ 5	9–12 months
Kia Soul	3–6 months
Nissan Leaf	6+ months
Polestar 2	5–6 months
Tesla Model S	18–24 months
Tesla Model 3	6–12 months
Volkswagen ID.4	12+ months

Tesla and Ford now require pre-registration for their most popular models, i.e., vehicles are built as pre-registration and order deposits are received. This helps the manufacturers calibrate their manufacturing output to match expected demand. In October 2021, Ford announced it had stopped taking new orders for its 2022 F-150 Lightening electric truck, as demand for the vehicle translated into a backorder of three years. For model year 2023, Ford capped reservations once they reached 200,000 in December 2022; customers who place an order in April 2023 can expect to wait one year.[7] Tesla also paused taking new orders for its Model 3 Long Range EV because the company's 2022 backlog extended into 2023.[8] Recent reports indicate wait times for some vehicle models are improving, although the availability gap is still measured in several months and in some cases, a year or more.

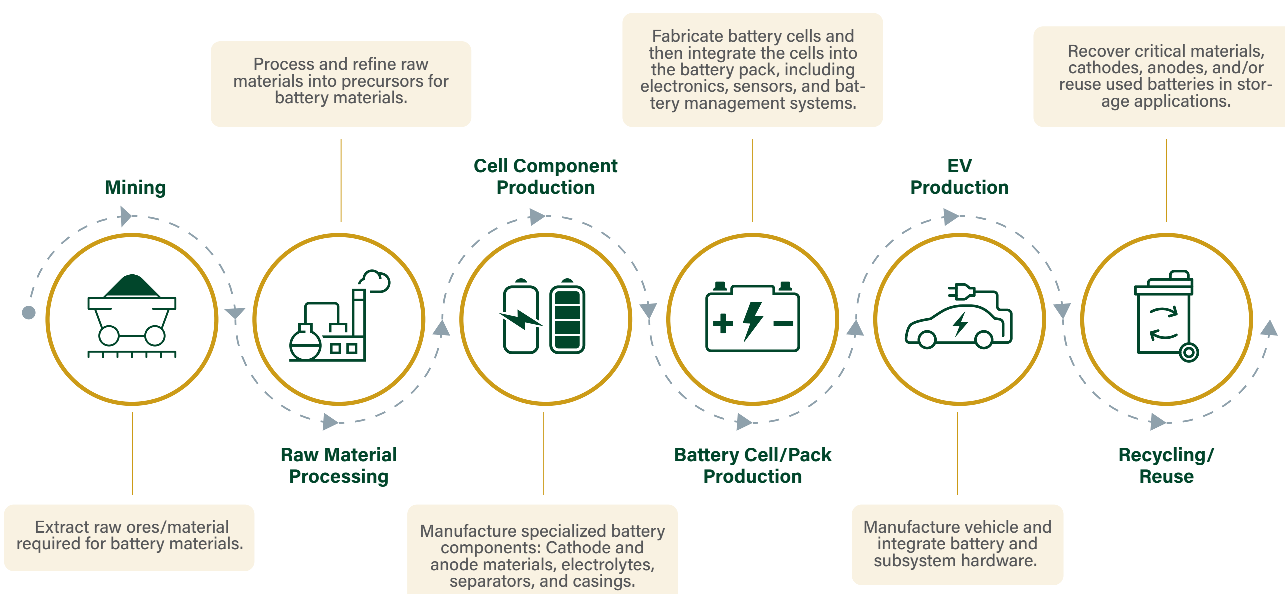
Predictably, demand in excess of supply has driven up prices that dealers charge to end consumers for supply-limited EV models. Automotive industry publication Edmunds reported that average retail sales prices for EVs were 2.6% higher than manufacturer's suggested retail price (MSRP), primarily because of the limited vehicle supply.[9]

1.1.2 Medium-Term Barrier: Component Parts Availability (Especially Battery Packs)

The availability of components and needed raw materials presents an ongoing risk to the EV supply chain. While projected to be sufficient in the near term, this risk will increase over the medium-term as EV production and consumption continues to increase.

The manufacturing of lithium-ion batteries, a critical component in EVs, relies on supply chain from mining raw materials, such as lithium, nickel, cobalt, and graphite, in Australia, China, and the Democratic Republic of the Congo, to processing the raw materials and fabricating battery and packs in China.

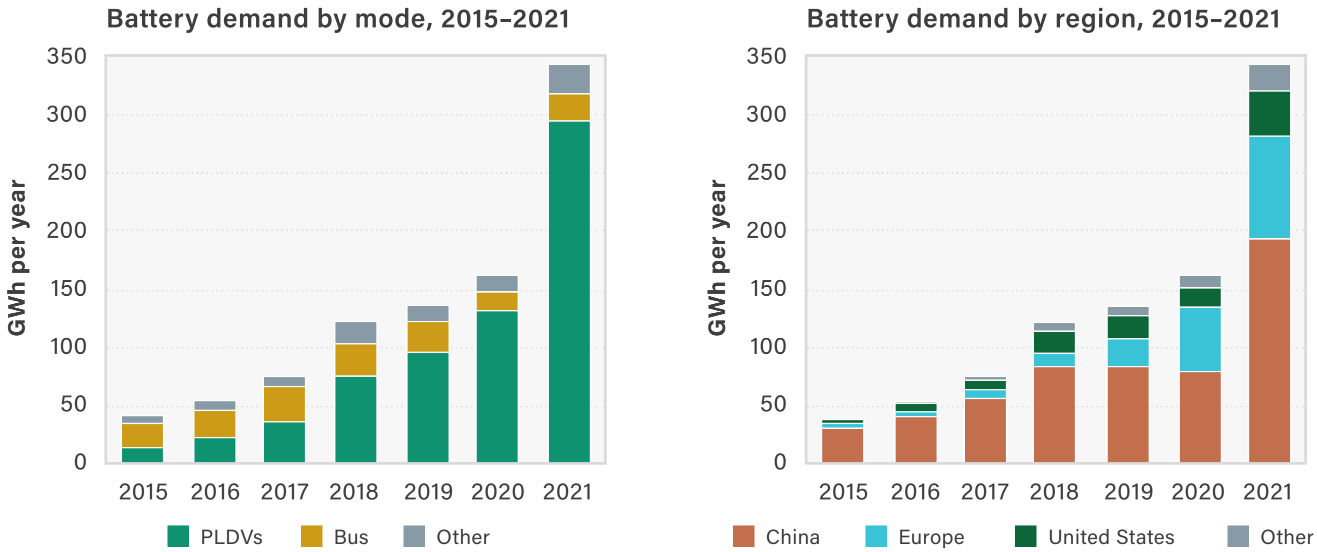
Figure 4: Production Lifecycle for Electric Vehicle Batteries
(Source: International Energy Agency [IEA], "Global Supply Chains of EV Batteries," July 2022.)



Battery demand, which skyrocketed in 2021 due in large part to EV sales in China, has spurred significant increases in demand for key metals used in their production (Figure 5). Between the start of 2021 and May 2022, lithium prices increased more than sevenfold, while cobalt prices more than doubled. Nickel, much of which comes from Russia, almost doubled over the same period, spiking in price in the days immediately following the invasion of Ukraine.

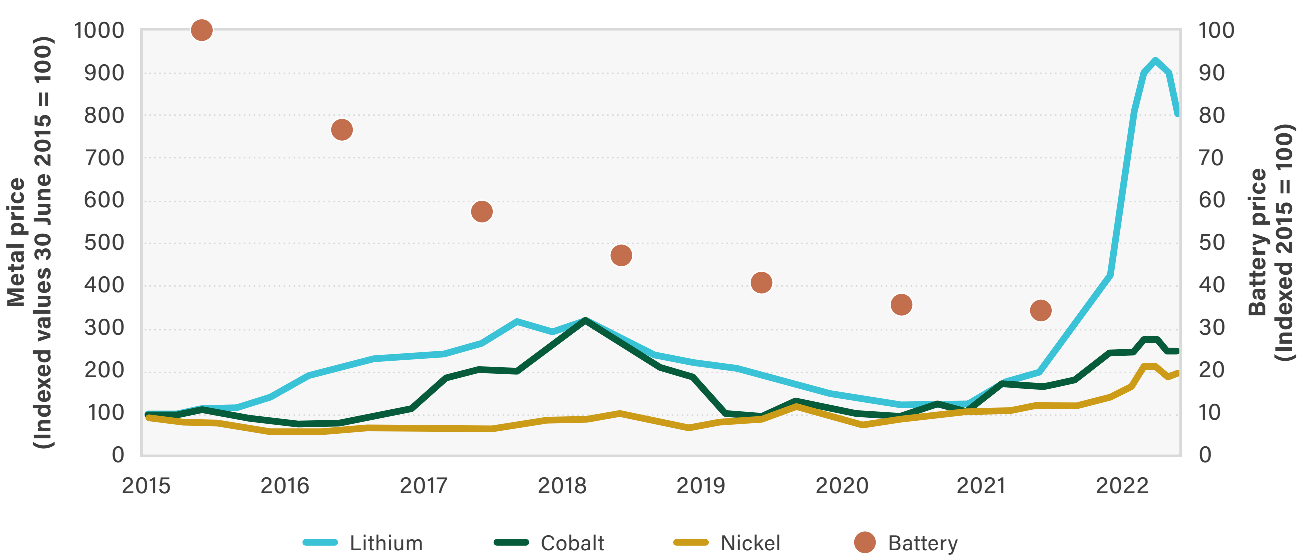
Because of production constraints and commodities speculations, increases in demand for raw earth materials required for batteries and industrial-sized energy storage units caused price increases in batteries.

Figure 5: Battery Demand, 2015-2021 (Source: IEA 2022)

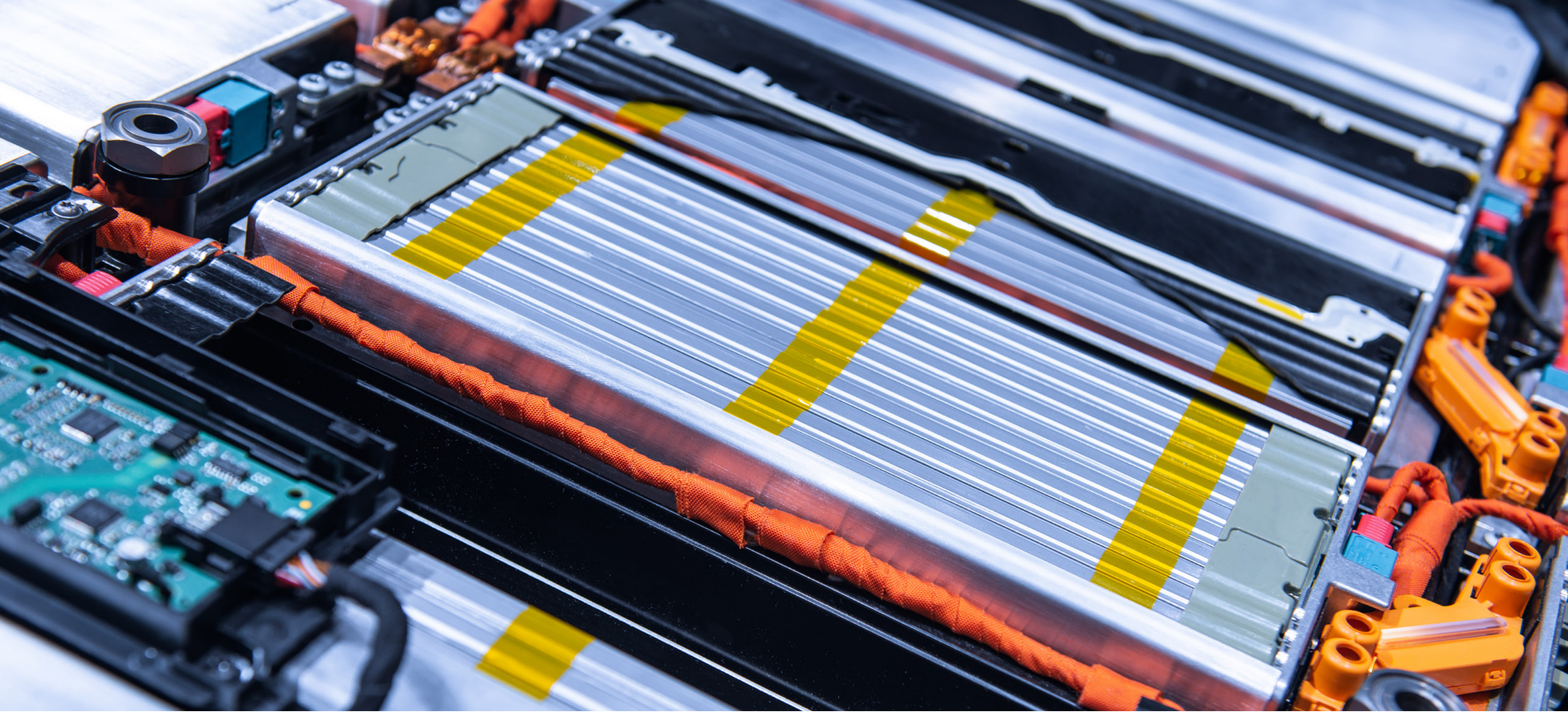


Notes: GWh = gigawatt-hours; PLDVs = passenger light-duty vehicles; Other includes medium- and heavy-duty trucks and two/three-wheelers. This analysis does not include conventional hybrid vehicles.

Figure 6: Battery Metals Prices, 2015–2022 (Source: IEA analysis based on S&P Global data)



Notes: Lithium prices are from June 2022. Cobalt and and nickel prices are from July 2022.



The unprecedented battery metal price increases have been caused not only by surging battery demand but also by increased pressure on supply chains and concerns around tightening supply. The supply constraints have been driven by three trends: production challenges caused by the pandemic, concerns around high-grade nickel supply from Russia, and structural underinvestment in new supply capacity during the three years preceding 2021 when metal prices were low.

Two of these constraints will likely ameliorate over time. Pandemic production challenges should ease as the world continues to adapt to living with COVID-19. Similarly, market forces should bring about increases in production to meet global demand. The supply of nickel from Russia is, however, difficult to predict while the war in Ukraine continues. Mineral needs for EV batteries–compounded by the parallel increase in demand for large-scale energy storage batteries to support renewable energy generation–will significantly drive overall market demand for minerals over the coming decades.

According to a report from the U.S. Department of Energy, new planned EV battery plants will significantly increase U.S. battery manufacturing capacity—from 55 GWh per year in 2021 to approximately 1,000 GWh per year by 2030. This significant increase in battery production will support manufacturing of approximately 10 to 13 million all-electric vehicles per year. In some states, new planned battery plants are being co-located with existing car manufacturing to optimize logistics.[10]

1.1.3 Short- and Medium-Term Barriers: Lack of Model Diversity

Subsequent sections of this study will provide more detail on the vehicle models most commonly driven by HCFUs. Encouraging these drivers to switch to EVs requires the models they prefer be available for purchase.

Initially, the EV model lineup available in the U.S. was dominated by smaller subcompact and compact cars, such as the Nissan Leaf, Chevy Volt, Ford Focus, and Toyota Prius Prime. Tesla’s Model S came to market as a midsize luxury sedan. Thus, unless shopping in the luxury car market, consumers were faced with deciding which version of a small EV they preferred.

The lack of model choices has been cited by prospective car buyers as a significant barrier to purchasing an EV. The 2018 Volvo/Harris Poll survey revealed that lack of vehicle model choice is among the top five reasons drivers cited for not purchasing an EV. More recently, *Consumer Reports'* survey found that 71% of drivers agree or strongly agree that automakers need more model types for EVs.

Figure 7: Consumers Want Pickups, SUVs, and Crossovers – 2022

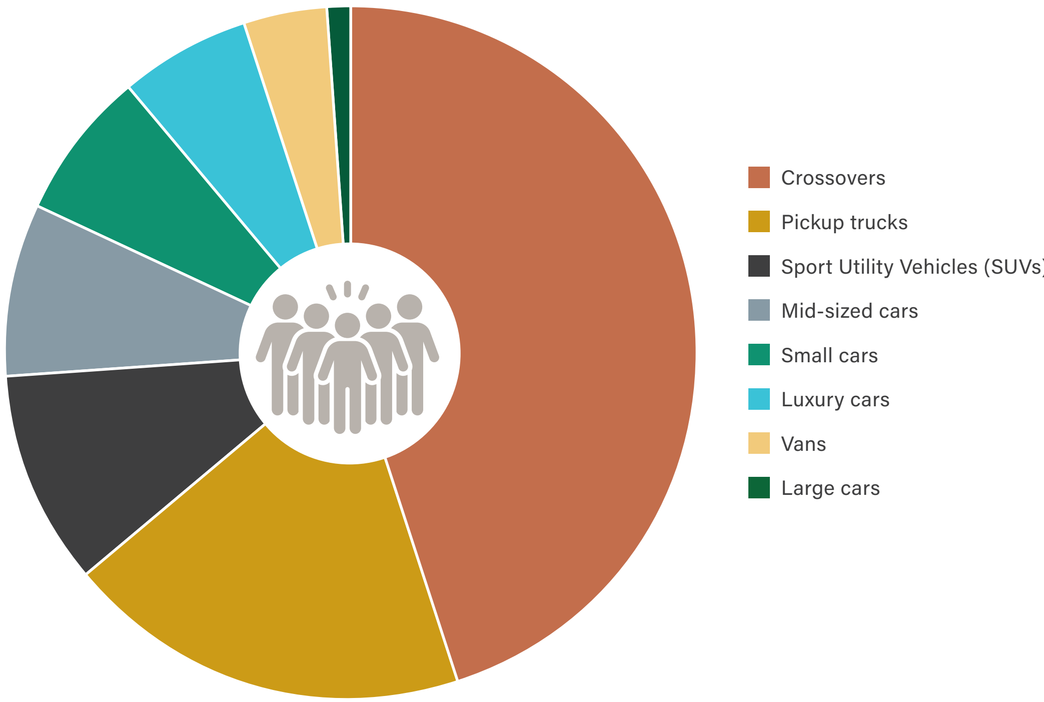
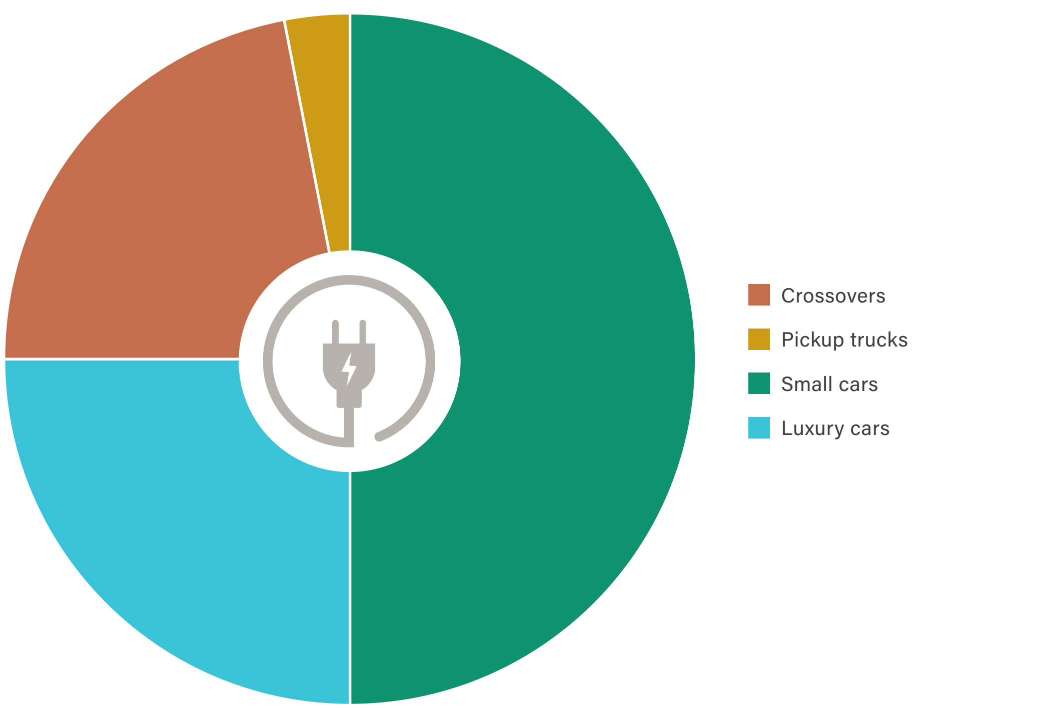


Figure 8: Automakers Are Producing Luxury and Small Electric Cars



U.S. automotive sales are heavily weighted with two types of vehicles that have not been widely available as EVs: sport utility vehicles (SUVs) and light-duty pickup trucks. More recently, crossover utility vehicles (CUVs) have risen in popularity. CUVs are utility vehicles that are built on a car chassis, while SUVs are built on a truck chassis. Collectively, pickups and SUVs (including CUVs) represent 74.7% of all vehicle sales in 2022. In contrast, small cars (7.1%) and midsized cars (8.1%) represent only 15.1% of the new vehicle market.

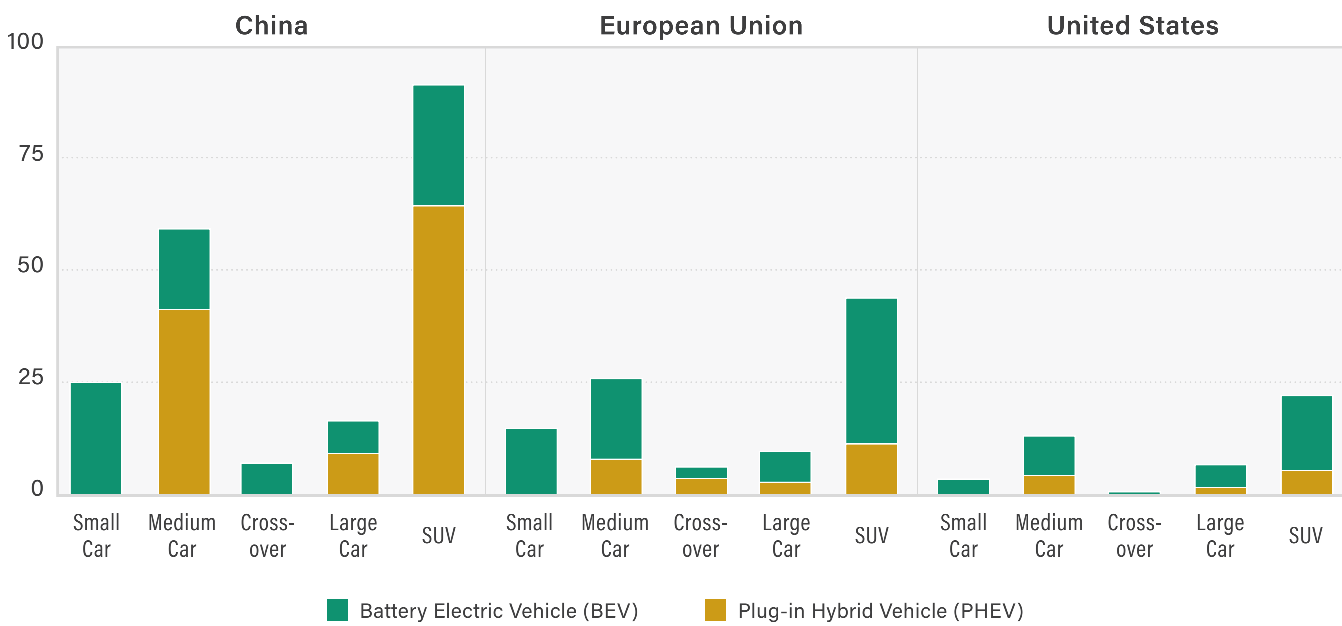
Fortunately, model availability for EVs is changing quickly.

1.1.4 Electric Vehicle Model Availability

Between 2001 and 2020, when the Nissan Leaf and Mitsubishi iMiev became the first production EVs to reach car dealerships, the number of EV models with at least 1,000 units sold grew to 31. The first wave of electric pickup trucks had reached the market, with more to follow,[11] including passenger cars, CUVs, pickup trucks, SUVs, and vans.

Although this represents a wide range of models available to consumers, the U.S. trails both Europe and China in model availability, as shown in (Figure 9) below.[12] The number of distinctive EV models in the U.S. has grown to 96 as of December 31, 2022,[13] but this means the U.S. market only offers about 23% of the 370 EV models available globally.[14]

Figure 9: Electric Vehicle Models Available by Region - 2020



The widest variety of models and the largest growth in 2020 was among (SUVs) and pick-up trucks. According to the International Energy Agency (IEA), more than 55% of announced models worldwide are now SUVs (including CUVs) and pickups. IEA cites the following possible motivations for why auto manufacturers are electrifying this segment:[15]

- SUVs are the fastest growing market segment in Europe and China, and already represent the largest market share in the U.S.
- SUVs command higher prices and offer higher profit margins than smaller vehicles. This enables OEMs to bear the extra costs of electrification for SUVs, because the powertrain accounts for a smaller share of the total cost compared with smaller cars.
- Electrifying the heaviest and most fuel consuming vehicles goes further toward meeting emissions targets than electrifying small vehicles, which already have the lowest emissions.

1.1.5 Automaker Commitments and Investments

Fortunately for U.S. consumers, 18 of the 20 largest OEMs have committed to increasing their model offerings and sales of EVs as illustrated in (Figure 10).[16]

Auto manufacturers have collectively committed to investing an estimated $515 billion in EV-related technologies over the next 5 to 10 years. Although this investment will help propel the expansion of the EV market, ABI Research finds that the auto manufacturers might not have adequately recognized the effect this acceleration will have on supply chains and manufacturing capacity constraints.

Figure 10: Automaker Commitments to Produce and Sell Electric Vehicles (Source: IEA.org)

Automaker	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
BMW Group			25		15-25%					10
BAIC Group	2				1.3					50%
Changan Automobile (Group)					33					
Daimler		10			25%					50%
Donglong Motor Co.	1	30%	1		1				1	1
FAW					40%					60%
Ford		40				100%*				
GM Group			22		30	1				1
Honda										40%T
Hyundai-Kia					1 29					
Mazda		1								5%
Renault-Nissan		20 20%								
Maruti Suzuki	1									1.5
SAIC					30%					30
Stellantis					38%* 31%**					70%* 35%**
Toyota Group	1				15					>1
Volkswagen			1		20% 3 75				26	70%* 50%**
Volvo (Greely Group)	1	1	1	1	50%					100%*

Percentage of sales electric   Annual sales (million)   New EV models (number)   Cumulative sales (million)

* European market only. ** Chinese and U.S. markets only. T Includes both EVs and HFCV

When evaluating auto manufacturer commitments around production of EVs, in most cases, these commitments include hybrids, EVs, and HFCVs in the counts. Additionally, if certain models are available as hybrids or plug-ins (either BEV or PHEV), the manufacturer can count each separately when calculating achievement toward their goals.

Some examples of manufacturer commitments follow:[17]

- Audi plans to have 30 electrified vehicles by 2025 (20 will be EVs); pledged to stop producing internal-combustion engine vehicles by 2033.
- BMW expects sales of hybrids and EVs to account for 15 to 25 percent of its global sales by 2025.
- Ford plans investments of $29 billion in EVs through 2025.
- GM will invest $27 billion in EVs through 2025 and plans to have 30 EVs on the market (20 available in North America).
- Volkswagen will stop selling internal combustion engine vehicles in Europe between 2033 and 2035 and plans to discontinue internal combustion engine vehicle sales in China and the U.S. soon after (no specific dates).

In Chapter 2 of this Joint Transportation Committee report, specific characteristics of EV models currently for sale in the U.S. are examined and contrasted with conventional gas-powered vehicles favored by HCFUs.

1.1.6 Hydrogen Fuel Cell Vehicle Availability

HFCVs are zero-emission electric vehicles that use hydrogen stored in the vehicle's fuel tank to create electricity for motive power. The hydrogen is passed through an on-board fuel cell, which converts the hydrogen gas into electricity. HFCVs must overcome many of the same adoption barriers as EVs before they reach a more mature stage of consumer appeal. Both HFCVs and the hydrogen fueling infrastructure that support them are still in the early stages of implementation, at least within the light-duty vehicle segment.

At present, only three automakers (Honda, Hyundai, and Toyota) offer models of light-duty passenger HFCVs available to U.S. consumers. These vehicles are concentrated in select markets like southern and northern California, where there is an early network of hydrogen fueling stations. As of January 2021, only Honda has publicly committed to produce an HFCV at scale, to help reach its target of 40% Zero-Emission Vehicles (ZEV) by 2030. However, other OEMs are currently testing HFCVs and may release light-duty versions for the consumer market.

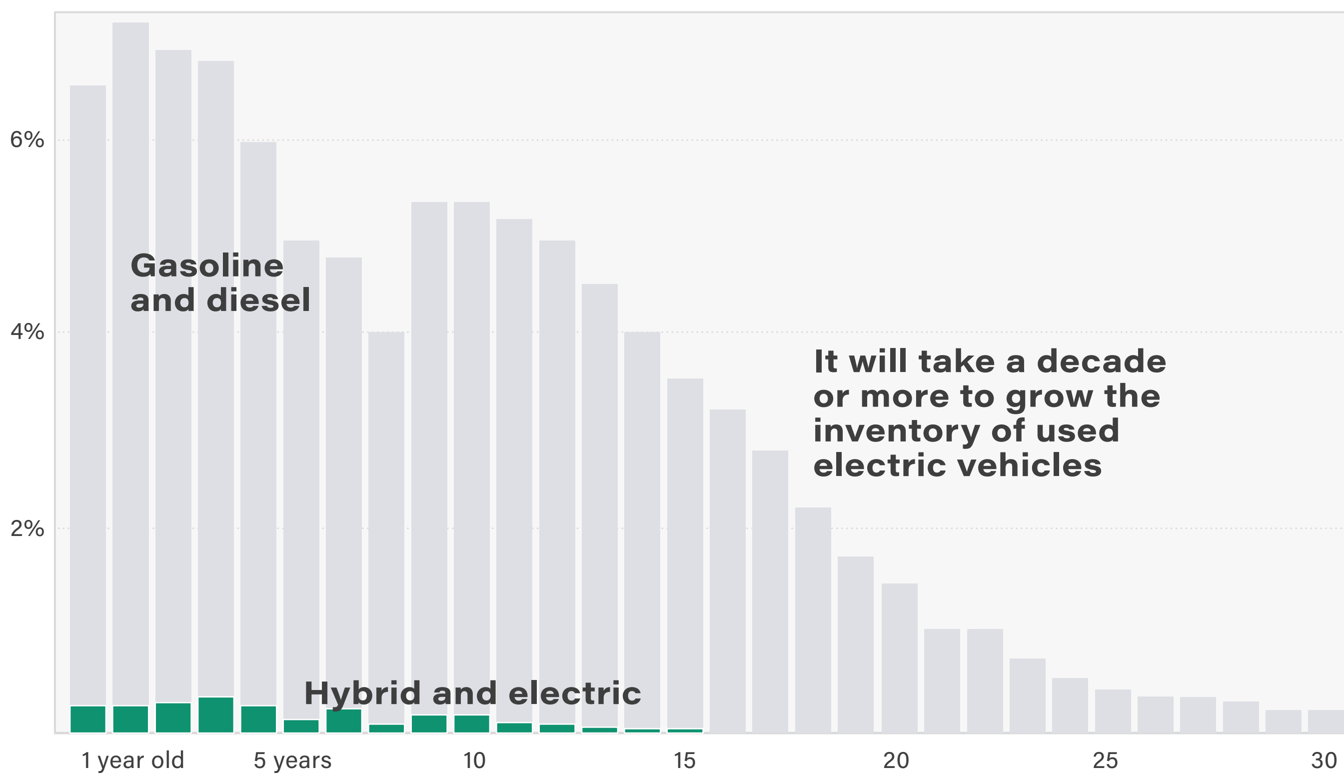
1.1.7 Short- and Medium-Term Barrier: Lack of Used Vehicles

In the U.S. about 74% of all vehicles sold are used vehicles (Figure 11).[18] Given that the first modern, mass-produced EV, the Nissan Leaf, made its debut in 2011, there are still relatively few EVs available on the used market in any significant quantity. Also significant, used EVs tend to be early-technology, lower-range models, which may be a limiting factor for potential EV purchasers.

As with internal combustion engine vehicles, many consumers might prefer a lower cost, used model. According to Forbes, the average price for used EVs sold across the U.S. during the first half of 2022 ranged between $15,000 and $20,000. The current supply issues for new EVs have also increased demand for used models, driving those prices up as well. As an example, a new Chevrolet Bolt can be ordered from a dealer in the Seattle area for $29,999 (MSRP $27,480 + market adjustment of $2,529). In contrast, a three-year-old Bolt with 20,000+ miles can be purchased today from a Seattle area used EV dealer for $28,995, which is $1,500 more than the MSRP for a new one (but with no preorder requirements or delivery wait times).

In 2021, the national average of total used cars sold was 3.4 million per month, the vast majority of them internal combustion engine vehicles.[21] With relatively few second-hand EVs available, and with new EVs out of reach for many, it is possible that older gasoline-powered cars will persist for even longer on U.S. roads, because consumers who are unable to afford newer, pricier EVs turn to cheaper, used internal combustion engine models.[22]

Figure 11: Age of Cars and Light Trucks on U.S. Roads[20]



1.2 Demand

Having an adequate supply of EVs available for retail purchase is an obvious precondition for consumer adoption of EVs. The other side of the equation is consumer demand. Section 1.2 examines some of the factors that affect consumer demand.

From congressionally chartered research commissions,[23] to automotive industry market research,[24] to direct consumer surveys,[25] the barriers to increased adoption of EVs have been studied extensively, and the findings across all studies are remarkably similar. Each of the following barriers are consistent across all sponsors and methods of research into consumer adoption of EVs. (Figure 12) shows the percentage of the total driving public with a particular concern versus percentage of EV drivers with that same concern. When compared against each other, results show that drivers' concerns lessen with actual EV experience.

Figure 12: Top Barriers to Purchasing an Electric Vehicle
(Source: Volvo Car USA/The Harris Poll, conducted October 11–17, 2018)

Total Drivers	EV Drivers	Total Drivers	EV Drivers
58%	38%	22%	22%
Running out of power		Not enough variety in models	
49%	30%	20%	22%
Low availability of charging stations		Not enough performance capability	
47%	40%	14%	17%
Initial vehicle costs		Risk of overwhelming electric grid	
37%	29%	EV drivers say they had range anxiety when they first purchased an EV, but it went away after a few months.	65%
Cost to services and repair the engine			

1.2.1 Demand Factors Potentially Affected by Public Policy Initiatives

1.2.1.1 Vehicle Purchase Price

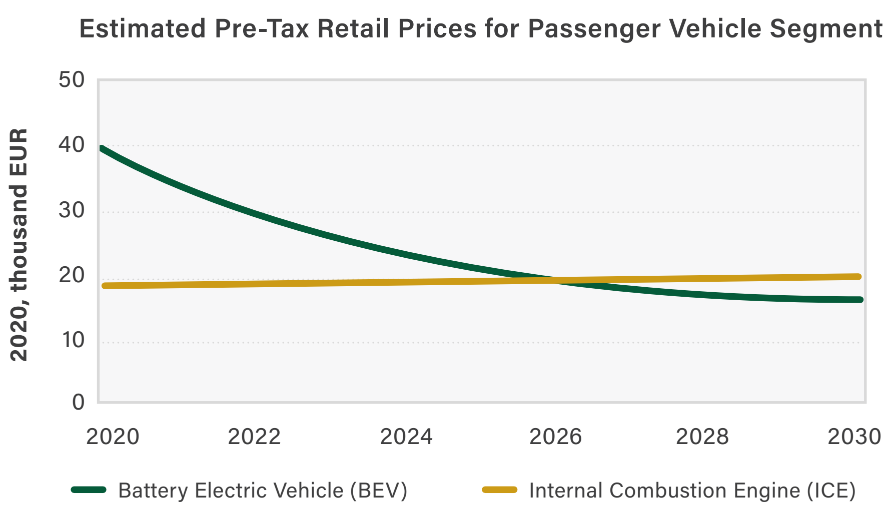
The cost of purchasing an EV has been a top concern for most prospective buyers since 2012. Policy incentives for EVs have focused on mechanisms to reduce an EV's initial purchase cost. These have included direct cash incentives and sales tax exemptions. Although this issue remains among the top three for consumers, there are indications that vehicle cost is becoming less of an obstacle as EVs approach price parity with conventional gas-powered vehicles.[26]

As of January 2023, the average sales price for a new EV stood at $61,448, according to Kelley Blue Book estimates.[27] Although down slightly from the prior peak reached in 2022 (due to recent price cuts for Tesla models), this figure is well above the average price of $49,507 for internal combustion engine vehicles. The average transaction price for new EVs track more closely with the average price of a luxury vehicle ($66,660). EVs are typically equipped with top-of-the-line trim packages and driving features, which draw a higher price. In addition, the best-selling EV maker in the U.S. is Tesla. To date, these vehicles are designed and marketed to the upper-end of the consumer market, since those drivers are more likely to be early-adopters of new technology.

As shown in (Figure 13), Bloomberg New Energy Finance (BNEF) projects that the "crossover point"–when EVs will cost less than gas-powered vehicles–will occur by 2027. This accounts for an upfront sales price without any purchase rebates or other financial subsidies.

When factoring in rebates and tax incentives at the federal level and available in some states, price parity could be reached earlier than 2027. Once price parity has been achieved, upfront purchase price should drop from the list of barriers to consumer adoption of EVs, at least among new car buyers.

Figure 13: Price Parity Crossover Point Between Electric Vehicles and Gas Vehicles



Sources: Bloomberg New Energy Finance (NEF)

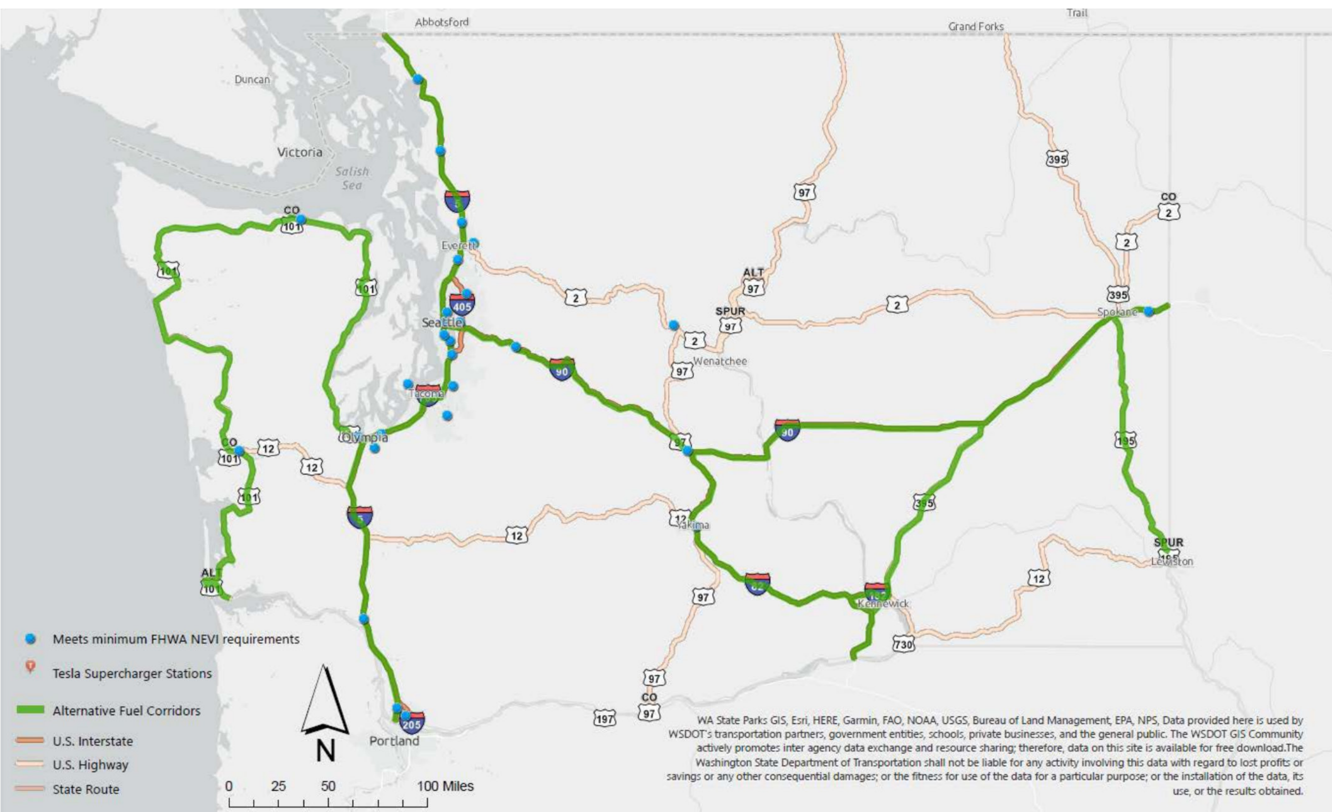
1.2.1.2 Availability of Publicly Accessible Charging

Although more than 80% of all EV charging occurs at home,[28] drivers still want (and need) the ability to charge their vehicles while in route to, or upon arrival at, their trip destinations. Concerns about the availability of publicly accessible charging stations are consistently ranked among the top barriers to EV adoption. A robust network of EV charging stations enables drivers to use their EV for a greater share of their miles driven, lessening the need to own a second car that is gas-powered.

Current Charging Network

The U.S. Department of Energy (DOE) Alternative Fuels Data Center maintains a database of EV charging station locations across the country. Users can search by location, charger type, and type of connections. Based on data from the DOE, there are approximately 46,000 EV chargers available in the U.S. The Alliance for Automotive Innovation reports that the number of publicly available EV chargers has increased 16 percent since January 2021. As the National Electric Vehicle Infrastructure (NEVI) program will spur development of a nationwide network of 500,000 EV charging stations by 2030. Many view the National Electric Vehicle Infrastructure (NEVI) program as a down payment on achieving the number of publicly available EV chargers needed in the U.S. to support widespread EV adoption.

Figure 14: Electric Vehicle Fast Charging Network along Washington State Highways, Active and Planned



Washington was one of the first states in the nation to deploy EV charging stations. In 2009, the greater Puget Sound metro area was selected as one of DOE's EV Project deployment cities. Shortly thereafter, the State of Washington led the creation of a network of Direct-Current (DC) fast-charging stations along major highway corridors in the state, ultimately connecting with a similar network in Oregon and stretching through California. This investment in public access charging stations has helped support Washington's comparatively high adoption rate of EVs.

Meeting the state's EV sales targets requires expanding the public access charging network, not just in Washington but throughout the U.S. According to McKinsey & Company, to reach the federal government's goal of 50% zero-emission vehicle sales by 2030, the U.S. needs an additional 1.2 million public access charging stations.[29] Analysis by the California Energy Commission, conducted in June 2021, estimated that California alone will need a similar number of public charging stations (approximately 1.2 million) to meet demands associated with the 7.5 million EVs expected on California's roads by 2030.[30]

Publicly Funded Charging Expansion

The passage of the Infrastructure Investment and Jobs Act (IIJA) and the creation of the NEVI funding program will allow for the build-out of a nationwide EV charging network. This network will allow EV drivers to travel across the country on designated Alternative Fuel Corridors with fast charging stations located, at most, every 50 miles. The availability of a ubiquitous, publicly accessible charging network for EVs would help alleviate concerns about limited range of these vehicles; however, such a comprehensive public charging network remains under development and will take at least six years (by 2028) for just the NEVI-funded stations to be fully deployed.

Private Investment

Publicly accessible charging stations must serve a reasonable number of EVs to justify the business case for private network operators to develop and expand EV charging. However, consumers are reluctant to purchase an EV without at least a basic network of EV charging stations in place to support their travel. In 2012, the federally funded EV Project aimed to deploy 8,650 early market EVs in 18 selected cities, concurrent with an initial network of 12,500 EV charging locations in those cities.[31] By concentrating both new EVs and new charging stations concurrently within these demonstration areas, the EV Project overcome the "chicken or the egg" dilemma of deciding which deployment should occur first–the EVs or the charging stations.

1.2.1.3 Inability to Charge at Residence

For people living in multi-unit dwellings like condominiums and apartments, or other housing without off-street parking, finding a location to charge at home can be difficult. EVgo, a national EV charging network operator, estimates 30% of Americans do not have access to home charging. This can create a barrier to ownership if consumers are not sure where they will be able to charge their vehicle at home. To address this issue, some states have passed laws that prohibit landlords from preventing tenants from installing EV chargers on-site. Washington state laws (RCW 46.32 et seq., and RCW 64.90) provides that common interest developments (which include community apartments, condominiums, and cooperative developments) may not prohibit or restrict installation or use of EV charging stations.

The NEVI program will also provide discretionary grants to address community charging barriers, including funding for charging infrastructure in these multi-unit residential locations.

1.2.2 Demand Issues Not Subject to Public Policy Initiatives

1.2.2.1 Range

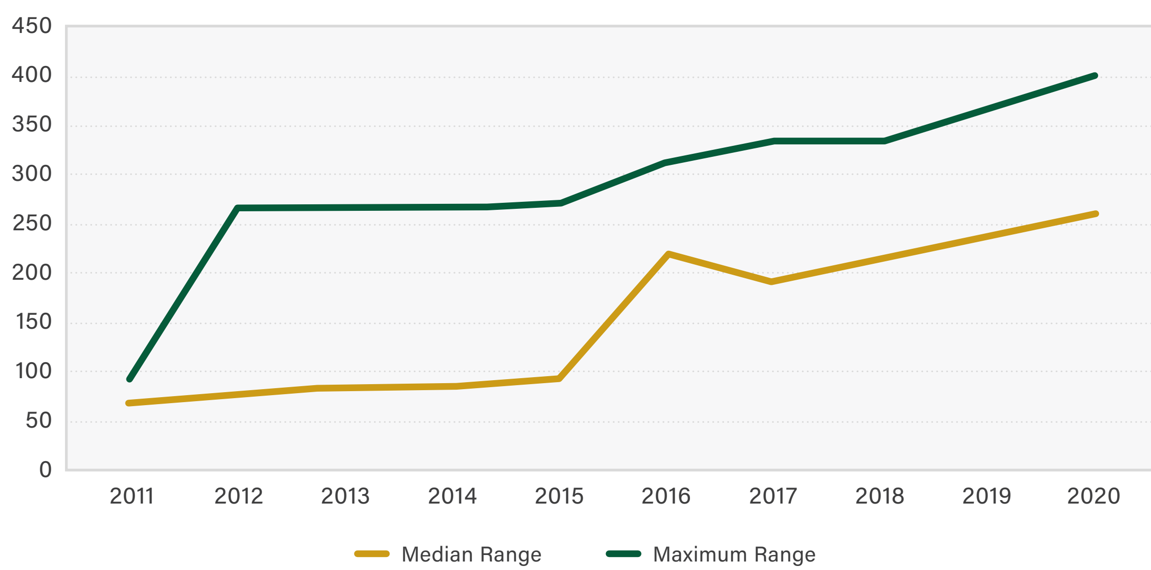
Range is a measure of how far an EV can travel on a single charge. The fear of running out of power is often referred to as "range anxiety," and it remains a top concern identified by consumers exploring an EV purchase. Over the last several years, automakers have done much to increase the range EVs can travel before needing to charge. Today, the average EV can travel about 250 miles on a single charge, and some can go as far as 350 miles. The forthcoming EV from Lucid Motors has an EPA estimated range of 520 miles, which helped it earn Motor Trend's Car of the Year for 2022.(This industry-leading range comes at a very steep price: the MSRP of the Lucid Air starts at $139,000). Even an average range of 250 miles represents a significant advancement from the earliest EV models, which could travel only 60 miles on a single charge.[33] Nonetheless, consumer research still indicates that limited vehicle range is a top barrier for consumers.

One countermeasure for limited-range EVs is offering the ability to recharge the vehicle conveniently and affordably.

1.2.2.2 Uncertainty Around Vehicle Performance Characteristics (Especially in Extreme Weather)

The American Automobile Association (AAA) found that an EV's range decreases by as much as 41% in cold temperatures and 17% in hot temperatures.[35] This variability can be partly attributed to using the car's heater or air conditioner. Additionally, EV batteries take longer to charge in cold weather. To address this barrier, newer models have been redesigned with features for greater energy efficiency, including heat pumps, defrosters, and seat heaters. DOE estimates that two-thirds of extra energy consumed is attributed to heating the passenger cabin. Newer battery chemistries are also expected to improve an EV's ability to retain energy, even in very cold temperatures.

Figure 15: Range of Electric Vehicles for Sale in U.S., Model Year 2011 – 2020[34]



Source: U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Jan. 4, 2021

1.2.2.3 Uncertainty Around Vehicle Servicing and Repair

While EVs tend to cost more at the time of purchase, regular servicing is less expensive than a typical internal combustion engine vehicle. Maintenance costs are lower for EVs because they do not require tune-ups, oil changes, air filters, spark plugs, or drive belt replacements. Maintenance costs savings for EVs average about $330 annually. According to a study conducted by McKinsey & Company, in addition to lower general wear and tear, EVs regenerative braking systems capture kinetic energy from the vehicle deceleration and converts it into electricity to recharge the battery, allowing for more efficient braking and lessening brake wear and tear. While service costs in general are lower for EVs, the type of service can be specialized in nature and somewhat complex. The complexity of EV servicing is an issue being monitored by auto manufacturers and dealerships.

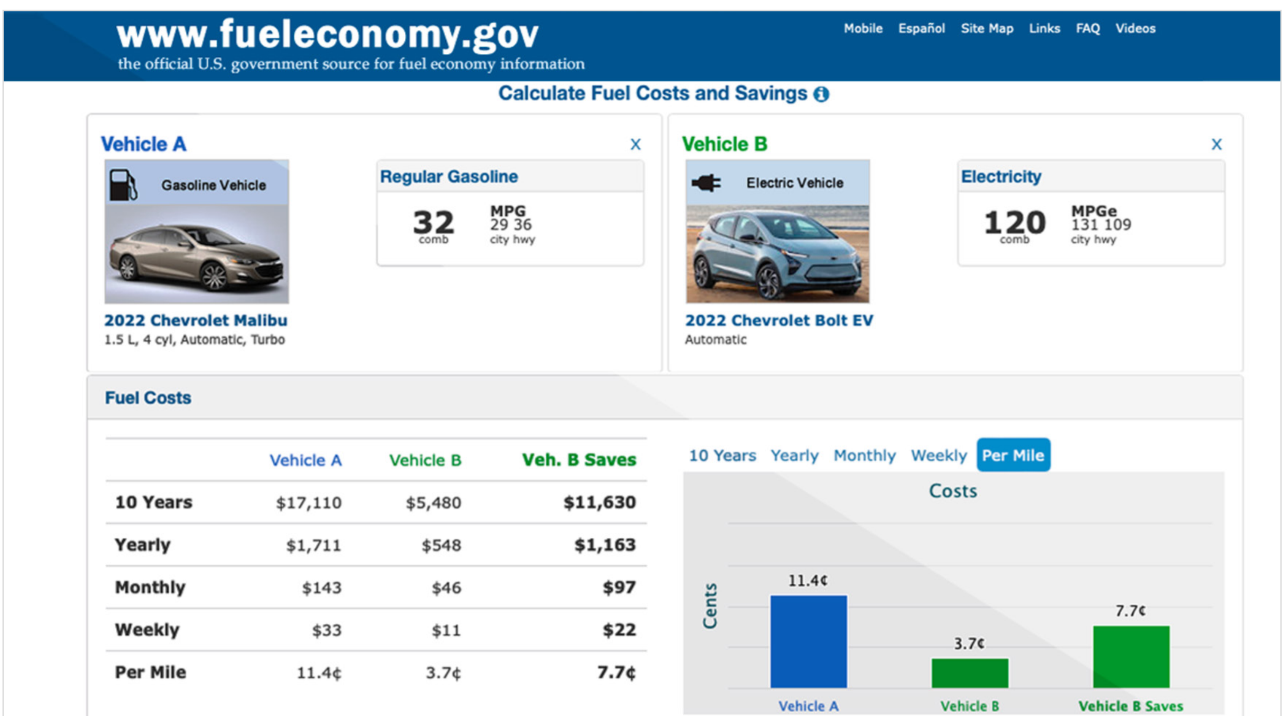
1.3 Macroeconomic Factors Affecting Electric Vehicle Adoption

In addition to supply and demand, larger economic forces affect the willingness (or ability) of consumers to switch to EVs. These macroeconomic factors exist without regard to the automotive industry or public policies to incentivize adoption. The three factors are the comparative price of fuels, fleet turnover rates, and inflation rates for durable goods.

1.3.1 Retail Price of Fuels

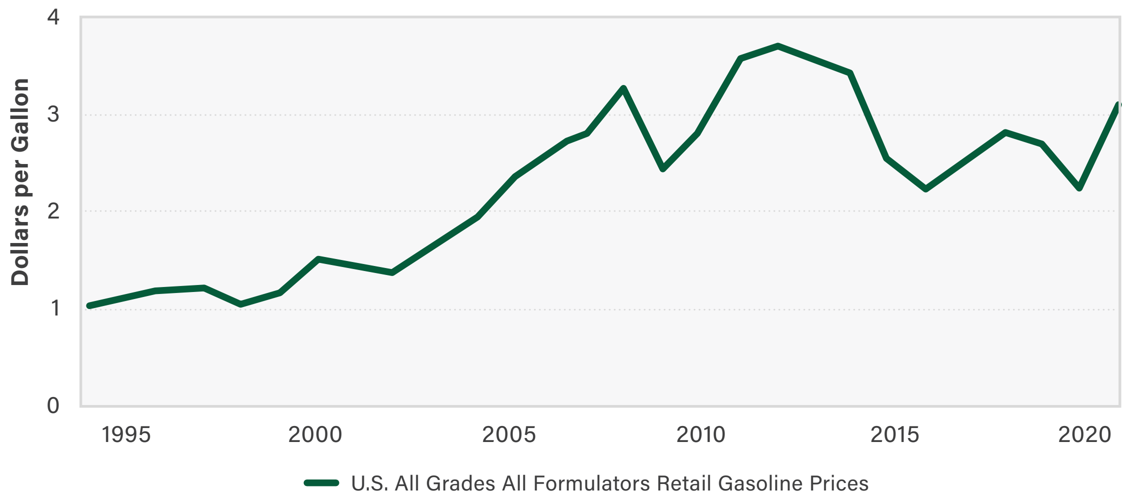
One of the most significant advantages EVs have over their gas-powered counterparts is the large difference in the price of fuel per mile traveled. Although the extent of this price advantage varies from state to state, throughout the U.S., the retail price of electricity (measured in kilowatt hours, or kWh) required to travel 1,000 miles is less than the retail price of gasoline to travel the same distance. This electricity price advantage is illustrated in (Figure 16), which compares a 2022 Chevrolet Malibu (national average fuel costs of 11.7 cents per mile) against a 2022 Chevrolet Bolt EV (national average fuel costs of 3.7 cents per mile).

Figure 16: Fuel Cost Savings between Chevrolet Malibu versus Chevrolet Bolt Electric Vehicle (Source: www.fueleconomy.gov)



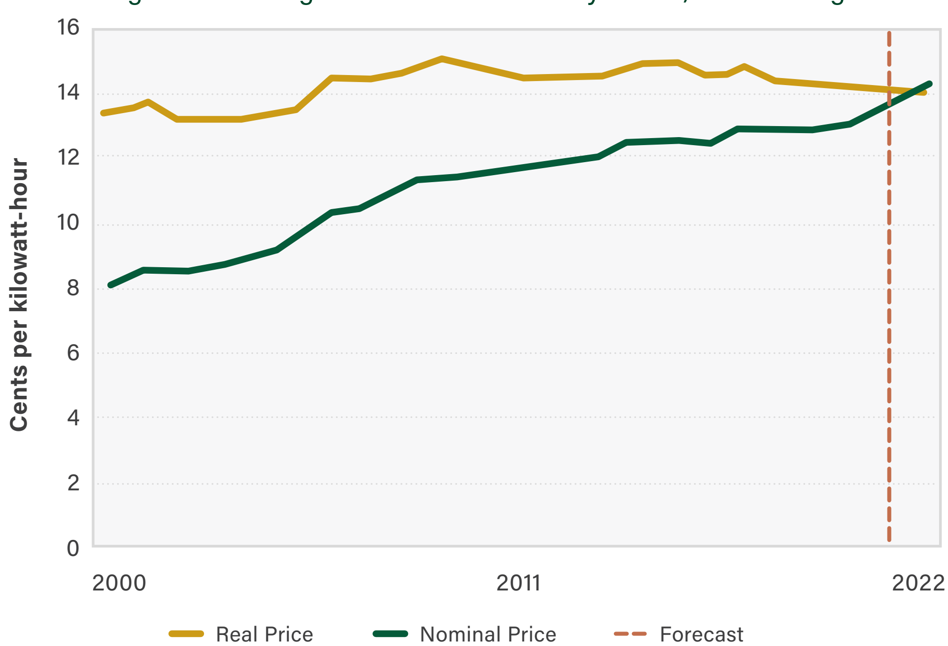
Not only is electricity less expensive on a per-mile basis, it also holds another important price advantage: historically, electricity prices are significantly less volatile than oil or gasoline prices. Since 1983, the average retail price of electricity delivered in the United States has risen by less than 2% per year in nominal terms.[36] Retail gasoline prices are much more likely to fluctuate–and by much greater amounts–than retail electric prices. As shown in (Figure 17), the average price of gasoline from 2012 to 2022 varied from a low of $1.87 (February 2016) to a high of $5.03 per gallon (June 2022). This represents a 169% increase between the 2016 low to the June 2022 high. In contrast, (Figure 18) shows the price of residential electricity rose from 11.88 to 14.75 cents per kWh, a 24% increase over the 10-year period ending August 2022.[37]

Figure 17: Average Retail Gasoline Prices, 1994 through 2022



Source: U.S. Energy Information Administration, Short-term Energy Outlook, September 7, 2022

Figure 18: Average Residential Electricity Prices, 2000 through 2022



Source: U.S. Energy Information Administration, Short-term Energy Outlook, September 7, 2022

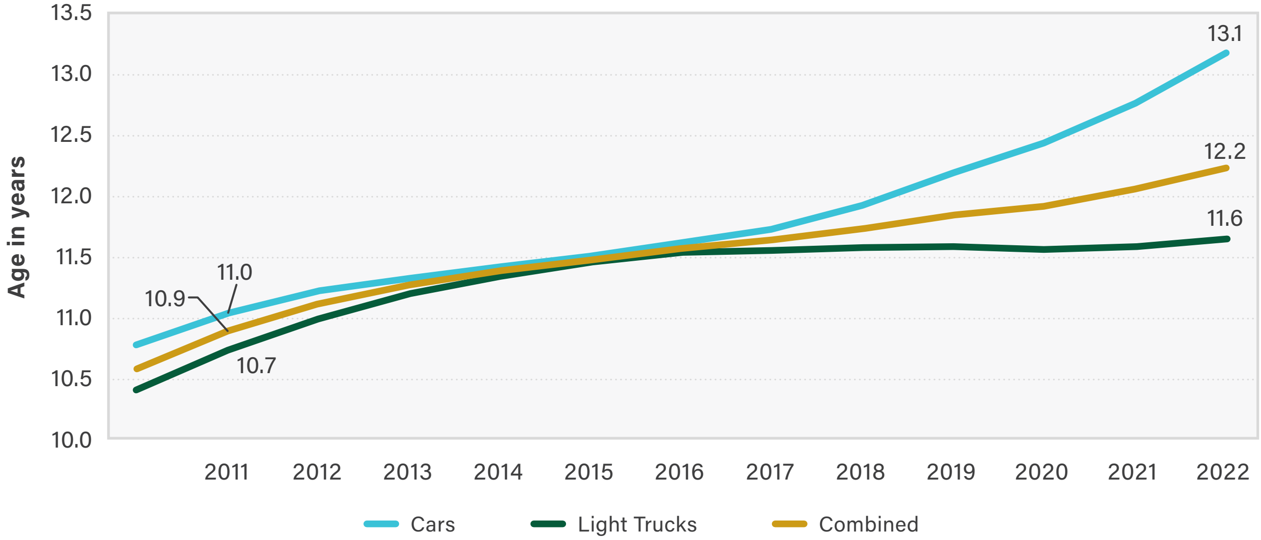
The greater the price differential between residential electricity and gasoline, the greater the financial incentive for drivers to consider switching to an EV.

1.3.2 Vehicle Fleet Turnover

People purchase a new vehicle when they are ready to replace their current vehicle. Even though the average age of vehicles operating in the Unites States is around 12 years, some vehicles remain in use much longer than average (Figure 19).[38] Moreover, as internal combustion engine vehicles have become more reliable, Americans tend to keep their vehicles longer. Today's average age of 12 years for a light-duty vehicle operating in the U.S. is up from 9.6 years in 2002.[32]

Given the relatively long useful lifespan of vehicles, turnover of the vehicle fleet could take decades.

Figure 19: Average Vehicle Age by Vehicle Type



Note: Data as on January 1 of each year

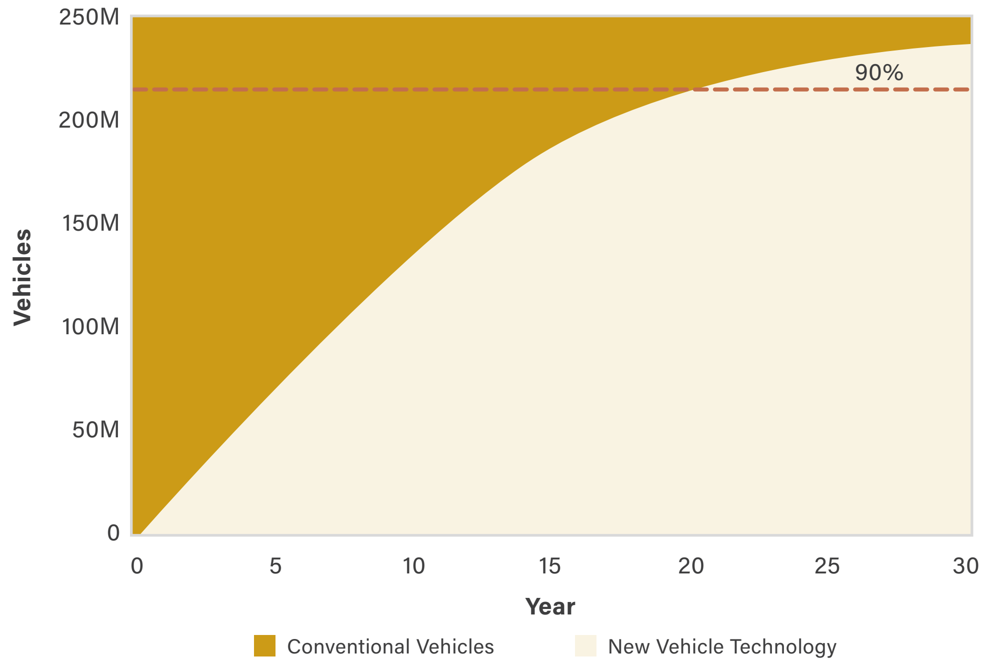
Source: S&P Global Mobility

It takes approximately 20 years for a new vehicle technology to account for 90% of the on-road fleet.[39] As a result, it is estimated that new internal combustion engine vehicle sales would have to cease by 2035 to have a 90% EV light-duty vehicle fleet by 2050.[31]

1.3.3 Inflation

Accurate forecasts of the trajectory of inflation have proven especially difficult for economists over the past 12 months. Forecasting prices of EVs may be difficult given the fierce competition (and financial speculation) for acquiring rights to mine the rare earth minerals needed to produce EV batteries. For this reason, inflation of EV prices may be higher than inflation for durable goods generally.[41]

Figure 20: Introduction of a New Vehicle Technology into the U.S.[40]




ELECTRIC
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PARKING

Section 2: Washington State's Electric Vehicle Policy Environment

Potential policies to encourage HCFUs to switch to EVs would need to work within the current framework of existing Washington and federal EV adoption policies. Those policies are outlined in this section and categorized as either market-based incentives or public policy incentives.

2.1 Washington Public Policy Incentives

The increase in EV adoption over the last decade can be linked in part to actions policymakers have taken at the federal and state levels, as well as utility-related programs and the Volkswagen class action lawsuit settlement. Incentives, subsidies, and other programs have spurred the interest in and purchase of hybrids and EVs over the last several years.

Washington remains a leader among states in supporting transportation electrification, including consumer adoption of EVs. This leadership is not just at the state government level–it is evident across all levels of government, many industry sectors, and in civil society. Notable examples of organizations providing leadership to support adoption of EVs include:

- Seattle Electric Vehicle Association and Plug-in North Central Washington
- West Coast Electric Highway partnership with Adopt-a-Charger
- Puget Sound Regional Council
- Cities of Seattle, Spokane, and many other cities throughout the state
- Electric power providers: Seattle City Light, Chelan Public Utility District, and investor-owned utilities Puget Sound Energy and Avista

EV adoption in Washington is already among the highest in the country, with total EV registrations ranking fourth in the nation. According to the Washington Department of Licensing, there were 107,932 registered EVs (PHEVs and BEVs included in this total) in the state as of August 2022 (Figure 13). The most recently available data from the Washington Department of Licensing shows that of July 2022, 8% of all new vehicle sales were fully electric vehicles, which is double July 2020.

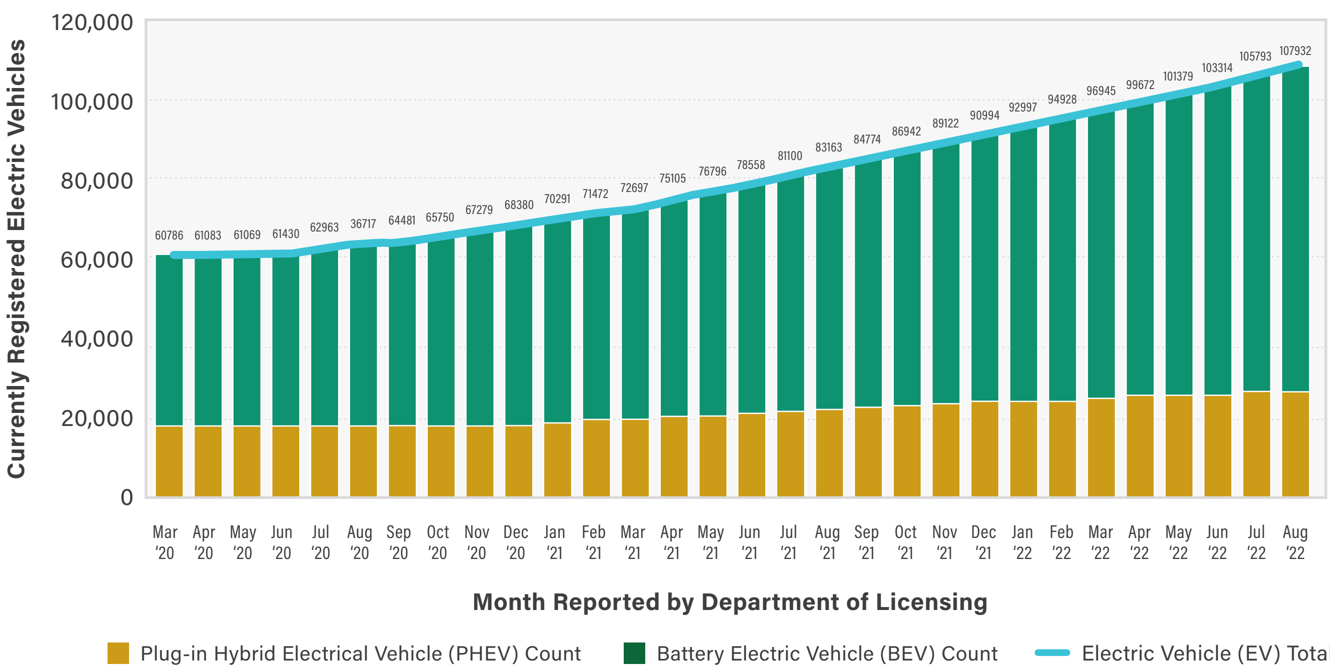
Nationally, EVs represented 6.6% of new light-duty vehicle sales in the second quarter of 2022, including a record 8% of new vehicle sales in June.[42] Sales of BEVs, specifically, totaled 224,000 in the second quarter of 2022, representing an increase of 2.83% above the previous quarter and 54% over the same period in 2021. Figure 21 illustrates sales of ZEVs by year.

Despite the rapid increase in the number of EVs sold, these vehicles still make up just under 1% of all registered light-duty vehicles in the U.S.[43]

2.1.1. Washington State Purchase Incentives

Vehicles that meet the state's definition of Alternative Fuel Vehicles, which includes EVs, but also natural gas, propane, and hydrogen, are exempt from the state's sales and use tax for the first $20,000 of the vehicle's purchase price. This incentive is not available for new vehicles valued greater than $45,000 nor for used vehicles valued greater than $30,000.[44]

Figure 21: Electric Vehicle Registrations in Washington



HFCV qualify for a separate incentive. The new law exempts 50% of the retail sales and use tax owed on the purchase or lease of new light-duty vehicles that are powered by fuel cells. This incentive is available only for the first 650 qualifying HFCVs sold or leased in the state. The maximum amount of this tax exemption is capped at $16,000 per vehicle.

Sales tax exemptions also apply to the purchase and installation of EV infrastructure, including home charging equipment.

Although not a financial incentive, it's worth mentioning that Washington does charge an additional registration fee for EVs, as do 31 other states.[45] The current fee has two components: for both battery-electric vehicles and PHEVs with an electric range of at least 30 miles, $150 is charged. A majority of this revenue is deposited in the motor vehicle account (state highway fund) where proceeds can be spent only on highway-related purposes. A smaller share of revenue is deposited into the state's the Multimodal account, where the proceeds are available for investment in any transportation-related project or program. The second component is an additional $75 fee (Transportation Electrification Fee) that is paid by the same EVs (for a grand total of $225) and by hybrid vehicles that do not plug in (for example, a Toyota Prius). Proceeds from this $75 fee must be deposited into the Multimodal account, and they are eligible for investment in any transportation-related project or program, including the state's growing network of EV charging stations.

2.1.2. Operational Incentives

Although there have been various proposals to incentivize EVs by allowing them to travel toll-free on Washington's tolled facilities, none have advanced in the legislature. Similarly, there have been proposals that would allow EVs to use high-occupancy vehicle (HOV) lanes. Some states offer this incentive, while others have repealed special HOV lane access for alternative fueled vehicles (including EVs) because the large number of vehicles qualifying for special access was causing the operational speeds of the lanes to fall below the designated minimum operating speed of 45 mpg.[46] Washington has declined to extend HOV or High Occupancy Toll (HOT) lane privileges to EVs.

At the local government level, many cities offer special parking privileges for EVs. In most cases, these involve specially designated parking stalls that have EV charging equipment available for use. Free on-street parking for EVs has been phased out in most municipalities that once offered this incentive.

2.1.3. Infrastructure Incentives

Washington was an early leader in providing publicly accessible EV charging stations, at both the local community level and along state highways.

Many cities and towns in Washington provide publicly accessible EV charging stations on municipal-owned property. Most of these charging stations allow visitors to recharge while at the public buildings. There is a wide range of policies related to fee collection for use of these public charging stations. Some are simple charging ports that do not require a membership, network authentication, or fees for using the service. At the other end of the spectrum, some municipal charging stations are connected to a network of other charging stations operated by an EV charging service provider (e.g., ChargePoint), require authentication of the EV as a member of the charging service (or a temporary guest pass), and collect a fee for use of the station.

At the state level, Washington was first in the nation to develop a network of DC fast-charging stations along major highways to allow EV users to travel greater distances.[47] When first deployed, EV drivers could recharge their vehicles at no cost to them–all of the costs, including installation of the chargers, operations, and the electricity–were provided through an innovative public–private partnership between the Washington State Departments of Transportation and Commerce, and AeroVironment, a private electric vehicle service provider. Seed funding was provided from State Energy Program (federal) funds. In return for the public funding contribution to develop and install the equipment, the private company committed to provide operations, maintenance, and electricity free of charge to EV drivers for a minimum of three years.

This model proved successful and has since been replicated in several states. The NEVI deployment program recently enacted by Congress provides similar seed funding to states to develop highway "corridor charging."

In addition to providing sales tax exemptions on the installation of certain electric vehicle supply equipment, Washington also has a program that collects an additional $75 fee from EV and hybrid vehicle drivers. This $75 fee is in addition to a separate $150 fee on EVs (discussed in Section 2.1.1). Through June 30, 2025, proceeds from the $75 fee must be deposited into the Electric Vehicle Account where they can be used to upgrade or expand Washington's network of EV charging stations as well as hydrogen. Beginning July 1, 2025, proceeds from the $75 fee will be deposited into the state's motor vehicle fund and will not longer be available to be used for EV charging stations.

2.2 Federal Public Policy Incentives Available to Washington Residents

2.2.1 Federal Purchase Incentives

The Inflation Reduction Act (IRA), enacted in August 2022, extends the current $7,500 tax credit for 10 years—through 2032. The $7,500 tax credit is broken into two parts: 1) $3,750 if the vehicle is made with a battery manufactured or assembled in the U.S. and 2) $3,750 if the battery is constructed with critical minerals mined in the U.S., or a U.S. free-trade agreement country, or recycled in the U.S. The credits can be transferred to the dealer at the time of purchase to lower the cost of the vehicle. New income limits do apply—those filing single must have an adjusted gross income (AGI) of under $150,000 and those married filing jointly must have an AGI under $300,000. Additionally, SUVs, trucks, and vans with an MSRP of $80,000 or greater are not eligible for the credit, and sedans must be priced under $55,000.

The IRA also provides a tax credit for first-time buyers of used EVs. The credit is $4,000 or 30% of the vehicle sale price, whichever is lower. There is a $75,000 income limit for individuals ($150,000 if married filing jointly). To qualify for this tax credit, the vehicle must weigh less than 14,000 pounds and have a sale price of less than $25,000, and it must be at least two years old.

2.2.2 Public Charging and Refueling Infrastructure

Through the settlement stemming from *United States v. Volkswagen Group of America et al.*, Volkswagen agreed to spend $14.9 billion as part of a settlement related to allegations of cheating federal emissions standards. Of that amount, $2 billion is being spent on national ZEV investments, and nearly $3 billion has been set aside to fund the Environmental Mitigation Trust, which is available to states and territories to invest in approved projects and programs that have the goal of reducing vehicle emissions.

States and territories must submit plans for spending the funds to the trust and receive approval. Many states have used the funding to incentivize certain types of infrastructure projects, including the deployment of EV charging stations. For example, some states have provided funding for the installation of DC fast chargers along certain highway corridors. Others have established rebate programs to spur installation of Level 2 chargers at multiunit buildings and workplaces.

As discussed earlier, the IIHA and NEVI program provides formula funding and discretionary grants to build out a nationwide DC fast charger network. Charging stations will be located no greater than every 50 miles along designated alternative fuel corridors. All 50 state Departments of Transportation, the District of Columbia, and Puerto Rico submitted NEVI plans by the August 1, 2022, deadline. All states have now received final approval and will begin implementation. The discretionary grants available under the NEVI program will help build publicly available fast chargers in communities and along other corridors.

The IRA also provides a federal tax credit for charging equipment. For individual and residential use, the credit is 30% of the total cost of the charging equipment, up to $1,000, and the commercial tax credit of 6%, up to $100,000. This credit is available through 2032.

2.3 Market-Based Incentives

Market-based incentives refer to price signals or subsidies available to EV owners provided by private companies (e.g., auto manufacturers or dealerships), electric utilities (whether investor-owned, public, or cooperatives), or a combination of economic factors that collectively create a financial advantage for consumers to purchase and/or operate an EV over a conventional gas-powered vehicle. The key distinguishing factor is that market-based incentives do not include government-provided incentives (e.g., free parking on streets) or subsidies (e.g., $7,500 EV purchase rebates, sales tax exemptions).

2.3.1 Operating Cost Incentives

Total cost of ownership (TCO) represents the complete cost of ownership during the time that the driver owns a vehicle. TCO studies show mixed results for the cost advantage of EVs relative to equivalent internal combustion engine vehicles, depending on car type, size, travel shed geography, and total miles traveled. Washington drivers can expect to save, on average, among the highest amount of any EV drivers in the nation, due to the combination of fuel cost savings and purchase incentives. However, few consumers make purchasing decisions based on such a robust TCO analysis, and instead rely heavily on the initial purchase price of the vehicle.

A DOE study from 2020 found that EV owners in Washington State experience an average savings of $14,480 over the life of their vehicles (the highest margin in the U.S.). In Hawaii, on the other end of the spectrum, EV owners can expect to spend $2,494 more over the same period of time than for a comparable gas vehicle. These cost differences are primarily because of fuel price differences. Residential electricity prices in Washington are among the nation's lowest; in Hawaii, electricity prices are among the nation's highest.

Chapter 2 of this report provides a more detailed discussion of Washington-specific TCO analyses.

2.3.2 Automaker and Dealer Incentives

Government and electric power companies provide the most incentives for purchasing an EV, not the manufacturer or local dealerships. However, there are some instances where the automaker offers a unique purchase incentive for EV buyers. For example, Chevrolet ran a promotion to pay for the equipment and installation cost for a Level 2 (medium speed, up to 240 volts) at-home charger for those purchasing a new Bolt EV or Bolt EUV.[48]

Another example of an automaker's purchase incentive: free charging. For years, Tesla offered free, unlimited supercharging on their proprietary charging network. However, the company has since pulled back and no longer includes this perk. Volkswagen offers a similar incentive: purchasers of Volkswagen ID model EVs receive 3 years of unlimited charging at any Electrify America charging station. Many automakers have followed: 15 additional manufacturers offer some level of free charging for purchasers of their vehicles, mostly at Electrify America charging stations.[49]

2.3.3 Electric Utility Incentives

Electric power companies in many areas of the U.S. offer some incentives for their customers to purchase an EV. There are several motivations for the electric industry to incentivize consumer adoption of EVs. First, electricity providers see a new, potentially enormous market to sell electricity for transportation purposes. This new opportunity can help offset current and future forecasts for declining revenue in residential and industrial markets, largely resulting from increased energy conservation measures and regulations.

Second, because EVs can be charged off-peak when electricity is more plentiful, power companies can sell their excess electricity during the evening and overnight hours. This can also help utilities that have significant renewable power generation during the night (e.g., wind and hydropower).

Third, many electric utilities do more than just sell electrons. They also offer other services related to power management. Some electric utilities maintain divisions of analysts that offer consulting services to larger (mostly commercial) customers to help them become more energy efficient in their operations. The ability to offer consulting services related to EVs is attractive to some of these electric companies.

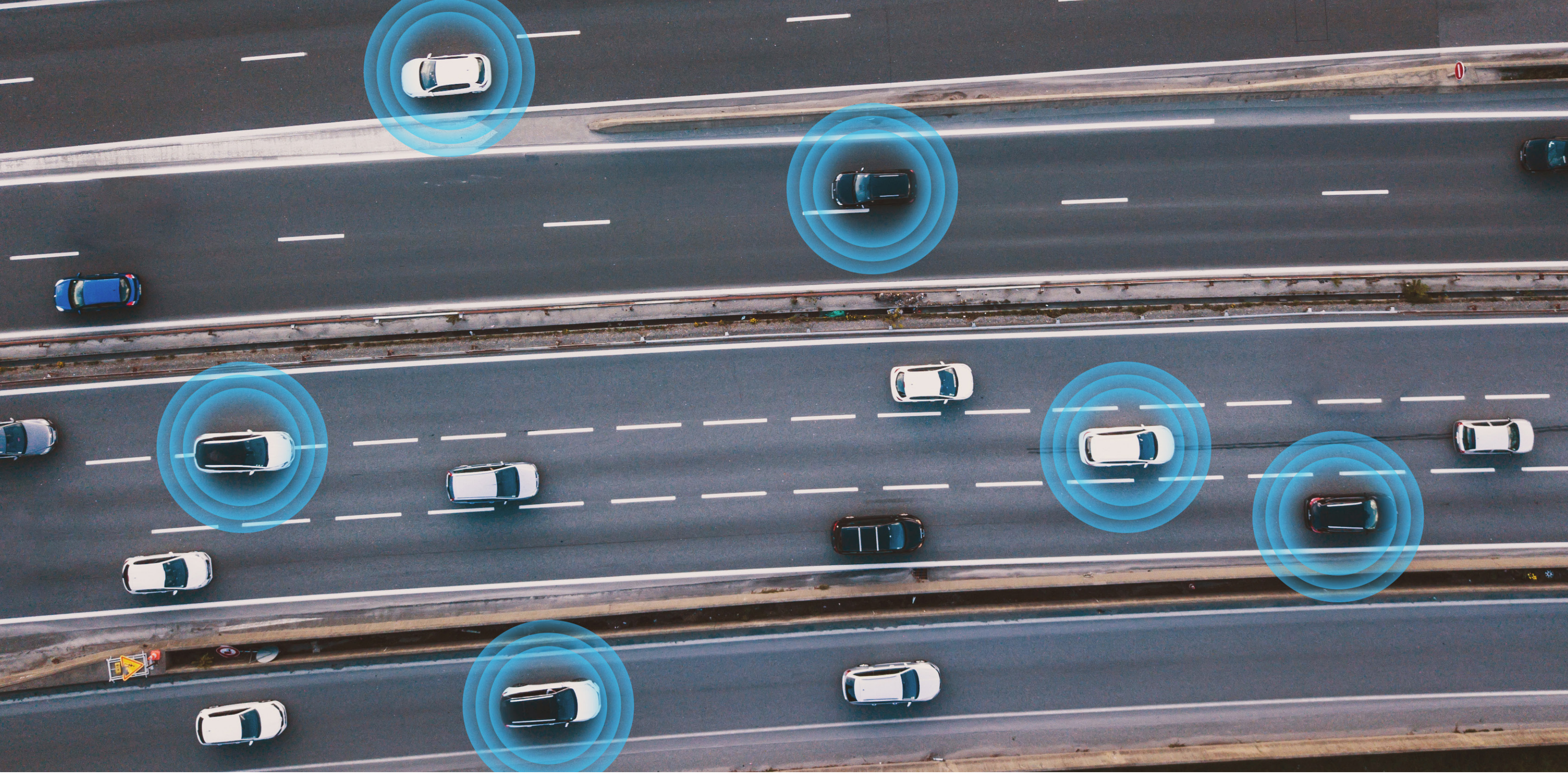
Finally, EVs represent a potentially valuable tool for grid management. They are a distributed source of power provision and storage. As advances are made in grid (V2G) technologies, there is an opportunity for electric companies and their EV customers to become "business partners" in managing electricity. If the capability exists for two-way transmission of electricity between a plugged-in EV and the power grid, then electric companies can draw power from a widely dispersed network of EVs to supplement the power supply during periods of the day where the grid is under stress. In return, EV owners might receive revenue or credits on their electric bill from their "sale" of electricity back to the power company. In this scenario, the power company benefits by having a readily accessible source of electricity in reserve, available when the grid is under stress. Having this distributed source of power lessens the need to pay for more power generation (e.g., building or expanding power generation facilities).

For these reasons, electric utilities are keenly interested in a transition to grid-enabled EVs. The incentives offered to EV owners varies greater from state to state (and community to community), but following are some notable examples of incentives:

- EV charging equipment rebates: These rebates are available to help defray the cost of the purchase and installation of chargers. These rebate programs are available for residential and commercial customers.
- Time of use (TOU) credits/rate incentives: Incentives consumer charging of EVs during off-peak or intermediate-peak hours.
- EV purchase rebates: Offered to residential customers to purchase new qualified EVs.
- EV charging equipment financing: Offers low- or no-interest loans to purchase Level 2 chargers for residential customers.
- Free EV charging equipment: Some utilities offer free Level 2 chargers to residential customers meeting certain requirements and after purchasing an EV.
- Electric vehicle supply equipment (EVSE) bill credits: Utility-offered one-time bill credit for residential customers owning an EV.
- Installation of multiunit residential chargers: Utilities in some states have begun to install charging stations at multifamily residential developments to encourage EV adoption among households who might otherwise find it difficult to charge at home.

Closer to home, utilities in Washington offer a range of specific programs that support development deployment of EV charging networks, including the following:

- Tacoma Power Utility (TPU) offers charging station rebates to residential customers, multifamily dwellings, and businesses. Residential customers are eligible for a $400 rebate, in the form of a bill credit for installation of a Level 2 charger. Multifamily dwellings and businesses located in the City of Tacoma qualify for rebates for the first two Level 2 chargers at multifamily dwellings and businesses. Businesses can apply for 60% of project costs, up to $12,000, and multifamily dwellings are eligible for 80% of project costs, up to $16,000. Rebates of up to $2,000 are available for every additional charging port installed. Infrastructure upgrade costs are eligible for rebates as well (100%, up to $25,000).
- Clark Public Utilities offers rebates to residential, commercial, and industrial customers. The rebates are available for Level 2 chargers and vary depending on charging station type. Clark Public Utilities also offers low-income residential customers a $2,000 rebate for the purchase of a used EV (purchase price may not exceed $20,000 and must be registered in Clark County).
- Snohomish Public Utility District offers residential customers a $500 rebate for purchase and installation of Level 2 chargers and a $400 account credit to go toward charging a newly purchased or leased EV.



2.4 Rate of Electric Vehicle Adoption in Washington

2.4.1 Washington Residents Enjoy Electric Vehicle Operating Cost Advantages

Washington enjoys perhaps the best economic environment for EV adoption in the U.S. While EV purchase prices do not vary significantly from state to state, two other important factors do: fuel cost savings and model availability.

The price differential between gasoline prices at the pump and residential electricity rates in Washington is widest in the U.S. The average retail price for regular gasoline in Washington was $4.63 cents in September 2022, the sixth highest (Oregon and Alaska were one and two cents higher, respectively).[50] At the same time, Washington recently posted the lowest average residential price for electricity, 10.49 cents per per kWh.[51] No other states were under 11 cents, with Utah (11.24), Idaho (11.38), Montana (11.61), and Wyoming (11.75) rounding out the top five for lowest residential electricity prices.

The obvious result of this price differential is that Washington has the most favorable EV fuel cost advantage for those buying an electric vehicle. The extent to which the fuel price advantage is leveraged depends on the fuel efficiency of the vehicles that might be purchased, and the number of miles to be traveled. Total cost of ownership of gas-powered vehicles versus the nearest EV counterpart, including Washington-based fueling costs.

On the whole, in Washington, the cost per mile to travel in an average EV (here, the Chevy Bolt) is about 3.2 cents, compared to 17.2 cents in a comparably equipped gas-powered vehicle.[52] In real dollar terms, where a driver travels 12,000 miles per year (near the Washington average), the EV saves $140 per month–or $2,058 per year▪over the similarly equipped gas-powered vehicle.

2.4.2 Electric Vehicle Availability is Higher in Washington

Another market-based incentive (or advantage) that prospective EV purchasers have in Washington is greater availability of EV models, compared to some other states. The relative lack of variety in EV models available for sale nationwide is a common obstacle cited by consumers. With production of EVs still limited and new model types like SUVs and pickup trucks just now being released in initial batches, those that are released to market are directed to dealerships in states that have the most favorable market conditions for EV adoption. “Favorable conditions” include factors such as a large population base, affluent buyers, financial incentives, public policies favoring EVs, public charging networks, and more. Adoption of California's ZEV regulations is an additional favorable factor for states.

Automakers wanting to continue to sell new vehicles in the California market must meet California’s ZEV sales thresholds. The regulations are complex and involve several calculations for determining whether the requirements are being met. Determining whether an automaker is meeting the threshold ZEV requirements includes adding up the number of qualifying vehicles that are offered for sale in all states that have adopted California’s ZEV regulations. An automaker’s ZEVs offered for sale in Oregon, for example, can be added to the automaker’s total ZEV offerings to meet the California regulations. Therefore, any EVs offered for sale in any of the 17 ZEV states can be counted toward meeting the automaker’s quota.

Before adopting the California ZEV requirement in 2020, Washington had only opted to participate in the California low-emissions vehicle (LEV) regulations program. During this period, EVs sold in Washington did not count toward an automaker’s quota for ZEV sales under the California regulatory scheme. A natural consequence of this choice was for automakers to prioritize markets located in the 10 states that had originally opted into the full California ZEV program. Illustrating this effect, the Portland, Oregon, market received an allotment of the newest EV models ahead of Seattle, even though the Seattle/greater Washington market had equal or greater advantages in many other respects.

Washington is now a full ZEV state. This helps ensure Washington car shoppers have a greater variety of EV models from which to choose.

2.4.3 Washington Electric Vehicle Adoption Rate

Washington has established goals, targets, and milestones for EV adoption in the state. Although goals are fundamentally different than a true market forecast (which projects what forecasters think will happen, rather than what policy makers want to happen), if these goals are backed with laws and effective regulations that require market conformance, ultimately, they can make EV adoption forecasts more accurate.

After more than a decade of already strong emissions standards, in November 2021, Washington State adopted California's ZEV standards, which requires a percentage of all sales to be ZEVs. At the time of its enactment, the standards would require that by 2024, 8% of light-duty vehicles meet this criterion, with the quota expanding to medium- and heavy-duty trucks starting in 2025.

The Washington Department of Ecology is currently promulgating new rules that mirror California's Advanced Clean Cars II (ACC II) regulations (that is, the California Air Resources Board rule that bans the sale of new gas-powered vehicles starting in 2035). Whether through increased consumer interest, government purchase incentives, or regulating the supply of new vehicle models, electric vehicle sales in Washington are expected to increase dramatically over the next 13 years.

Section 3: Other States and International Vehicle Policy Environment

3.1 Other States

In developing policies to encourage HCFUs to switch to EVs, it is helpful to look at how other states are encouraging EV ownership.

In the U.S., many states have implemented tax credits and rebates for EVs and charging station costs, both residential and commercial. According to the National Conference of State Legislatures (NCSL), 47 states plus the District of Columbia offer incentives and other programs to support EV and hybrid adoption. Additionally, tax credits have been offered at the federal level most recently with the enactment of the IRA.

Examples of state legislative incentives for EV and other alternative fuel vehicles include:

- Emissions Inspection Exemptions – Exempts alternative fuel vehicles, including EVs, from emissions inspections requirements.
- High-Occupancy Vehicle Lane Exemptions – Permits alternative fuel vehicles, including EVs, to use HOV planes regardless of the number passengers in the vehicle.
- EVSE Tax Exemption – These programs exempt EVs and EVSEs (i.e., EV charging equipment) from sales and use taxes.
- Alternative Fuel Vehicles Rebates/Credits – Provides rebates or tax credits to assist in purchasing or leasing new AFVs. The programs typically have limits associated with income levels and purchase prices.
- Free or Subsidized Parking – Provides access to otherwise paid and/or preferential parking at no cost or reduced cost to EVs.

Table 1: Electric Vehicle Policy Incentives and Support in Washington, Oregon, and California[54]

	Washington	Oregon	California
Tax credits/rebates for vehicle purchase	✓	✓	✓
Tax credits/rebates for evse installation	✓	✓	✓
Financing programs (low interest/interest-free)			✓
Grants for evse installation	✓		
TOU rates		✓	✓
Tax credits/rebates for purchase/lease of medium- and heavy-duty vehicles	✓		✓
Commercial tax credits/rebates for evse installation	✓		✓
Emissions inspections exemptions	✓		
Grant funding to support planning and deployment of transportation electrification projects		✓	

Operational incentives refer to public policies that have been enacted to provide some benefit to EV drivers in how they operate their vehicle. The two most common incentives are access to restricted travel lanes (such as HOV lanes or HOT lanes) and preferential parking policies.

Thirteen states have laws that allow certain types of alternative fuel vehicles to drive in HOV and HOT lanes regardless of the number of passengers. (Table 2) shows the states that provide these exemptions and details about identification methods and eligibility. Some states, like California, have an application process and eligibility requirements that consider annual gross income. New Jersey and North Carolina do not have an identification requirement, thereby allowing qualifying out-of-state vehicles to travel in the HOV lanes along with in-state vehicles.

Early adopters of these programs–Arizona, California, and Virginia–found that this incentive was an effective policy to encourage drivers to purchase hybrid-electric vehicles. The three states met planned hybrid-electric vehicle targets earlier than originally planned. In response, these states have since limited access on fewer HOV lanes, to avoid further congestion that has impaired operations of the highway facility.

Table 2: State High-Occupancy Vehicles and High-Occupancy Toll Lane Exemptions for Electric Vehicles

State	Exemption Type	Identification Method	Eligible Vehicles
Arizona	HOV Exemption	License Plate	AFV (dedicated), PEV, HEV (restrictions apply)
California	HOV and HOT Exemption	Decal	FCEV, NGV, PEV
Colorado	HOV Exemption	Decal and HOV Toll Transponder	HEV
Florida	HOV Exemption	Annual Decal	HEV, ILEV
Georgia	HOV and HOT Exemption	License Plate	HOV: AFV, HEV, PEV HOT: AFV, PEV
Hawaii	HOV Exemption	License Plate	PEV
Maryland	HOV Exemption	Decal	PEV
New Jersey	Partial HOV Exemption	None	HEV
New Jersey	10% HOT Discount	Toll Transponder Registration	Fuel economy greater than 45 mpg and meets California Ultra Low Emission Vehicle standards
New York	HOV Exemption and 10% HOT Discount	Sticker and Toll Transponder Registration	HEV, PEV
North Carolina	HOV Exemption	None	FCEV, NGV, PEV
Tennessee	HOV Exemption	Decal	ILEV, Energy-Efficient, and Low Emission Vehicles
Utah	HOV Exemption	Decal or Plate	HEV, NGV, PEV, Propane
Virginia	HOV Exemption	License Plates	AFV (dedicated), HEV (depending on road)

Source: U.S. Department of Energy Alternative Fuel Data Center, September 2022.

AFV = Alternative Fueled Vehicle **PEV =** Plug in Electric Vehicle **HEV =** Hybrid Electric Vehicle
ILEV = Inherently Low Emission Vehicle **FCEV =** Fuel Cell Electric Vehicle **NGV =** Natural Gas Vehicle

Other public incentives related to operating an EV include preferential parking, either reserved parking stalls for EVs that are located nearest the entrances to public venues or, in some cases, allowing EVs to park on public streets and metered stalls for longer periods of time and, sometimes, free of charge. Many airports have also adopted preferential parking policies that allow EVs to park free of charge.

According to the Alliance for Automotive Innovation, California has the highest percentage of EV sales for 2022 year-to-date (19%), followed the District of Columbia 14%), and Washington (11%). (Figure 22) shows the rankings for the top 12 states.

Figure 22: Top States for New Electric Vehicle Sales, January through June 2022

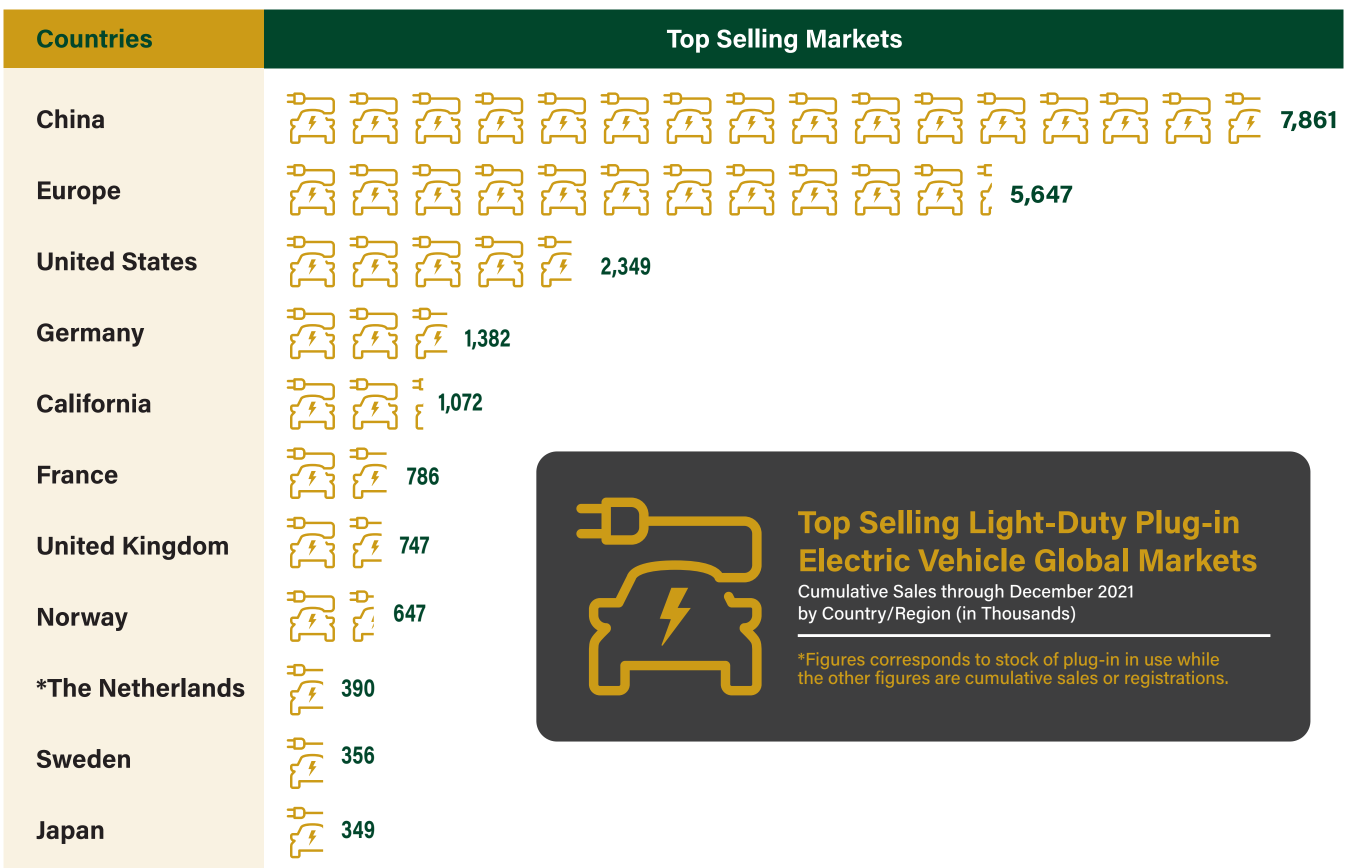
States/District	
California	18.98%
District of Columbia	13.63%
Washington	11.03%
Oregon	10.42%
Colorado	9.66%
Nevada	9.07%
New Jersey	8.20%
Massachusetts	7.73%
Maryland	7.52%
Hawaii	7.45%
Utah	7.37%
Connecticut	7.11%

3.2. International Electric Vehicle Environment

EVs are available globally. Policy initiatives designed to encourage HCFUs in Washington to convert to EVs must take into account policies in other countries that regulate the sale of electric vehicles, produce EVs outside of the United States, and compete to attract these electric vehicles to market.

Globally, China and many countries in Europe are leading the way to widespread EV adoption through a combination of public policy incentives and bans on the sale of gasoline-powered vehicles. Incentives act to nurture the EV market in advance of bans on the sale of gaslone vehicles, expected to take effect 10 or more years from now. For example, England and France both intend to ban the sale of internal combustion engine vehicles by 2040, and both maintain significant purchase price incentives, including for vehicle leaseholders (in the case of France). China offered subsidies averaging $15,000 per vehicle in 2016 to help encourage EV adoption in advance of their requirement that at least 10 percent of new car sales be electric in 2019.

Figure 23: Top Selling Light-Duty Plug-in Electric Vehicle Global Markets



Section 4: Current Electric Vehicle Adoption Goals, Forecasts, and Model Availability

This section scans the various EV adoption goals, forecasts, and sales targets used by governments to guide their supportive policy actions. Next, progress toward meeting EV adoption goals and targets are examined, as well as forecasts for future adoption. Finally, this section considers the adoption curve that must be met for automakers to meet California's recently enacted ZEV regulations known as Advanced Clean Cars II (ACC II), as well as the production of compliant models needed to meet these regulations.

4.1 Looking Ahead: Forecasting Future Electric Vehicle Adoption

In reviewing available information on forecasts for EV adoption, three caveats are important to note. First, some forecasts relied upon for policymaking are not so much forecasts of what is expected to happen, but they are rather timelines and milestones plotted along a hypothetical EV adoption curve that ends with EV adoption meeting the desired policy goal or target. These forecasts represent what must be achieved to meet ZEV or EV adoption targets over a given time horizon. This information is relevant for legislators and the executive branch as they attempt to craft public policies best able to support achievement of these EV adoption targets. However, these are not, strictly speaking, independent or market-based forecasts of what is likely to happen.

Second, like all forecasts, those projecting EV adoption are entirely dependent on varying (and sometimes contradictory) scenarios for the future, as well as subjective beliefs (or biases) in favor of faster or slower EV adoption rates. Rather than spending time "analyzing the analysts," instead this section identifies multiple forecasts that represent different perspectives on future conditions and resultant EV adoption. The forecasts noted in this section avoid those produced by advocacy groups or industry enthusiasts. Instead, the forecasts presented are sourced from national or international energy organizations, the automotive industry, sector-specific media outlets, and credible automotive market research firms.

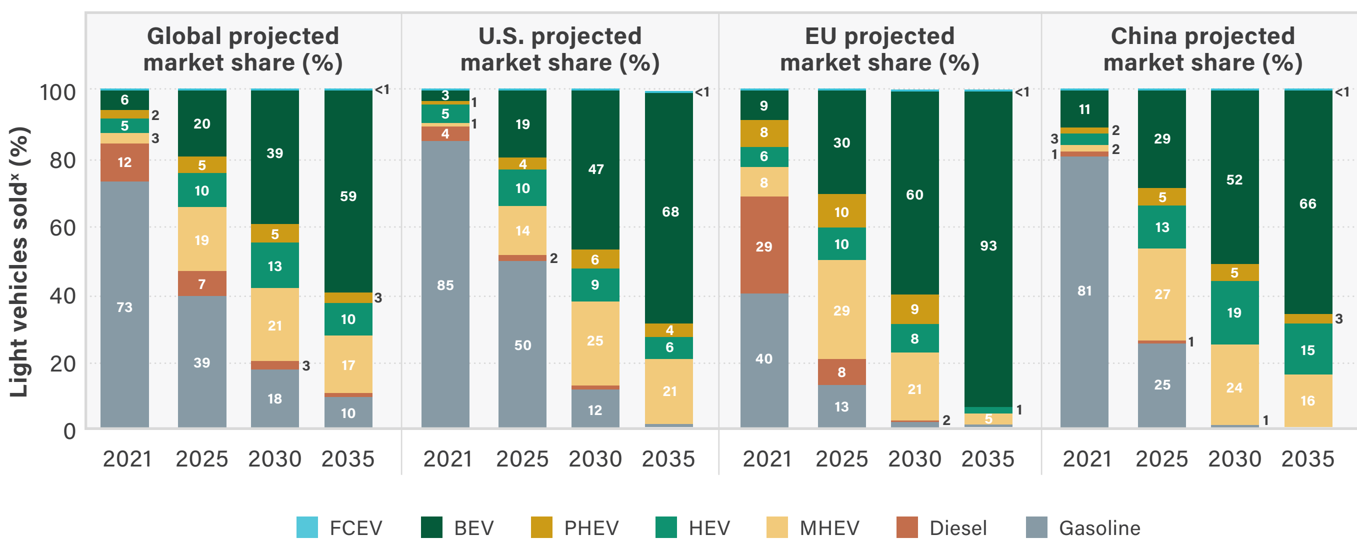
Third, certain intervening factors can have an outsized effect on the forecast, and in some instances, make forecasts themselves much less useful. For example, government mandates that require new vehicle sales to be 100% ZEV by 2025 (Norway) or 100% ZEV by 2035 (California and up to 16 other states that may soon adopt this rule) essentially render earlier EV market penetration forecasts obsolete, because the primary decision factor shifts from market demand (i.e., consumer preference) to market supply (sales of new vehicles sales limited to ZEVs only).

Considering these factors, the following two plausible scenarios for consumer adoption of EVs are presented: 1) a scan of recent forecasts for EV adoption from credible sources, notwithstanding the regulatory effects of California's ACC II regulations (mandating 100% ZEV sales by 2035) and 2) available projections of an EV adoption curve that results in achievement of 100% ZEV sales by 2035.

4.2 Global and U.S. Forecasts for Electric Vehicle Adoption

AlixPartners, an automotive research firm, projects that EV sales will reach 33% globally by 2028 and 54% by 2035.[55] EV sales accounted for less than 8% of global sales in 2021 and just under 10% in the first quarter of 2022. Boston Consulting Group (BCG) has a slightly more optimistic projection of future EV sales. As shown in Figure 15, BCG projects that, by 2035, EVs will account for 59% of global light-duty vehicle sales and 68% of U.S. light-duty vehicle sales.[56] EIA, on the other hand, has a more conservative projection of future EV sales. The EIA estimates that EVs (including BEVs and PHEVs) will reach just 8% of the vehicle stock by 2050.[57]

Figure 24: Global Sales Forecast for Battery Electric Vehicles, to 2025



Source: BCG analysis

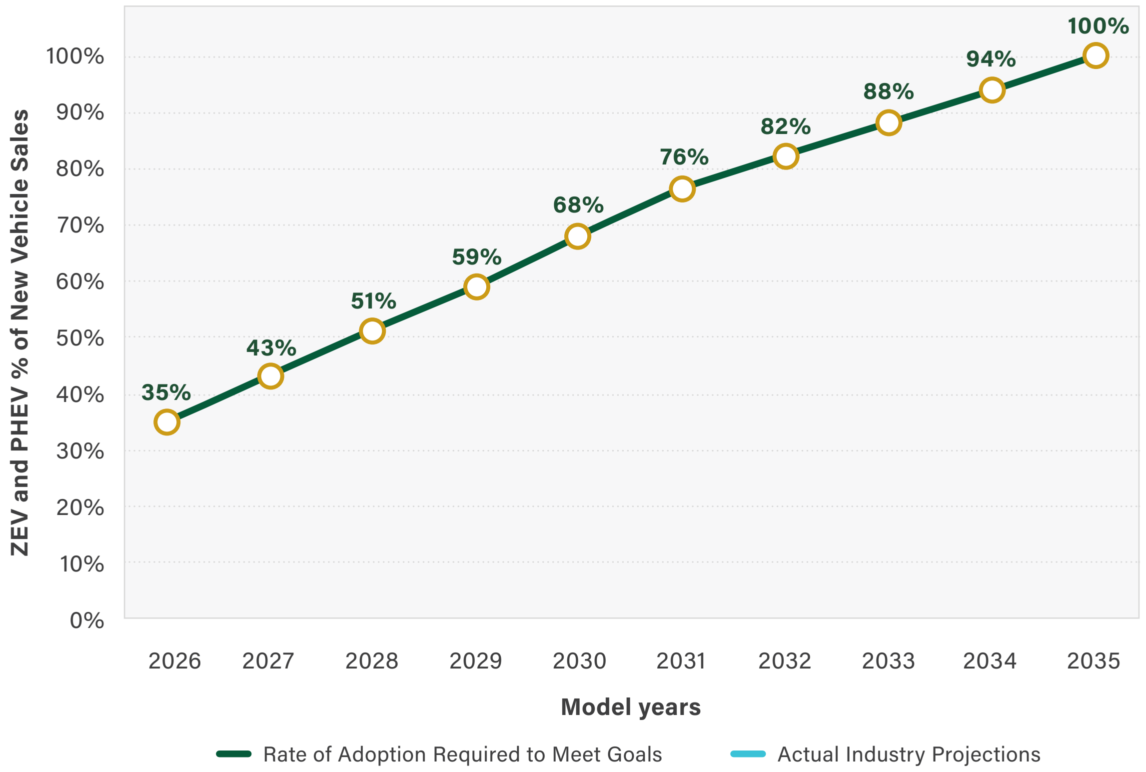
Note: FCEV = fuel cell electric; BEV = battery electric; PHEV = plug-in hybrid electric; HEV = full hybrid electric; MHEV = mild hybrid electric. Because of rounding, the percentage total for a particular year may not equal 100%.

[X]Forecast includes cars, SUVs, and all other light vehicles, except heavy vans.

As noted, forecasts for the U.S. auto market do not yet take into account the effects of California's mandate that 100% of all new light-duty vehicle sales be ZEVs by 2035, nor recently proposed federal U.S. Environmental Protection Agency (EPA) rules. For California and the other 16 states that may opt into California's new ZEV standard, the glidepath to reach this requirement by 2035 is represented in Figure 25.

The proposed federal EPA standards for new model vehicles are also projected to accelerate the transition to EVs. Depending on the compliance pathways manufacturers select to meet the standards, EPA projects that EVs could account for 67% of new light-duty vehicle sales and 46% of new medium-duty vehicle sales in Model Year 2032.

Figure 25: Projected Adoption of Electric Vehicles in California to Comply with 2035 100 Percent Zero-Emission Vehicles Mandate



Source: California Air Resources Board, 2022

Summary and Key Takeaways

Effective policy incentives encouraging HCFUs to switch to EVs require an adequate supply of EVs available for purchase. While there's adequate supply of certain models of EVs, for some of the most sought-after body types, delivery has been delayed. Current analysis predicts that supply constraints on EVs will ease sometime in late 2023 or 2024.[58]

According to the latest Ernst & Young (EY) Mobility Consumer Index (MCI), the number of consumers looking to buy EVs globally has hit 52%. BloombergNEF's findings are consistent with the EY study, as BloombergNEF asserts that EV adoption is set to continue to rise sharply to 2025 as global policy pressure grows, more electric car models become available, and consumer interest increases. For example, the reduction in Tesla's dominance in the EV market is another sign that EV adoption is gaining momentum, because other car manufacturers are making similar models.

The future looks bright for EVs, but there are warning signals coming from the EV battery crisis, their chain, and limited access to critical minerals, as well as increased bulk materials pricing, macroeconomic factors, and lack of federal policies to promote promote research and development and manufacturing. An adequate supply chain for lithium-ion batteries—the single most important component in the EV—simply doesn't exist. The unprecedented battery metal price increases have been caused not only by surging battery demand, but also by increased pressure on supply chains and concerns around tightening supply. The supply constraints have been driven by three trends: production challenges caused by the pandemic; concerns around high-grade nickel supply from Russia; and structural underinvestment in new supply capacity during the three years preceding 2021 when metal prices were low. While some of automotive companies are making an effort to step up their own supply chain, Congress must implement a strategy to stimulate domestic battery production, including cost-effective and environmentally safe mining of critical minerals here in the U.S. However, despite all barriers, latest data for April 4, 2023, show that waiting times for EVs currently is at an average of 24 weeks, down by 13% (from 28 weeks) since the same time in December, and 26% (35 weeks) from the peak in October 2022.

To meet the rising EV demand, the IIJA included the NEVI program to support the build-out of a nationwide DC fast charging network along highways designated as alternative fuel corridors by the Federal Highway Administration (FHWA). This charging network will allow EV drivers to make cross-country trips without worrying about where to find the next charging station. Additional funding is available through NEVI discretionary grants to support installation of EV chargers in communities and along other corridors. State governments and utilities have also created incentives and policies to help expand EV adoption, including tax credits for EV purchases and rebates for charger installation. Additionally, the IRA, enacted in August 2022, further supports transportation electrification through tax credits for new and used EV purchases, and through rebates available to businesses and residences that install charging infrastructure.

The California Air Resources Board (CARB) recently voted unanimously to ban the sales of new gas-powered vehicles beginning in 2035. This new rule may be adopted by up to 16 other “Section 177” states that together comprise approximately 40% of the U.S. auto market. Each state will have to initiate a process to adopt this rule, but some, including Washington, have already adopted similar laws.

The Biden administration believes that recent policies and guidance along with sections of IIJA and IRA will incentivize EV supply equipment manufacturers to locate production facilities in the U.S. Increasing costs and supply-chain constraints associated with increased demand of necessary EV components, including batteries, continue to be monitored. However, the cost competitiveness of EVs remains constant thanks to the comparative affordability of electricity as a motor fuel, avoiding the higher prices of fossil fuels. Other inflationary factors including the war in Ukraine and its impact on costs of nickel make it difficult to assess long-term effects and costs related to EV manufacturing.

Perhaps the most significant question remaining is how to effectively deploy resources to support the Washington vehicle fleet’s transition to EVs by 2035 (following California). Assuming the ban on sales of new gasoline vehicles by 2035 remains in effect, the question is no longer whether the state will transition to EVs; the question is how policymakers can best support this transition.

CHAPTER 2

High-Consumption Fuel Users: Ability to Transition to Electric Vehicles and Potential Impacts

Section 2: High-Consumption Fuel Users: Ability to Transition to Electric Vehicles and Potential Impacts

In commissioning this study, the Washington State Legislature included the following specific questions:

- Which high-consumption fuel users (HCFUs) can switch to electric vehicles (EVs) for a high percentage of their driving needs?
- How much money can HCFUs save by switching to EVs?
- How many gallons of fuel can be displaced by HCFUs switching to EVs?

This chapter identifies and examines characteristics of HCFUs, including answering the specific questions posed above.

2.1 Defining and Identifying High-Consumption Fuel Users

A disproportionate amount of the total fossil fuel burned is consumed by a relatively small percentage of vehicles. A 2021 analysis of vehicle miles traveled (VMT) and vehicle attribute (year, make, model, fuel economy) data provided by the 2017 National Household Travel Survey (NHTS) estimated 10% of vehicles burn 32% of total fuel consumed—more than the bottom 60% of vehicles combined. These "superuser" drivers use more than 1,000 gallons of gasoline per year. They drive three times more miles than average and are more likely to do so in lower-mileage pickup trucks and sport utility vehicles (SUVs).

Using the Washington Department of Licensing's (DOL) vehicle registry and private data sources, this report identifies the prevalence of HCFUs in Washington and categorizes them by geography and vehicle type to identify driver profiles and market segments where an EV may be an adequate substitute for a comparatively less fuel-efficient vehicle.

The vehicle data used in this report contains individual vehicle-level VMT estimates and vehicle attribute data (year, make, model, fuel economy) for 99% of the vehicle fleet in Washington as of February 2023. Data come from thousands of sources, including state and local government records and other industry sources.

Previous research efforts have relied on data from the 2017 National Household Travel Survey. The 2017 NHTS includes a national sample of 129,179 households, 27,621 of which are in the Pacific Region, which includes Washington as well as California, Oregon, Alaska, and Hawaii.[1]

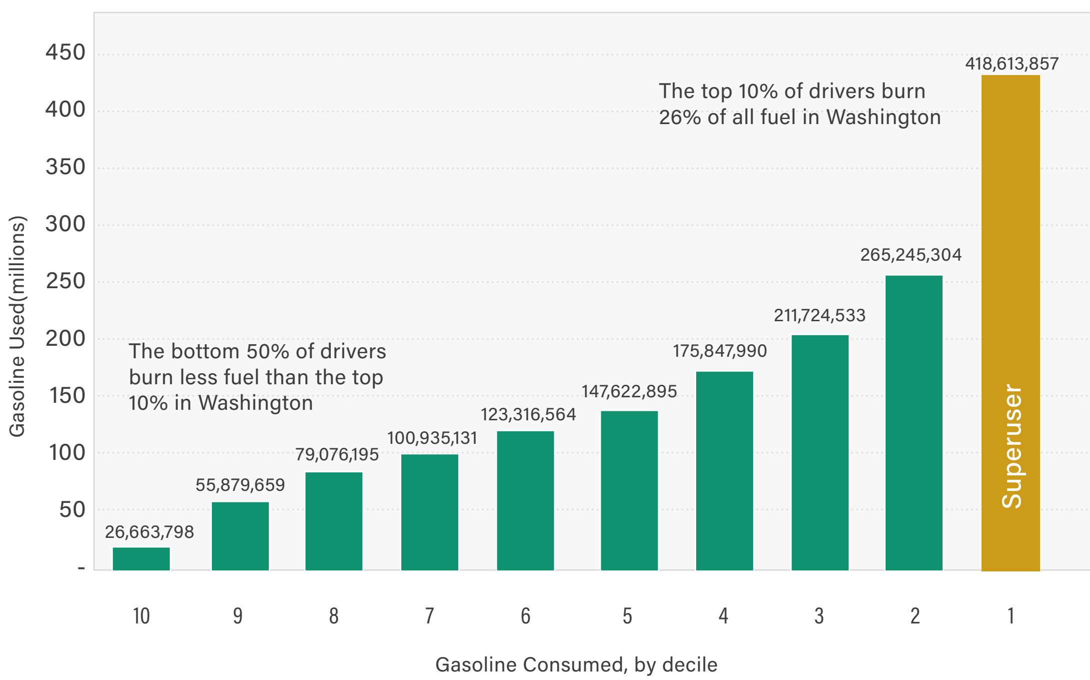
In contrast, this analysis uses a more robust data set of Washington-specific vehicle data (including year, make, model, body style, VMT, and fuel economy), covering more than 99% of the Washington vehicle fleet.

While the broader trends in the VMT, fuel consumption, and vehicle types of HCFU are similar in both this analysis and prior work, differences in specific findings may be attributed to the data sources used.

Data revealed that, collectively, the top 10% of Washington drivers in terms of fuel consumption use more gasoline and diesel (419 million gallons or 26% of all fuel consumed in Washington) than the bottom 50% of Washington drivers (386 million gallons or 24% of all fuel consumed) (Figure 26).

What constitutes the top 10% of fuel burners (the threshold defined in the 2021 analysis of superusers nationally) could be somewhat of a moving target, however, because average VMT, vehicle types, and vehicle fuel efficiency changes over time. In this report, HCFU vehicles are defined at a specific

Figure 26: Fuel Consumption among Washington Drivers by Decile



threshold—vehicles that burn 1,000 gallons of fuel or more per year—to help policymakers target a specific subset of vehicle owners to incentivize the switch from an internal combustion engine (ICE) vehicle to an EV.

Table 3: Washington Vehicle Fleet Attributes by Region

Region	Vehicles	Mean Annual VMT	Mean MPG	Mean Vehicle Age	Median Vehicle Age
Central Puget Sound	3,544,6429	9,602	24.6	13.9	11
Central Washington	973,091	10,718	21.4	16.5	15
Eastern Washington	669,208	9,953	21.5	16.6	14
Northwest Washington	601,458	9,903	22.6	16.8	15
Southwest Washington	1,153,341	10,611	22.9	15.7	13
Washington	**6,941,727**	**9,992**	**23.4**	**15.1**	**12**

2.2 Prevalence of High-Consumption Fuel Users in Washington State

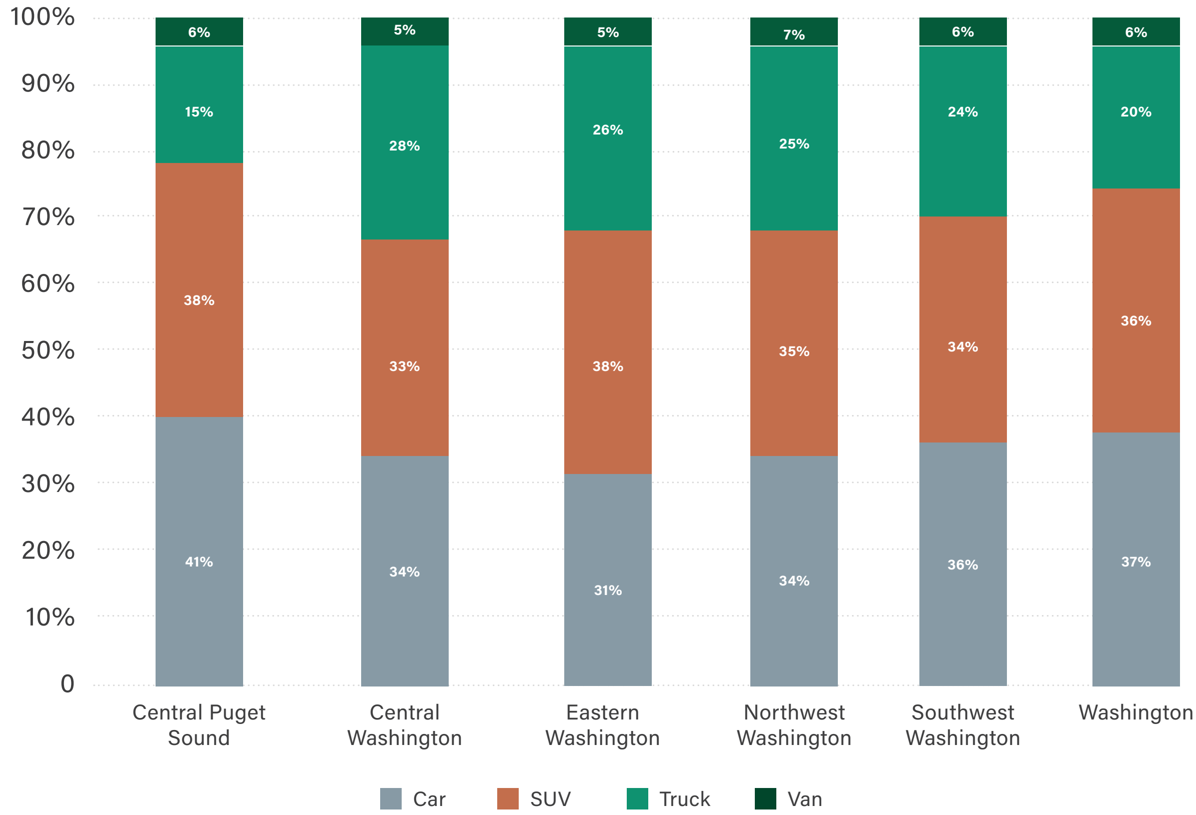
2.2.1 Washington Vehicle Fleet Characteristics

As of December 2022, there were nearly 7 million vehicles in the Washington DOL vehicle registry. The typical Washington vehicle accrues 9,992 miles annually and achieves a U.S. Environmental Protection Agency (EPA) fuel economy rating of 23.4 miles per gallon (mpg) (Table 3).

Drivers in the Central Puget Sound region tend to drive newer and slightly more fuel-efficient vehicles than the statewide average. They also accrue less annual VMT than the statewide average, likely because of the higher density urban characteristic of the region. Central Washington drivers, on average, drive the least fuel-efficient vehicles and accrue the highest annual VMT of any region in the state.

Outside the Central Puget Sound, which has a higher number of cars and SUVs but fewer pickup trucks than the state average, there is little variation in vehicle type region to region. Eastern Washington has the most non-car vehicle types of any region in the state. Combined, 69% of the regional vehicle fleet comprise pickups, SUVs, and vans.

Figure 27: Vehicle type by Region



2.2.2 High-Consumption Fuel Users by Region

Statewide, there are 434,270 vehicles driven by HCFUs (6.3% of the Washington vehicle fleet). The Central Puget Sound region has the highest quantity of HCFUs because it is the most populous region of the state and home to more than half of all registered vehicles. However, Eastern and Central Washington have the highest concentration of HCFUs (Table 4).

Table 4: Washington High-Consumption Fuel Users by Region

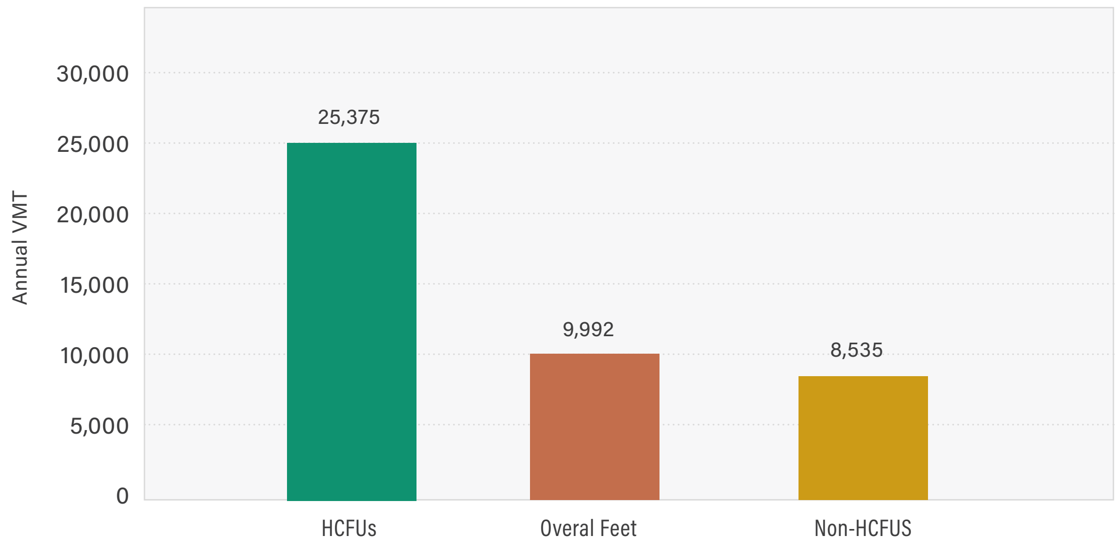
Region	Vehicles	HCFUs	Percentage of Regional Fleet that is HCFU	Percentage of Total HCFUs	Average Annual VMT	Mean MPG
Central Puget Sound	3,544,629	174,589	4.9%	40.2%	25,672	19.4
Central Washington	973,091	85,646	8.8%	19.8%	25,341	18.7
Eastern Washington	669,208	48,499	7.2%	11.1%	24,822	18.5
Northwest Washington	601,458	39,875	6.6%	9.1%	24,768	18.7
Southwest Washington	1,153,341	85,662	7.4%	19.8%	25,371	19.1
Washington	**6,941,727**	**434,270**	**6.3%**	**100%**	**25,375**	**19.1**

HCFU vehicles are defined as vehicles that burn 1,000 gallons of fuel or more per year.

HCFUs, on average, drive two and a half times as many miles each year than the average Washington driver fleet-wide, and three times as many miles each year than non-HCFUs.

HCFUs in the Central Puget Sound region have a higher annual average VMT than HCFUs in other regions of the state. Since HCFUs in the Central Puget Sound region have a higher average MPG than HCFUs in other regions of the state, more annual mileage is required to hit the 1,000-gallon HCFU threshold. Conversely, HCFUs in Eastern and Northwest Washington average 850 to 900 fewer annual miles than HCFUs in Central Puget Sound, but average 0.7 to 0.9 fewer miles per gallon.

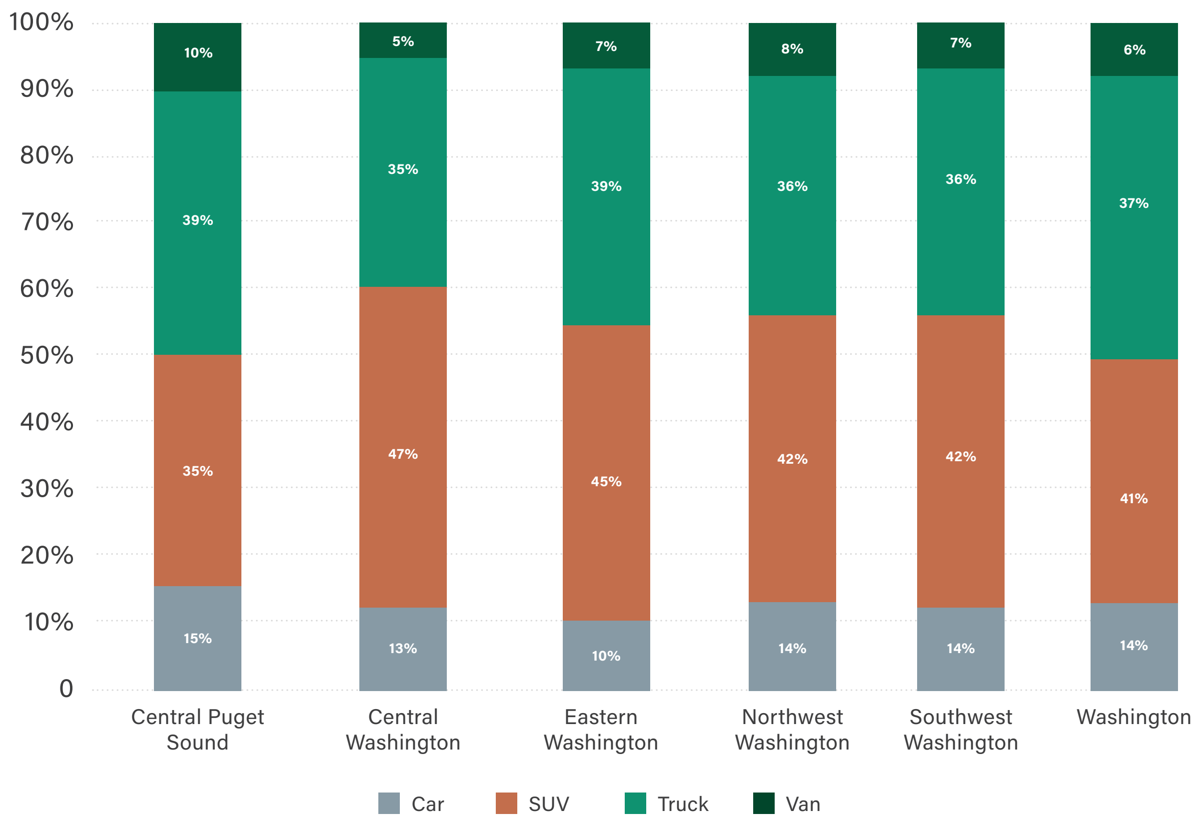
Figure 28: Annual VMT of Washington HCFUs, Overall Fleet, and Non-HCFUs



2.2.3 High-Consumption Fuel Users by Vehicle Type

HCFUs tend to driver larger, less fuel-efficient vehicles than the rest of the vehicle fleet. While SUVs are both common among HCFUs and the overall Washington vehicle fleet, there are significantly more pickup trucks driven by HCFUs. Combined, 78% of HCFU vehicles comprise trucks and SUVs, while vans make up another 8%. Only 15% of superusers drive cars (sedans, coupes, etc.).

Figure 29: HCFU Vehicle Types by Region



2.2.3.1 Most Common High-Consumption Fuel Users Vehicle Models

The Ford F-150 has been the best-selling truck in the U.S. for 46 straight years, and the best-selling vehicle overall for 41 of those years. Because pickup trucks also get relatively poor fuel economy, it is no surprise that most Washington HCFUs drive it. Statewide, 8.2% of all HCFUs drive F-150s, and nearly 17% of all F-150 drivers are HCFUs. Of the top 10 most common HCFU vehicle models, seven are pickup trucks. SUVs like the Toyota 4Runner, Jeep Grand Cherokee, and Chevrolet Tahoe also rank among the most common HCFU models (Table 5).

Table 5: Washington High-Consumption Fuel Users by Model Type

Make	Model	Percentage of HCFUs Driving Models	Percentage of Model Drivers that are HCFUs
Ford	F-150	8.2%	16.9%
Chevrolet	Silverado	7.8%	17.7%
Dodge/Ram	Ram/1500	6.6%	17.8%
Toyota	Tundra	3.5%	17.8%
Toyota	Tacoma	3.3%	9.6%
GMC	Sierra	3.2%	17.5%
Toyota	4Runner	2.6%	12.9%
Ford	F-250	2.5%	15.8%
Jeep	Grand Cherokee	1.8%	11.5%
Chevrolet	Tahoe	1.7%	15.7%

2.3 Market Segments and Profiles of High-Consumption Fuel Users

From the Washington-specific, detailed data on the prevalence of HCFU vehicles provided in Section 2.2, this section examines factors specific to HCFUs' ability to transition to EVs. To aid this examination, Washington HCFUs are first divided into relevant market segments based on why they drive vehicles that burn so much fuel. Greater insights into how different types of HCFUs use their vehicles allows better assessments of the suitability of whether (or which) EVs will meet their needs.

2.2.3.1 Most Common High-Consumption Fuel Users Vehicle Models

Assessing functional requirements of HCFUs involves examination of the reason for their high consumption. Determining causation requires an examination of both proximate causes and ultimate cause.

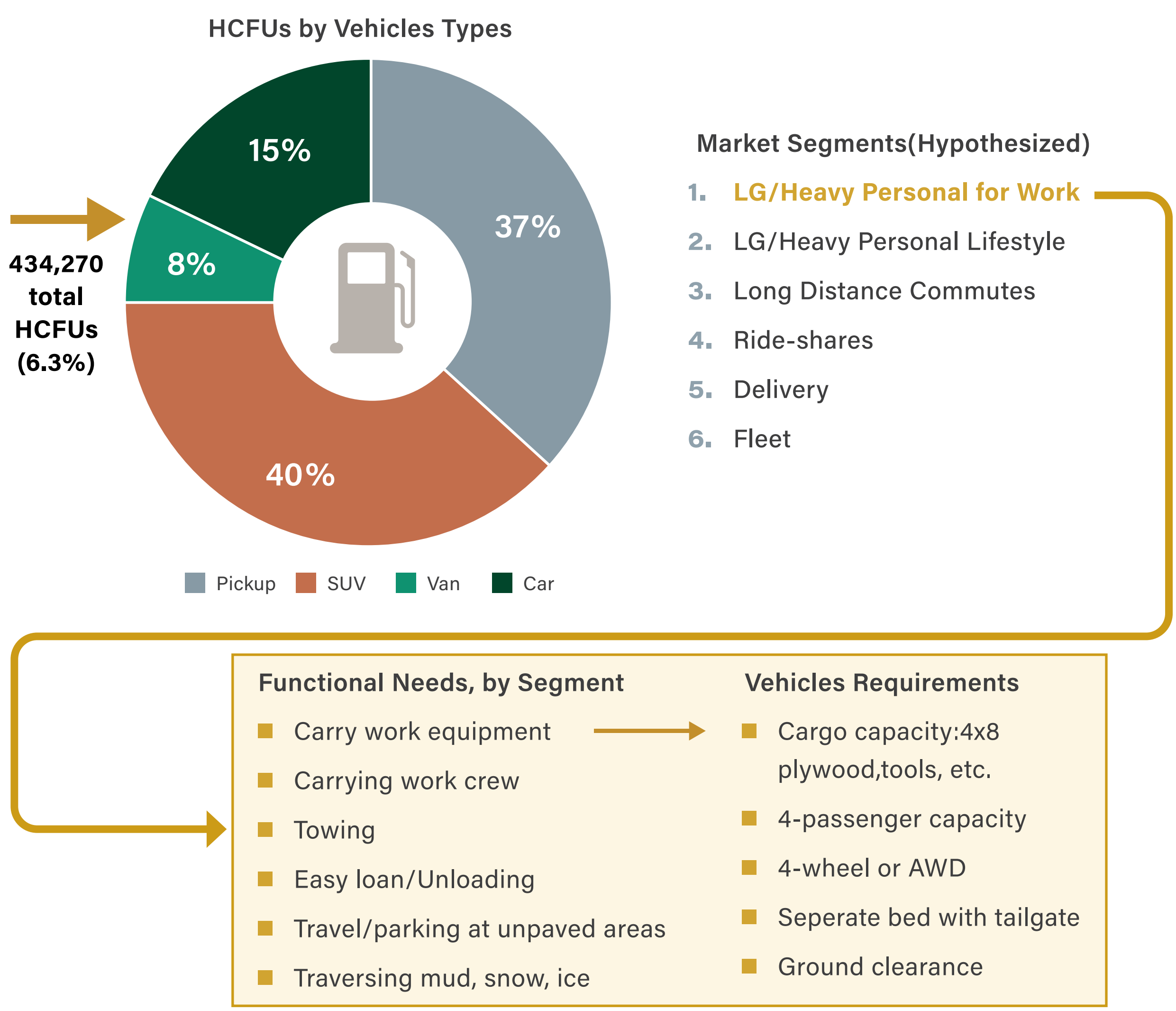
Proximate Cause: Two broad categories objectively explaining high fuel consumption are vehicle characteristics and vehicle usage.

- Vehicle characteristics include engine type, vehicle weight (both laden and unladen), powertrain requirements (for providing off-road or poor-weather traction), and engine fuel economy (measured in MPG).
- Vehicle usage is simply measured in total miles traveled, but it also must account for daily commute patterns, number of in-service hours (for vehicles used for transporting goods or passengers), number of drivers (for shared vehicles in a fleet), terrain, and elevation—all usage factors that will impact fuel consumption.

Ultimate Cause: To design effective policies to encourage HCFUs to transition to EVs, more than just proximate causes of high fuel consumption must be considered. Ultimate causes of high fuel consumption—that is, why drivers want or need vehicles with these characteristics and why the vehicles are driven in a certain manner—must be considered. By capturing these insights, relevant market segments of HCFUs can then be devised.

Assessing the more objective, functional requirements of a vehicle driver is more straightforward than evaluating other, more subjective (and qualitatively measured) motivations that influence an HCFU's vehicle choice, such as preferred vehicle styling. Based on data collected and described in Section 2.2, Figure 30 illustrates how vehicle characteristics and use cases of HCFUs were organized into market segments or profiles. The purpose of organizing HCFUs into these market segments is to better identify EVs capable of meeting these drivers' functional needs, and thereafter, probing what information, messages, or incentives might be persuasive in transitioning them to EVs.

Figure 30: Functional Requirements Assessment Approach

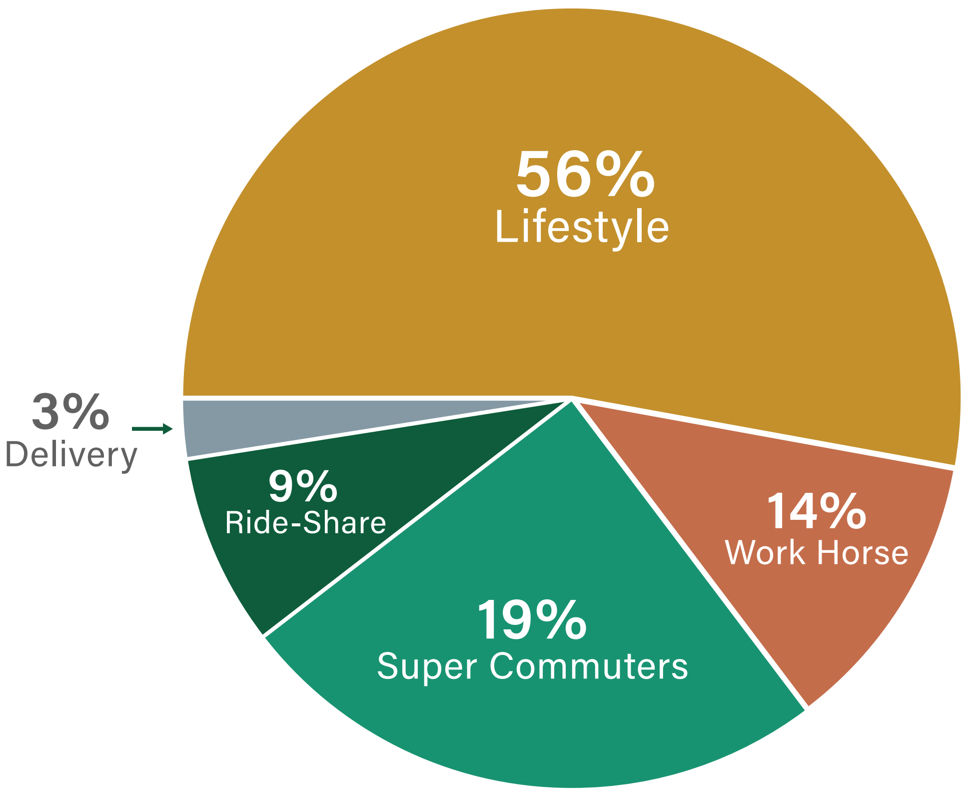


Simple catchphrases (profiles) have been given to each market segment to quickly convey the general vehicle types and uses, recognizing that not all situations will fall neatly into one of these profiles:

- Work Horses
- Lifestyle
- Super-Commuters
- Ride-Sharers
- Delivery
- Fleets

Following are six market segments profiled in more detail.

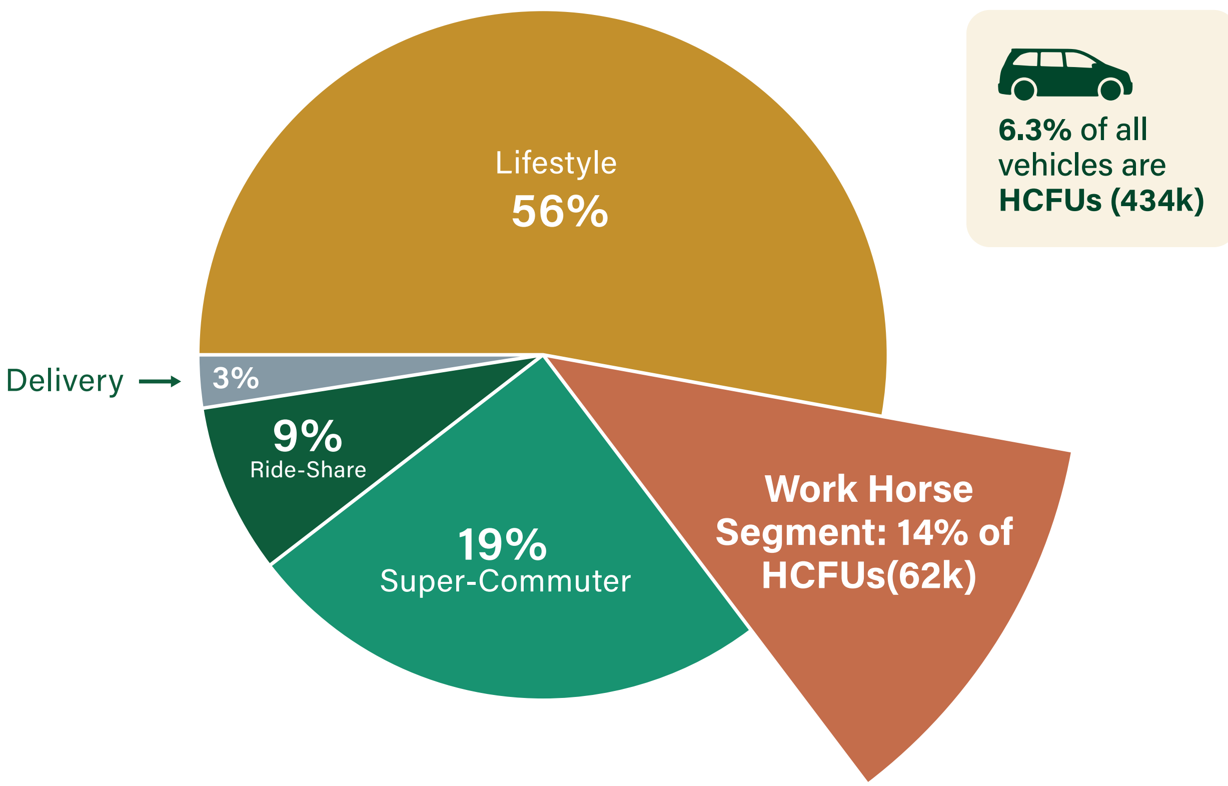
Figure 31: HCFU market segments



2.3.2 Market Segment: Work Horses

General description

This market segment includes drivers with larger/heavier personal vehicles that serve a wide range of functional needs, particularly to travel to work sites where roadway conditions could make access difficult. Capacity to carry tools, materials, tow equipment or work trailers, and transport coworkers is important. When not being used for work, these vehicles may help meet personal transportation needs.



Functional Requirements

- Carrying materials and equipment for work
- Traveling to or parking at unpaved areas
- Carrying coworkers or a work crew
- Easy loading, unloading, dumping
- Traversing mud, ice, snow
- Towing capability at steeper grades

Resulting Vehicle Specifications

- Cargo capacity: 4- by 8-inch plywood, tools, equipment, materials, etc.
- Higher ground clearance
- Four-passenger capacity
- Separate bed with tailgate
- Four-wheel or all-wheel drive; traction tires
- Above-average horsepower

After examining the functional requirements of Work Horses, it is obvious that only pickup trucks are capable of fulfilling the vehicle specifications.

The data analysis highlighted in Figure 29 shows that pickup trucks represent the largest share of HCFUs, by vehicle type, at 41%; that is, about 178,000 pickup trucks in Washington burn more than 1,000 gallons of fuel per year. Not all drivers who drive pickup trucks fit the Work Horse profile (i.e., the primary reason for owning a pickup is to support their worksite needs); a greater number of HCFU pickup drivers likely fit the Lifestyle profile. To analyze the potential market for Work Horses, it's assumed that 35% of HCFUs who drive pickups fit this profile, resulting in a raw number of about 62,000 vehicles.

Table 6: Common Internal Combustion Engine Vehicles that Meet the Work Horse Profile

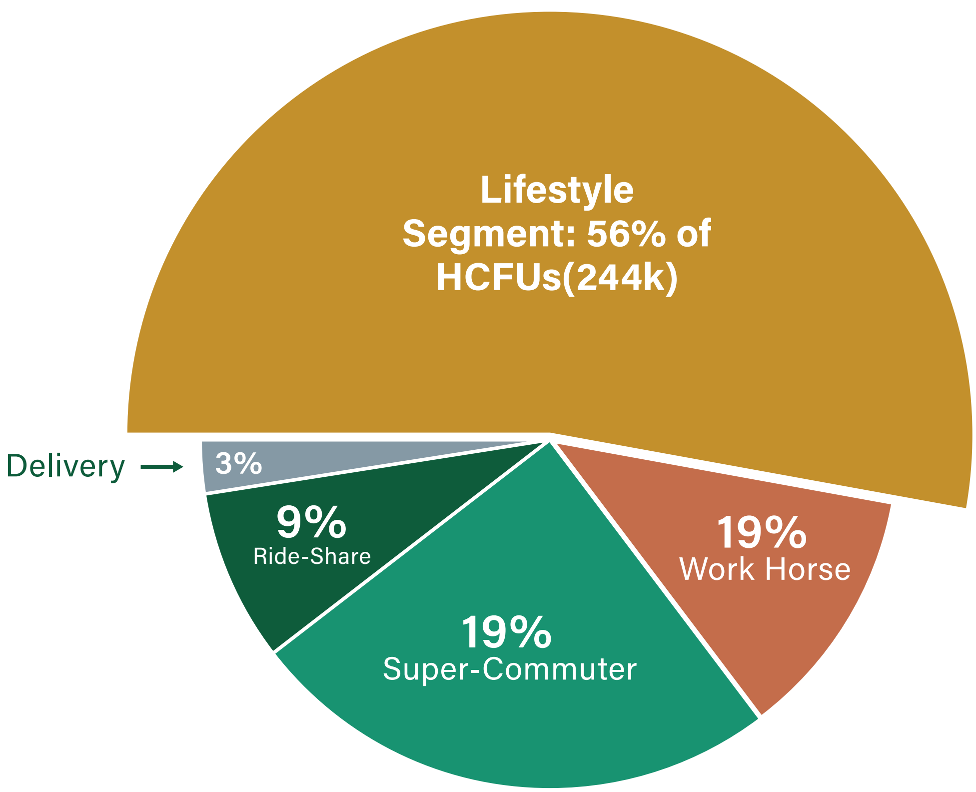
Make	Model	WA HCFUs Driving Make/Model (nearest 100)	Estimated Percentage of HCFU Fitting Work Horse Profile	Estimated # of HCFUs in Work Horse Profile (nearest 100)
Ford	F-150	8.2% (35,600)	35%	12,500
Chevrolet	Silverado	7.8% (33,900)	35%	11,900
Dodge	Ram	6.6% (28,700)	35%	10,000
Toyota	Tundra	3.5% (15,200)	35%	5,300
Toyota	Tacoma	3.3% (14,300)	35%	5,000
GMC	Sierra	3.2% (13,900)	35%	4,900
Ford	F-250	2.5% (10,900)	35%	3,800
Other	Other Pickups	5.9% (25,600)	35%	9,000
TOTAL		**41% (178,000)**	**14%**	**62,400**

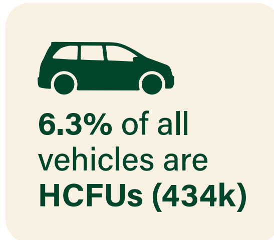
N = 434,270 HCFUs in Washington (1,000 or more gallons of fuel consumed per year), 2023.

2.3.3 Market Segment: Lifestyle

General description

This market segment includes drivers with larger/heavier personal "lifestyle" vehicles that, in addition to providing everyday transportation, also support leisure activities. These vehicles are used to tow boats, campers, trailers, and other recreational equipment; travel off-road; and support other leisure activities, such as winter sports. These activities require greater horsepower engines and often four-wheel or all-wheel drive capability. Vehicle aesthetics may be an important factor for this market segment (e.g., classic "muscle" cars, rugged styling such as jeeps, etc.).





Functional Requirements

- Towing capacity for heavier loads
- Traveling to or parking at unpaved areas
- Traversing mud, ice, snow
- Crossing mountain passes

Resulting Vehicle Specifications

- Tow hitches and 3,500+ pound (lb) towing capacity
- Higher ground clearance
- Traction tires, four-wheel or all-wheel drive preference
- Above-average horsepower

Without deep consumer research into style preferences and image projection, it is difficult to know the number and type of vehicles HCFUs choose for these reasons. Although, it is likely that a certain percentage of HCFUs drive pickup trucks, SUVs, and certain cars for aesthetic reasons. In analyzing this market segment, the focus is strictly on these vehicles' functional characteristics.

The second largest category of HCFU vehicles in Washington are SUVs, which includes crossover SUVs (that is, SUVs that are built on a passenger car platform rather than a truck platform). SUVs are driven by 37% of all HCFUs in the state, equating to about 161,000 vehicles. SUVs are prime candidates for inclusion in the Lifestyle market segment because, like pickup trucks, most SUVs can meet the functional requirements detailed above. The estimated percentage of SUVs falling under the Lifestyle profile is 85%, with the remaining 15% allocated to Super-Commuters (10%) and Delivery or Fleet vehicles (5%).

Overall, pickup trucks exclipse SUVs in terms of highest HCFU ownership, with 41% of all HCFUs driving them. However, many HCFUs' pickups are used more as a work-supportive vehicle (Section 2.3.2). To reflect these distinctions, the HCFUs' pickup trucks are split between Work Horse (35%) and Lifestyle (60%) profiles, with the remaining 5% of HCFU pickups assumed to be scattered between the Delivery and Fleet profiles.

Certain performance cars probably fit the Lifestyle profile—classic muscle cars, roadsters, etc. However, even with below-average fuel economy, these types of vehicles are rarely driven the requisite number of miles required to meet the 1,000-gallon fuel consumed threshold of an HCFU. As a result, these models do not appear in the list of top vehicle models driven by users in this market segment.

Table 7: Common Internal Combustion Engine Vehicles that Meet the Lifestyle Profile

This profile includes primarily SUVs and pickup trucks, with SUVs being predominant. The most commonly driven vehicle makes and models within the Lifestyle segment are as follows:

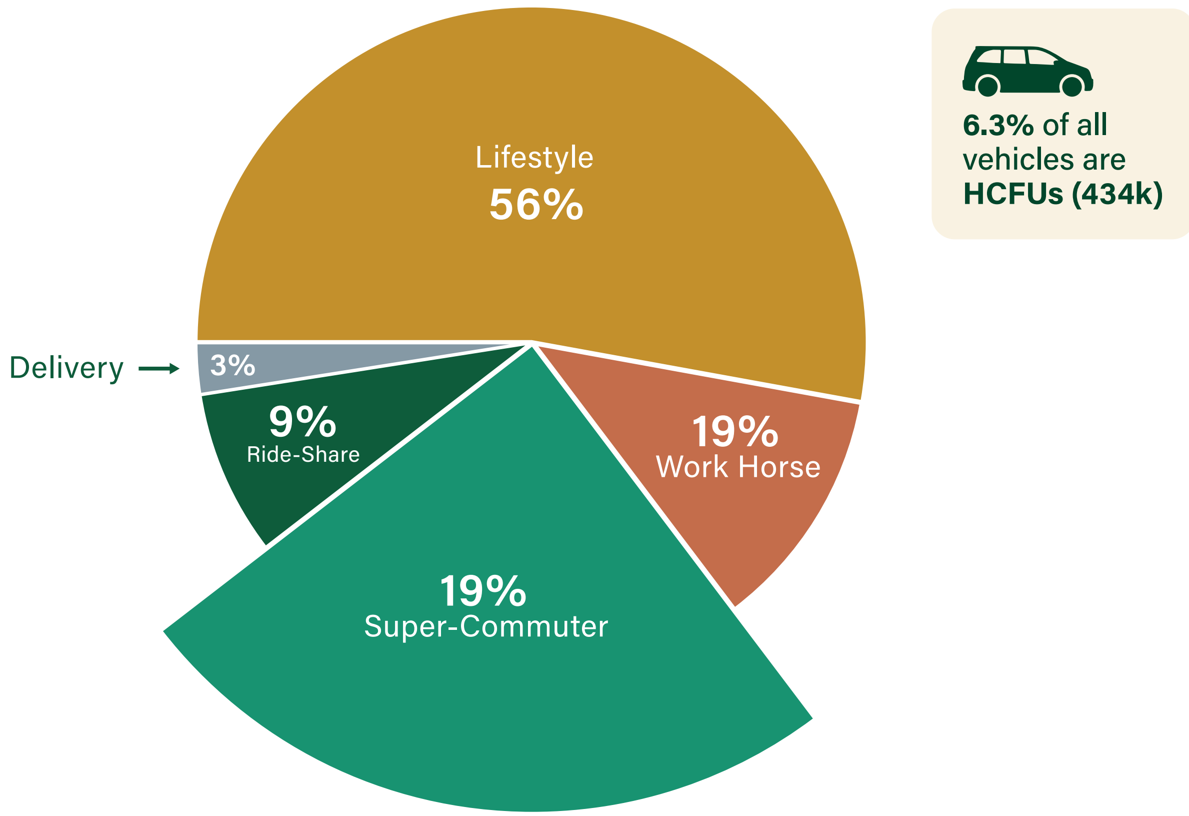
Make	Model	WA HCFUs Driving Make/Model	Estimated Percentage of HCFU Fitting Lifestyle Profile	Estimated # of HCFUs in Lifestyle Profile
Ford	F-150	8.2% (35,600)	60%	21,400
Chevrolet	Silverado	7.8% (33,900)	60%	20,300
Dodge	Ram	6.6% (28,700)	60%	17,200
Toyota	Tundra	3.5% (15,200)	60%	9,100
Toyota	Tacoma	3.3% (14,300)	60%	8,600
GMC	Sierra	3.2% (13,900)	60%	8,400
Ford	F-250	2.5% (10,900)	60%	6,500
Toyota	4Runner	2.6% (11,300)	85%	9,600
Jeep	Grand Cherokee	1.8% (7,800)	85%	6,600
Ford	Explorer	1.7%% (7,400)	85%	6,300
Chevrolet	Tahoe	1.7% (7,400)	85%	6,300
Chevrolet	Suburban	1.5% (6,500)	85%	5,500
Other	Other Pickups	5.9% (25,600)	60%	15,400
Other	Other SUVs	27.7% (120,300)	85%	102,300
TOTAL			**56%**	**243,500**

N= 434,270 HCFUs in Washington (1,000 or more gallons of fuel consumed per year), 2023.

2.3.4 Market Segment: Super-Commuters

General description

This market segment includes drivers who use their vehicles for regular, high-mileage driving, either to/from a workplace or within a large geographic region (e.g., people who cover a "territory" for their work). While their vehicle fuel economy might be better than average, the sheer number of miles traveled in a year (e.g., more than 25,000 miles) might result in high fuel usage of 1,000 gallons or more per year.



Functional Requirements

- Reliable longer-distance travel
- Cost-effective transportation, including purchase cost, fuel, maintenance, and repair
- Vehicle longevity
- Interior comfort

Resulting Vehicle Specifications

- Reliability
- Driving range (travel distance on a full tank)
- Affordable ownership costs
- Low operating costs (including fuel)
- Track record for vehicle longevity
- In-vehicle infotainment, other comfort features

As a broad category, passenger cars represent 14% of all HCFUs in Washington. From a functional perspective, almost any vehicle model could be used as a high-mileage driving vehicle; no special performance, configuration, or equipment specifications are required. However, since Super-Commuters are likely to be cost-conscious, including fueling costs, it is more likely that they drive mid- or compact-size passenger cars. It is less likely that they would drive pickup trucks or heavier SUVs that typically have below-average fuel economy, even though 78% of all HCFUs in Washington drive those vehicles from those two categories.

Although pickup trucks are not represented in the Super-Commuter profile, it is reasonable to assume some representation from SUVs, particularly "crossover" sport utility vehicles. Crossovers are smaller SUVs that resemble the styling of a larger, traditional SUV, but are built on a car chassis, offering a smoother ride and better fuel economy. Most of the HCFUs (85%) who drive SUVs are assumed to fit the Lifestyle profile as a result of the functional requirements assessment. However, because Super-Commuters use these vehicles for long-distance commuting (not just for "lifestyle" preferences), it is assumed that about 10% of SUVs meet the 1,000 gallon threshold to qualify as HCFUs.

Passenger vans represent 8% of all HCFU vehicles. Based on the styling and features among the top vans, the more family-oriented minivans outnumber the utilitarian passenger/cargo vans among the top models. For this Super-Commuter market segment, it is assumed that 60% of passenger vans fit the profile, with all remaining vans assumed to be better fits for the Ride-Sharer, Delivery, or Fleet segments.

Table 8: Common Internal Combustion Engine Vehicles that Meet the Super-Commuter Profile

This profile includes primarily passenger sedans and minivans, with smaller SUVs also represented. Commonly driven vehicle makes and models within the Super-Commuter segment include the following:

Make	Model	WA HCFUs Driving Make/Model (nearest 100)	Estimated Percentage of HCFUs Fitting Super-Commuter Profile	Estimated # of HCFUs in Super-Commuter Profile (nearest 100)
Toyota	Sienna	1.3% (5,600)	60%	3,400
Subaru	Outback	1.2% (5,200)	95%	4,900
Toyota	Camry	1.1% (4,800)	60%	2,900
Honda	Accord	1.0% (4,300)	60%	2,600
Honda	Odyssey	0.8% (3,500)	60%	2,100
Ford	Escape	0.8% (3,500)	95%	3,300
Dodge	Grand Caravan	0.7% (3,000)	60%	1,800
Toyota	Corolla	0.6% (2,600)	60%	1,600
Subaru	Legacy	0.5% (2,200)	95%	2,100
Ford	Edge	0.5% (2,200)	95%	2,100
Other	Other Passenger Cars	8.3% (36,000)	75%	27,000
Other	Other SUVs	37% (160,700)	10%	16,100
Other	Other Vans	5.2% (22,600)	60%	13,600
TOTAL			**19%**	**83,500**

N= 434,270 HCFUs in Washington (1,000 or more gallons of fuel consumed per year), 2023.

2.3.5 Market Segment: Ride-Sharers

General description

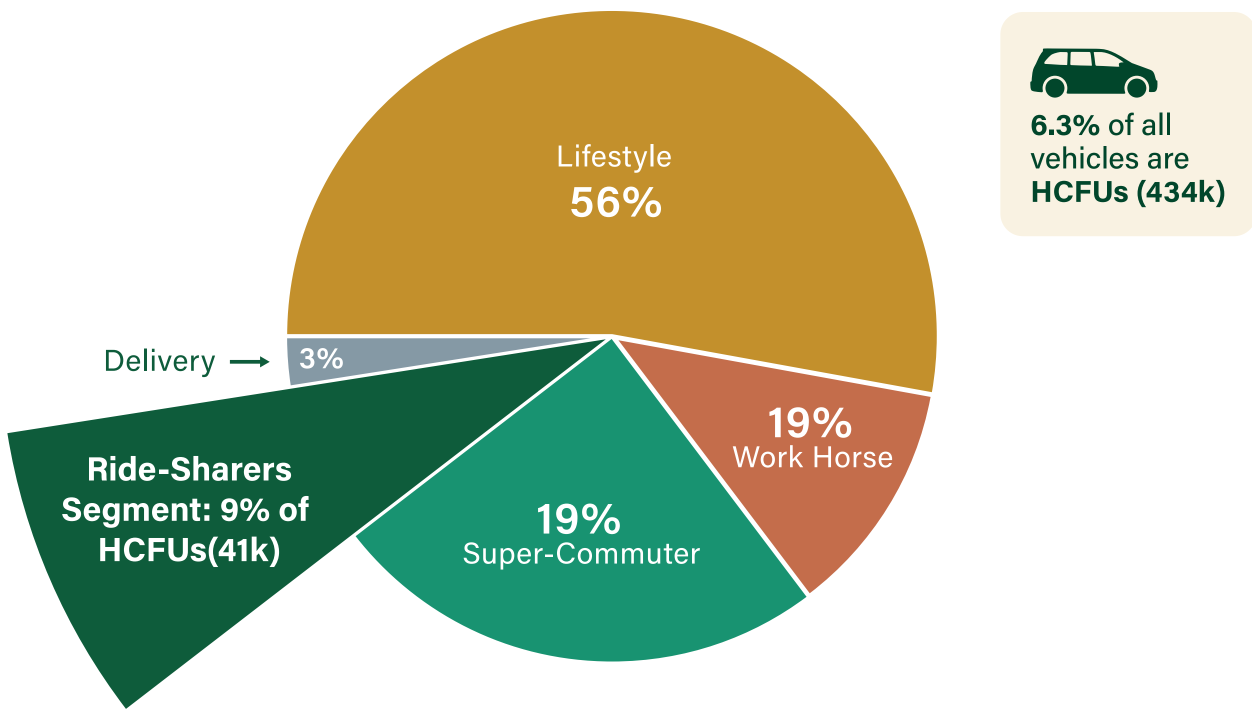
This market segment includes drivers who use their vehicles to transport passengers (or for personal food delivery) as a regular activity. If working for hire (e.g., Uber or Lyft), these vehicles tend to be newer models with comfortable 4+ passenger seating and enough capacity for luggage. Whether used for passenger transport or food delivery, the primary characteristic of this market segment is that vehicles spend 30 to 40 hours per week “in service,” even if individual trips are relatively short. These vehicles are typically used for personal transport when not in service.

Functional Requirements

- Many consecutive trips
- Fuel-efficient
- Four-person carrying capacity, plus luggage
- Interior comfort
- Minimal downtime for fueling or servicing
- Good value for money

Resulting Vehicle Specifications

- Reliability
- Low operating costs (especially fuel)
- Four-door vehicle with trunk or hatchback
- Newer vehicles, with climate control
- Driving range (travel distance on a full tank)
- Track record for vehicle longevity



There's likely broad overlap in the fleet composition of this Ride-Sharer segment with the Super-Commuter segment: primarily passenger cars, with some SUVs and minivans also serving as Ride-Sharer (or food delivery) vehicles. There are a few distinguishing characteristics between these segments. First, Ride-Sharer vehicles are more likely to be newer-model vehicles, because the established transportation network companies (Uber and Lyft) place certain requirements on the age, safety, comfort, and appearance of the vehicle. Second, because Ride-Sharer vehicles are most likely to be owned and operated as a personal business, drivers of these vehicles may be more willing or able to purchase higher-mpg, newer technology vehicles like hybrids. Third, since Ride-Sharer vehicles are likely to have better-than-average fuel economy (i.e., greater than 23.4 mpg), these drivers attain HCFU status by driving many more miles than the average HCFU.

Following are the most common HCFU vehicles that meet the functional requirements for Ride-Sharers and are more likely to conform to the three additional characteristics identified above: newer-model features, better-than-average fuel efficiency, and reputation for reliability under heavy use.

Table 9: Common Internal Combustion Engine Vehicles that Meet the Ride-Sharer Profile

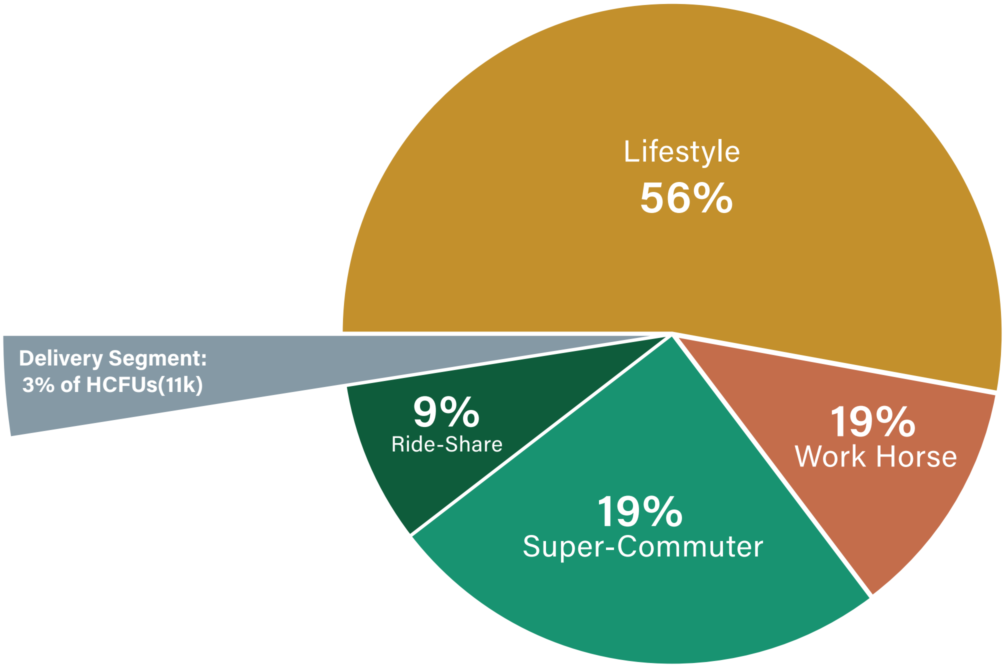
Make	Model	WA HCFUs Driving Make/Model (nearest 100)	Estimated Percentage of HCFU Fitting Ride-Sharer Profile	Estimated # of HCFUs in Ride-Sharer Profile (nearest 100)
Toyota	Camry	1.1% (4,800)	40%	1,900
Toyota	RAV4	1.0% (4,300)	25%	1,100
Honda	Accord	1.0% (4,300)	40%	1,700
Toyota	Corolla	0.6% (2,600)	40%	1,000
Honda	Civic	0.5% (2,200)	25%	600
Nissan	Altima	0.4% (1,700)	40%	700
Nissan	Rogue	0.3% (1,300)	40%	500
Toyota	Prius	0.2% (900)	40%	400
Other	Other Passenger Cars	10.2% (44,300)	25%	11,100
Other	Other SUVs	35.7%% (155,000)	5%	7,800
Other	Other Vans	8% (34,700)	40%	13,900
TOTAL	**Other SUVs**	**8% (34,700)**	**9%**	**40,700**

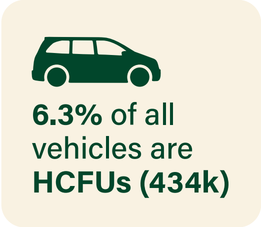
N= 434,270 HCFUs in Washington (1,000 or more gallons of fuel consumed per year), 2023.

2.3.6 Market Segment: Delivery

General description

This market segment includes drivers who use vehicles for small- and medium-sized parcel and goods delivery. These vehicles may be part of a fleet owned by a company (e.g., an auto parts chain), or may be personally owned vehicles where a driver contracts to provide paid deliveries (e.g., Amazon). While the type of vehicle required depends on the size (and type) of goods delivered, transport of larger parcels or goods may depend on a van.





Functional Requirements

- Small-/midsized cargo carrying capacity
- Multiple delivery trips per day

Resulting Vehicle Specifications

- Configurable for packages
- Favorable vehicle life-cycle costs (acquisition, operating, depreciation) compared to alternatives

Many (but not all) vehicles used for delivery are owned by an organization—a company, a government agency, a hospital, etc. Some are privately owned vehicles where the owner may provide delivery services on a contracted basis. While a small percentage of vehicles in this market segment may include passenger cars and/or SUVs, the main type of vehicle is likely a light-duty van. Categorically, 8% of all HCFUs drive vans. Both the Ford Transit Connect and the Chevrolet Express have full-height doors that open wide, and the interiors are designed to be configured based on vehicle purpose. These two van models each fall within the top 20 of the most common HCFU vehicles in Washington. It is estimated that most configurable vans are used for delivery purposes. Minivans can also be modified to provide delivery services, although this unlikely a common use.

Table 10: Common Internal Combustion Engine Vehicles that Meet the Delivery Profile

Make	Model	WA HCFUs Driving Make/Model (nearest 100)	Estimated Percentage of HCFUs Fitting Delivery Profile	Estimated # of HCFUs in Delivery Profile (nearest 100)
Ford	Transit	1.1% (4,800)	100%	4,800
Chevrolet	Express	1.1% (4,800)	100%	4,800
Toyota	Sienna	1.3% (5,600)	2%	100
Other	Other Passenger Cars	14% (60,800)	2%	1,200
Other	Other Vans	4.5% (19,500)	2%	400
TOTAL			**3%**	**11,300**

N= 434,270 HCFUs in Washington (1,000 or more gallons of fuel consumed per year), 2023.

2.3.7 Market Segment: Fleets

General description

This market segment is focused on companies or organizations that own vehicles driven frequently by multiple drivers, resulting in an above-average number of miles driven. Owners of these vehicles typically employ professional fleet managers who oversee vehicle usage, operations, maintenance, repair, and replacement of the fleet. The functional requirements of these vehicle owners are diverse and dependent on the particular size and services of the owner's organization. For example, a single public agency fleet might include work trucks for roadway, parks, or public space maintenance; passenger vans for transporting groups of workers; SUVs to support travel across mountain passes; larger sedans for office workers carpooling to attend meetings with colleagues; smaller, compact cars for general purpose and local travel, etc.

Since Fleets represent the largest possible range of vehicle types, it is not feasible (or useful) trying to delineate the functional requirements and resulting vehicle specifications for this market segment. Instead, the most salient factors considered by fleet managers are as follows:

Salient Factors for Fleet Managers' Vehicle Purchase Decisions:

Total cost of ownership (TCO) (Section 2.4)

- Ease (or difficulty) of the vehicle to be operated by multiple drivers with different experience levels
- Ease of maintenance and repair, particularly if the organization provides these services in-house
- Availability and convenience of fueling for the fleet, including depot or on-site refueling
- Schedule and organizational budget for vehicle retirement and replacement

Purchase decisions may be based on these factors, and more. Consumer incentives, such as tax deductions, may not be available to Fleet owners. For example, unless special provisions are made for municipalities, a federal income tax deduction for purchasing an alternative fueled vehicle is not beneficial, since public agencies do not owe federal income taxes.

For certain Fleets, organizational budgets, policy directives, or even laws also might influence (or mandate) purchase decisions. The decision whether to purchase an EV instead of a gas-powered vehicle might be made by the state legislature, by a governor's executive order, or a corporate sustainability policy, removing the fleet manager's independent discretion.

Unfortunately, the Washington DOL does not have data on which (or how many) vehicles are owned or operated as part of a public or private fleet. Other sources of information, including NHTS and private sector data sources, do not provide enough detail to determine the prevalence of Fleet vehicles in Washington.

Knowing that Fleet vehicle purchase decisions include the factors identified above, and suspecting that TCO is probably the most influential factor among fleet managers who have authority to make purchase decisions, Section 2.4 includes a TCO analysis pairing a common gas-powered passenger Fleet vehicle against a comparable EV.

A recent study by the Joint Transportation Committee (JTC) identified approximately 52,000 light-duty vehicles that are owned and managed by public agencies in Washington (state, school districts, transit agencies, cities, and counties). Although the report found insufficient data to provide an exact count of city and county-owned vehicles (estimated at 23,000), approximately 5%, or 1,650, of the remaining public Fleet vehicles were deemed good candidates for conversion to EVs.[2]

While it is unknown how many of these approximately 1,650 vehicles use 1,000 or more gallons of fuel, it is more likely that the drivers of these vehicles would qualify as HCFUs, since the TCO analysis conducted as part of the earlier JTC study found a business case in favor of moving to electricity as a fuel.

2.4 Determining Total Cost of Ownership

TCO is a financial calculation that considers all costs associated with owning and operating a vehicle over its lifetime. More than just the initial purchase price, TCO includes expenses such as fuel, insurance, maintenance and repairs, depreciation, financing costs, and any other relevant expenses.

Private company or public agency fleet managers heavily rely upon TCO. TCO can be used to compare different vehicle makes and models to make purchasing decisions to optimize operational costs and meet specific vehicle use requirements (Section 2.3.7).

Consumer advocacy websites and publications often conduct TCO analyses to help potential car buyers understand the total value proposition of a particular vehicle make, model, engine, or fuel type, since many car buyers may be overly influenced by only the initial purchase price when determining a vehicle's affordability.

2.4.1 Total Cost of Ownership Factors and Assumptions

The TCO of a vehicle encompasses all fixed and ongoing vehicle-related costs, including the manufacturer's suggested retail price (MSRP), taxes, license and registration, gasoline or electricity, ongoing maintenance, insurance, and home charger installation, as well as any existing credits or incentives for the purchase of an EV or EV chargers. Table 11 presents the factors and assumptions used to create the TCO model.

Table 11: Total Cost of Ownership Factors and Assumptions

Factors	Assumptions
VMT	■ Annual mileage required to burn 1,000 gallons of fuel at the HCFU vehicle's mpg rating ■ 55% city miles; 45% highway miles (U.S. Department of Energy)
Fuel and Electricity Costs	■ $4.55 per gallon Washington average (American Automobile Association [AAA]) – updated April 19, 2023 ■ $0.12 per kilowatt hour (kWh) for residential electricity, Washington average (U.S. Bureau of Labor Statistics) ■ $0.48 per kWh for public charging (Electrify America) ■ 80% home charging / 20% public charging (U.S. Department of Energy) ■ Future prices estimated using EIA 2023 Energy Outlook
Vehicle Cost	■ MSRP ■ Delivery fees ■ Washington sales tax (6.5%) + Washington motor vehicle sales/lease tax (0.3%)
Financing	■ 10% down payment, 5-year loan, 7% interest (Edmunds)
Incentives	■ Federal tax credits (up to $7,500) depending on location of final vehicle assembly and MSRP ■ Washington sales tax exemption (first $15,000 exempt on vehicles with MSRP of up to $45,000) ■ Federal tax credit on home charging equipment and installation (30% of cost up to $1,000 total credit) ■ Washington sales tax exemption on home charging equipment ■ Utility incentives ($200–$700 statement credits; assumed $350 given range of possible incentives depending on utility provider)
Tires and Maintenance	U.S. Office of Energy and Renewable Energy Estimate: ■ ICE: $0.101 per mile ■ EV: $0.061 per mile
Insurance	■ Rates estimated based on typical premiums for Washington drivers
License & Registration	■ DOL filing fees, registration fees, service fees, plate transfer, vehicle weight fees, EV fees
Home Charging	■ $650 typical price of Level 2 charger ■ $1,600 installation ■ $35 permits
Depreciation	■ 44% of MSRP after 5 years (insurer estimate)

Some variables such as the price of gasoline can change daily. The price used in the analysis reflects the average price of regular unleaded at the time of the analysis. Other factors like the cost of insurance can vary widely depending on vehicle type, coverage, and the age, gender, and driving history of the individual insured. The estimated cost of insurance is within the range of typical insurance premiums for Washington drivers.

The MSRP plus delivery fees and Washington sales and use tax were used as the purchase price for each vehicle model analyzed. While present market conditions have caused some dealers to price both ICE and EV vehicles over MSRP, market conditions will change over time. Regional transit authority (RTA) taxes are excluded from the purchase price of the vehicle because they are dependent on where in the state the vehicle is registered.

2.4.1 Total Cost of Ownership of High-Consumption Fuel User Use Cases and Potential Electric Vehicle Replacements

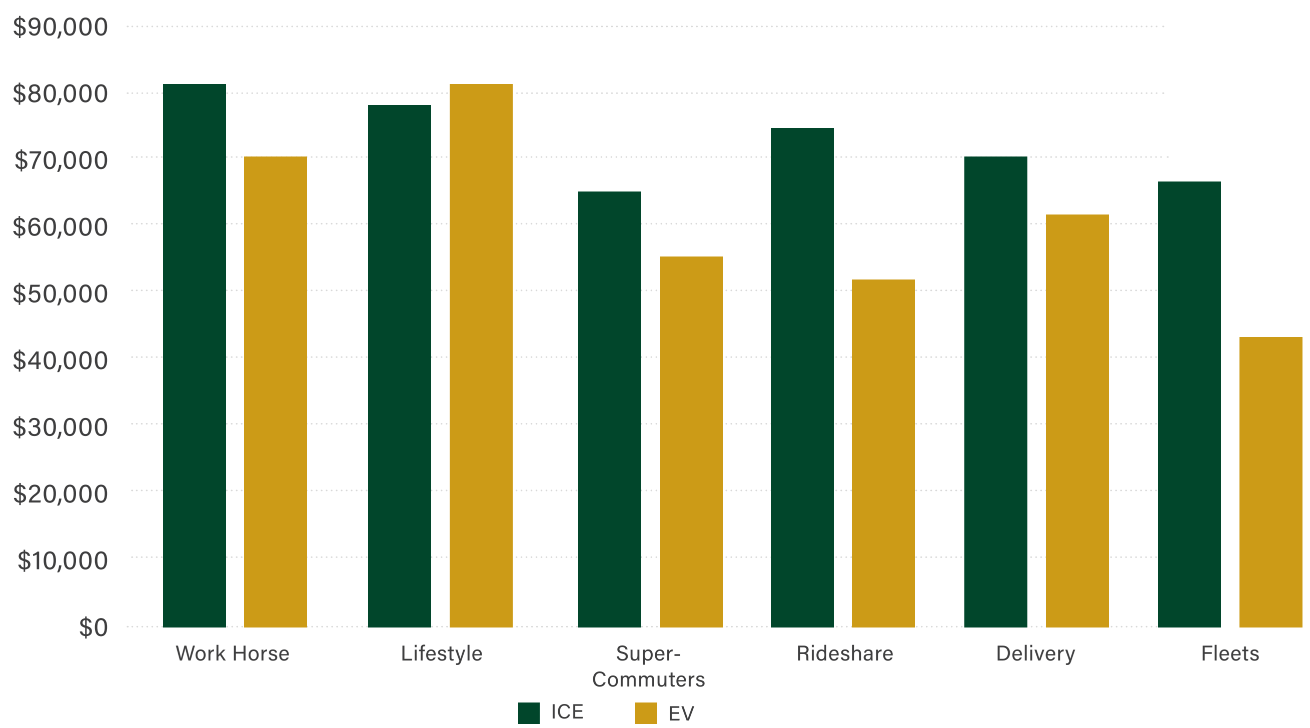
In this section, TCO of six different HCFU vehicle profiles are compared to potential EV replacement vehicles that meet many of the same requirements and have similar capabilities to their HCFU counterparts. Not all HCFU vehicle types have an EV currently on the market that fills the same specific niche. For example, among HCFUs, the Toyota 4Runner is the most common SUV in Washington and has a starting MSRP of $39,555. While the Rivian R1S also offers optional third row seating and off-road capability, it is targeted more toward a luxury/enthusiast market and has a starting MSRP of $78,000. All models compared are generally the base trim unless otherwise noted, and were specified with comparable options. (Table 12) describes the six vehicle profiles and specific models analyzed.

Table 12: Total Cost of Ownership Vehicle Profiles

Profile	Description	HCFU Make/Model	EV Replacement
Work Horses	Larger/heavier personal vehicles are used on jobsites to haul materials, tools, and a small crew.	Ford F-150 XLT SuperCrew (EcoBoost 3.5L Turbo V6)	Ford F-150 Lightning XLT (Standard Battery)
Lifestyle	Larger/heavier "lifestyle" vehicles support leisure activities (towing recreational vehicles [RVs], off-roading, hauling people or gear, etc.).	Toyota 4Runner (SR5) Toyota 4Runner (Limited)	Rivian R1S (Dual-Motor, Standard Range)
Super-Commuters	Vehicles relied on for regular, high-mileage driving, either for commuting or within a large region (e.g., persons that cover a "territory").	Toyota Camry (LE)	Tesla Model 3 (RWD)
Ride-Sharers	Newer-model vehicles with comfortable passenger seating, which spend 30 to 40 hours per week or more "in service." These vehicles also may be used for local food delivery.	Toyota Prius (LE)	Chevrolet Bolt (1TL)
Delivery	Vehicles that accommodate small- and medium-sized parcel delivery.	Ford Transit	Ford E-Transit
Fleet	Organizational vehicles driven frequently by multiple drivers, resulting in above-average VMT.	Ford Escape	Chevrolet Bolt Electric Utility Vehicle (EUV)

In all market segments, except for Lifestyle, EVs have a lower TCO after five years than similarly equipped ICE models, even when the initial purchase price of the EV is higher than the comparable ICE vehicle because of the lower costs of maintenance and operation, as well as federal and state incentives. Cases where the TCO of an ICE vehicle is lower than that of an EV may represent a gap in the EV market for that particular vehicle niche.

Figure 32: TCO by Market Segment (5 Year)



2.4.1.1 Work Horses

Work Horses, like the Ford F-150, are large vehicles used by professionals whose job necessitates a vehicle that can haul cargo and tools, tow, and carry a small crew. The F-150 has been the best-selling truck in the United States for 46 straight years, and the best-selling vehicle overall for 41 of those years. Because pickup trucks also get relatively poor fuel economy, it is no surprise that it is most commonly driven by HCFUs in Washington.

The Ford F-150 Lightning is an EV version of the F-150 that can achieve 230 (standard battery) to 320 (extended-range battery) miles of range on one charge. While range is reduced significantly when towing heavy trailers, the F-150 Lightning may suit the needs of work crews who use the truck bed, but seldom tow trailers, or of crews who work locally.

The F-150 equipped with the EcoBoost 3.5L Turbo V6 engine would need to drive about 21,000 miles in a year to qualify as an HCFU vehicle, assuming an EPA-reported fuel economy rating (real world fuel economy may differ) (Table 13).

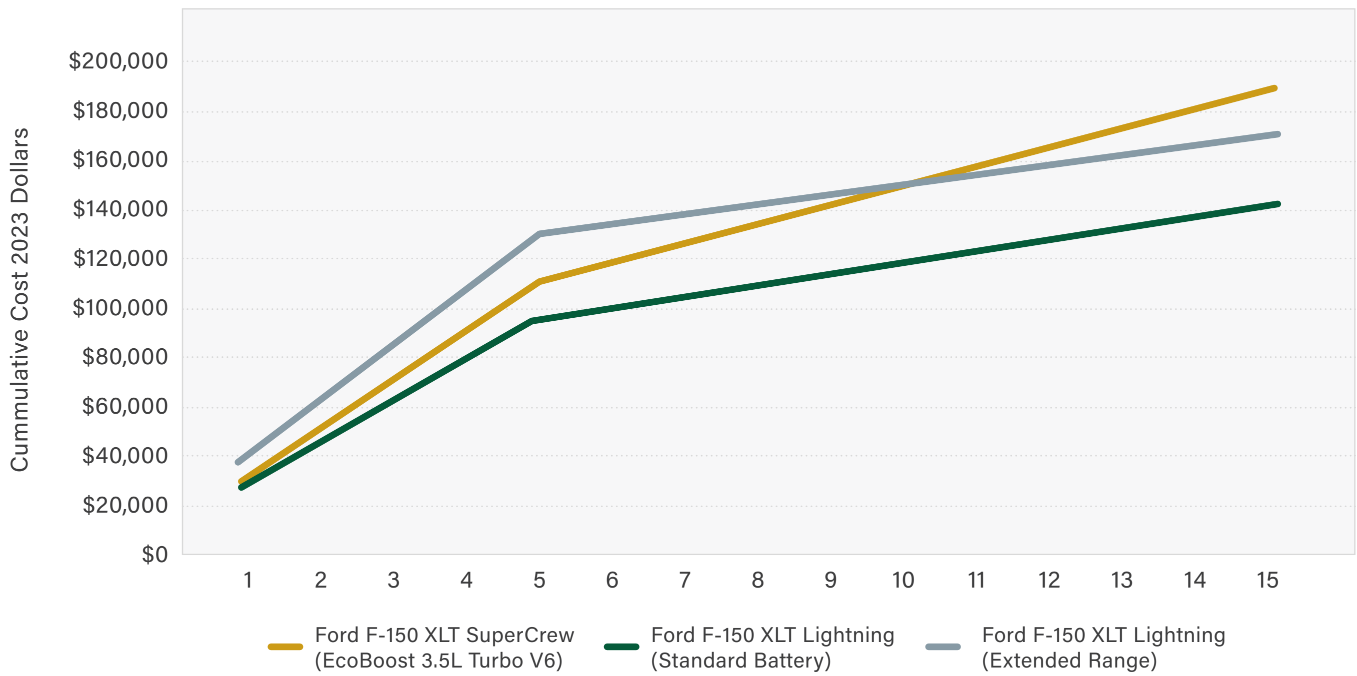
Table 13: Work Horse Total Cost of Ownership: Ford F-150 (ICE) versus Ford F-150 Lightning (EV)

Profile	Ford F-150 XLT SuperCrew (EcoBoost 3.5L Turbo V6)	Ford F-150 XLT Lightning (Standard Battery)	Ford F-150 XLT Lightning (Extended Range)
MSRP + Delivery Fees	$56,585	$65,896	$83,369
5-Year TCO including Resale Value of Trade-In (2023 dollars)	**$82,676**	**$70,531**	**$89,953**
MPG/MPGe(City/ Highway)	18/24	76/61	76/61
Federal Tax Credits	N/A	$7,500	Does Not Qualify (MSRP >$80,000)
Washington Sales Tax Exemption	N/A	Does Not Qualify (MSRP >$45,000)	Does Not Qualify (MSRP >$45,000)
Home Charger Installation Incentives	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	21,000 miles		

Because the Ford F-150 Lightning is eligible for the full $7,500 federal tax credit, the EV version of the F-150 is cheaper to own within the first year. The savings increases over time because maintenance costs on an EV are generally lower than their ICE counterparts, and because the cost of electricity is less than gasoline, especially after the fifth year of ownership when the vehicle loan is fully paid (Figure 33). By the fifth year of ownership, the difference in total cost is $11,360 ($12,145 when the estimated resale value of both vehicles is considered).

The extended-range version of the F-150 Lightning has a significantly higher starting price, and it is over the MSRP threshold for the federal tax credit. Therefore, it is more expensive to own than a lightly optioned ICE version of an F-150 until the 11th year of ownership, which would likely be at or near the end of its useful life if driven 21,000 miles annually.

Figure 33: Work Horse Cumulative Cost of Ownership by Year



2.4.1.2 Lifestyle

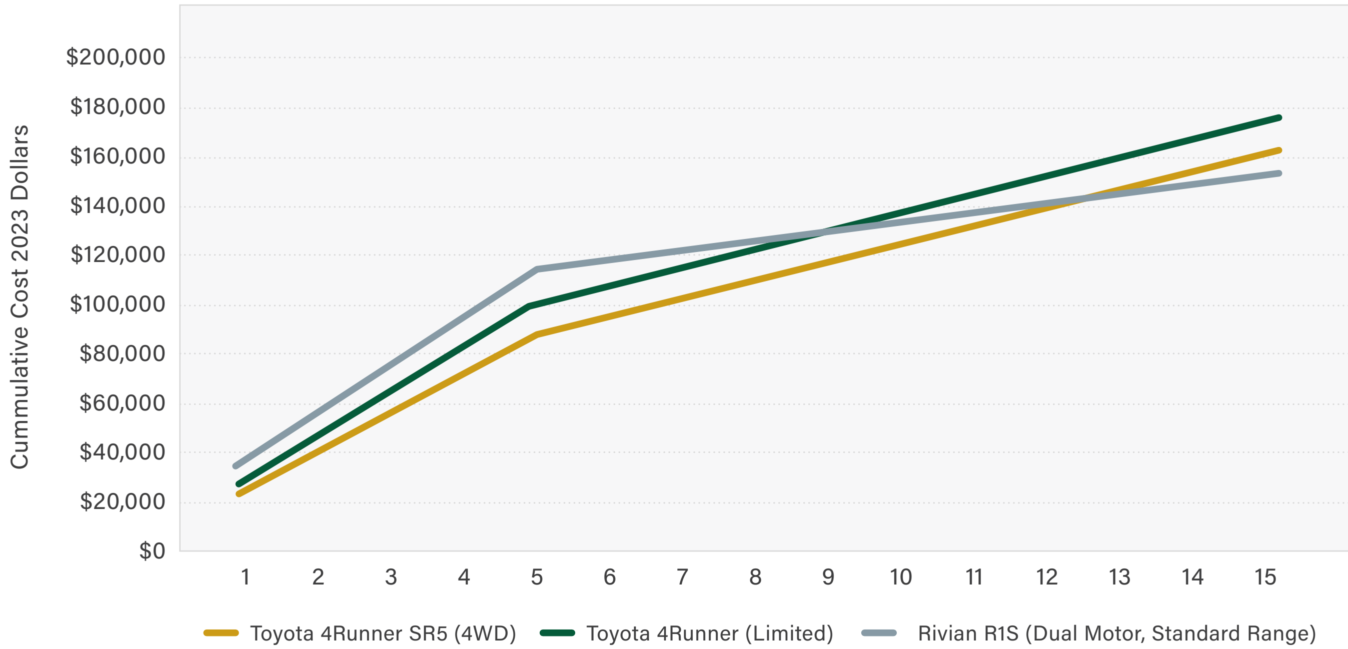
Lifestyle are larger "lifestyle" vehicles used to support leisure activities, such as towing an RV, off-roading, and hauling gear or people. Among HCFU vehicles, the Toyota 4Runner is the most common SUV in Washington. The Rivian R1S was chosen as a comparison because it offers optional third row seating and off-road capability. However, it is targeted more toward a luxury/enthusiast market and has a much higher MSRP of $78,000 than the Toyota 4Runner ($40,930). This represents a potential gap in the EV market for non-luxury vehicles with some off-road capability and optional third row seating. To compare more like-for-like vehicles, the more luxury-oriented "Limited" trim of the 4Runner ($49,825) is also considered in the TCO analysis (Table 14).

Table 14: Lifestyle Total Cost of Ownership: Toyota 4Runner versus Rivian R1S

Profile	Toyota 4Runner SR5 (4WD)	Toyota 4Runner Limited (4WD)	Rivian R1S (Dual Motor, Standard Range)
MSRP + Delivery Fees	$42,265	$51,160	$79,895
5-Year TCO including Resale Value of Trade-In (2023 dollars)	$69,108	$78,252	$82,136
MPG/MPGe(City/Highway)	16/19	16/19	73/65
Federal Tax Credits	N/A	N/A	Partial Tax Credit ($3,750)
Washington Sales Tax Exemption	N/A	N/A	Does Not Qualify (MSRP >$45,000)
Home Charger Installation Incentives	N/A	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	**17,500 miles**		

Because the Rivian RS1 base model has a significantly higher starting price than the top trim of the Toyota 4Runner, it does not become cheaper to own until the 10th year of use, despite lower operating costs. However, when considering resale value, its 5-year TCO is only $4,000 more than the 4Runner, for a much more capable vehicle in terms of on- and off-road performance.

Figure 34: Lifestyle HCFU Cumulative Cost of Ownership



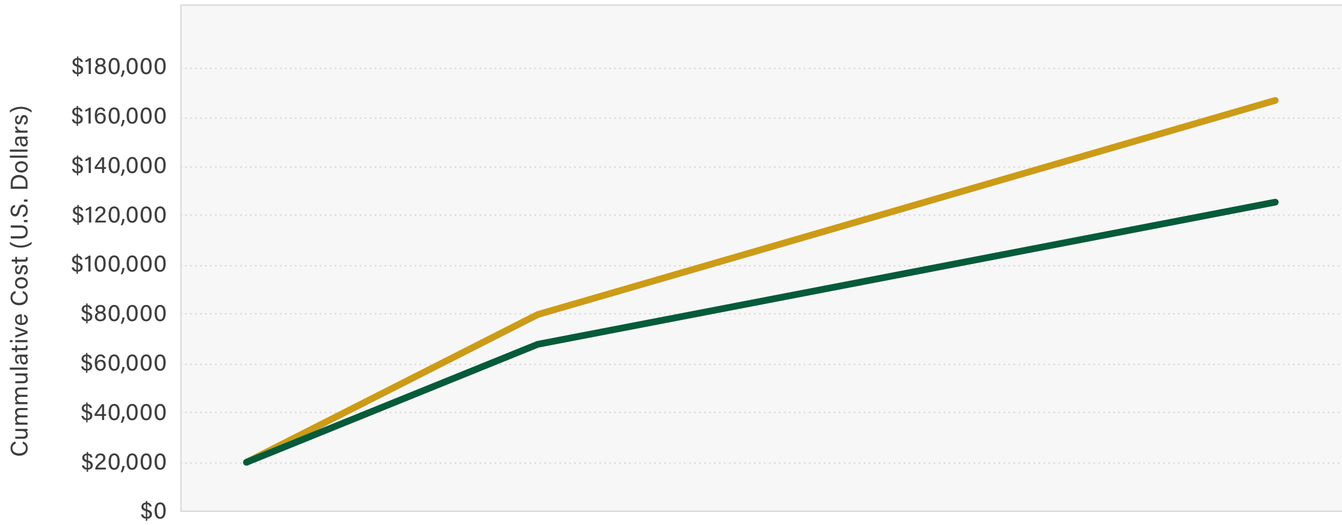
2.4.1.3 Super-Commuters

Super-commuter vehicles are vehicles that are relied on for regular, high-mileage driving, either for commuting or driving within a large region (e.g., people who cover a “territory”). Owners of these vehicle may prioritize fuel efficiency and comfort over other capabilities like a large cargo area or off-road performance.

Table 15: Super-Commuter Total Cost of Ownership: Toyota Camry (LE) versus Tesla Model 3 (RWD)

Profile	Toyota Camry (LE)	Tesla Model 3 (RWD)
MSRP + Delivery Fees	$27,315	$41,630
5-Year TCO including Resale Value of Trade-In (2023 dollars)	$65,834	$55,768
MPG/MPGe(City/ Highway)	28/39	138/126
Federal Tax Credits	N/A	Partial Tax Credit ($3,750)
Washington Sales Tax Exemption	N/A	$1,020
Home Charger Installation Incentives	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	**33,500 miles**	

Figure 35: Super-Commuter HCFU Cumulative Cost of Ownership by Year



Despite an MSRP that is $14,315 higher, the Tesla Model 3 (RWD) is cheaper to own than the Toyota Camry LE by the second year of ownership because of lower operating costs, the Model 3's eligibility for a $3,750 federal tax credit, and Washington sales tax exemption on the first $15,000 of the purchase price. The Model 3 qualifies for the Washington sales tax exemption for EVs because it has an MSRP under $45,000 (Table 16). Including the trade-in value of the vehicle, the TCO of Tesla Model 3 is more than $10,000 less than the Toyota Camry after five years.

2.4.1.4 Ride-Sharers

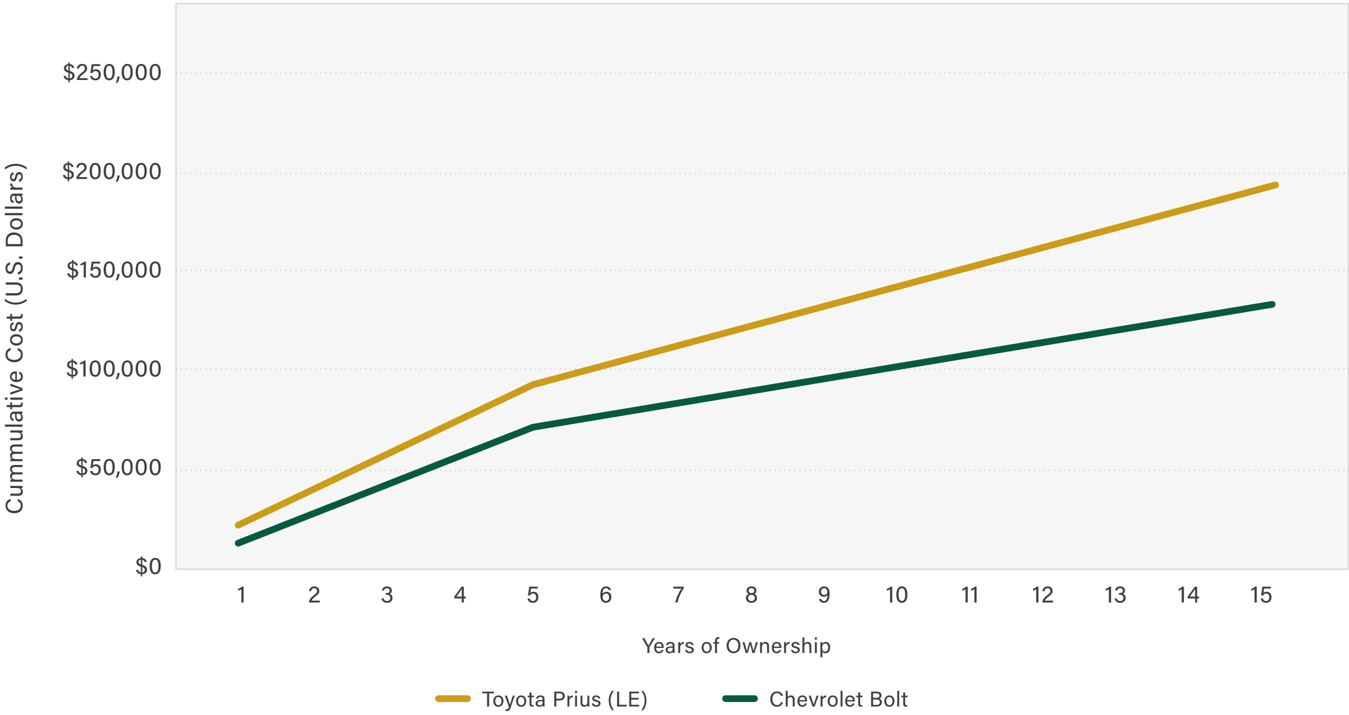
Table 16: Ride-Sharer Total Cost of Ownership: Toyota Camry (LE) versus Toyota Prius (LE) versus Chevrolet Bolt (1TL)

Profile	Toyota Camry (LE)	Toyota Prius (LE)	Chevrolet Bolt (1TL)
MSRP + Delivery Fees	$27,315	$28,545	$27,495
5-Year TCO including Resale Value of Trade-In (2023 dollars)	$65,834	$75,553	$53,798
MPG/MPGe(City/Highway)	28/39	57/56	131/109
Federal Tax Credits	N/A	N/A	$7,500 Federal Tax Credit
Washington Sales Tax Exemption	N/A	N/A	$1,020
Home Charger Installation Incentives	N/A	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	**56,500 miles**		

Ride-sharer vehicles are newer-model vehicles with comfortable passenger seating, and are driven 30 to 40 hours per week or more "in service." These vehicles may also be used for local food delivery. Because they accrue high annual VMT as a result of all-day use, some Ride-Sharer vehicles could be defined as HCFU vehicles despite being relatively fuel-efficient.

For example, there are approximately 1,000 Toyota Prius HCFUs (used here as an example) statewide. While this is a small fraction of the Washington vehicle fleet, many Ride-Sharer operators drive vehicles that are less fuel-efficient than the Toyota Prius.

Figure 36: Ride-Sharer High-Consumption Fuel User Cumulative Cost of Ownership by Year



The Chevrolet Bolt has a lower MSRP than the Toyota Prius, and because it qualifies for both the federal clean vehicle tax credit and the Washington EV state sales tax exemption, it is $9,642 cheaper after taxes and delivery fees, assuming the owner has enough taxable income to take full advantage of the $7,500 federal clean vehicle tax credit. The lower per-mile operating costs of a Chevrolet Bolt in a Ride-Sharer role that is in service 40+ hours per week results in a 5-year TCO that is $21,755 less than the Toyota Prius when considering the resale value of both vehicles.

An annual VMT of 56,500 miles would require an average daily VMT of 226 miles, assuming 250 days in service. This would stretch the Bolt's range of 259 miles, but it is plausible especially if using Level 2 or Direct Current (DC) Fast charging stations.. With such high usage, Ride-Sharer HCFU vehicles are unlikely to remain in service for 5 years; however, the Bolt is cheaper to own than the Prius regardless of the duration of its service life.

2.4.1.5 Delivery

This class of vans include vehicles used for delivery of small- and medium-sized parcels. Work crews with different needs than the Work Horse category of vehicles also may use them.

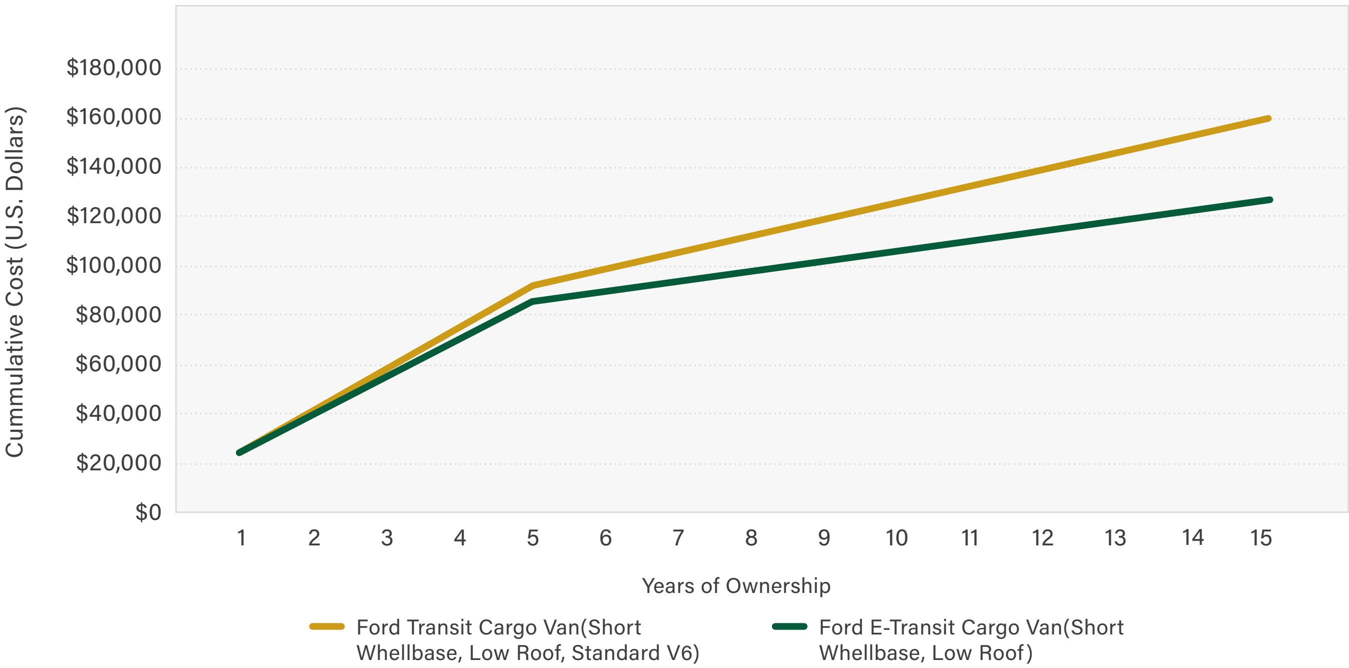
Table 17: Delivery Total Cost of Ownership: Ford Transit (ICE) versus Ford E-Transit (1TL)

Profile	Ford Transit*	Ford E-Transit*
MSRP + Delivery Fees	$46,350	$55,685
5-Year TCO including Resale Value of Trade-In (2023 dollars)	$70,479	$62,155
MPG/MPGe(City/ Highway)	14/18	62/62*
Federal Tax Credits	N/A	$3,750 Federal Tax Credit
Washington Sales Tax Exemption	N/A	Does Not Qualify (MSRP >$45,000)
Home Charger Installation Incentives	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	**15,000 miles**	

*Both models have a short wheelbase and low roof.
**EPA estimate is not published yet. MPGe is estimated by range and battery size.

The Ford E-Transit, which is an EV version of the Ford Transit van, has a higher starting MRSP than the gasoline version. However, because it qualifies for a partial ($3,750) federal clean vehicle tax credit and has lower operating costs than the gasoline version, it becomes cheaper to own by the second year of use. After 5 years of ownership, the E-Transit is $8,324 cheaper when considering the resale value of both vehicles.

Figure 37: Delivery High-Consumption Fuel User Cumulative Cost of Ownership by Year



2.4.1.6 Fleet

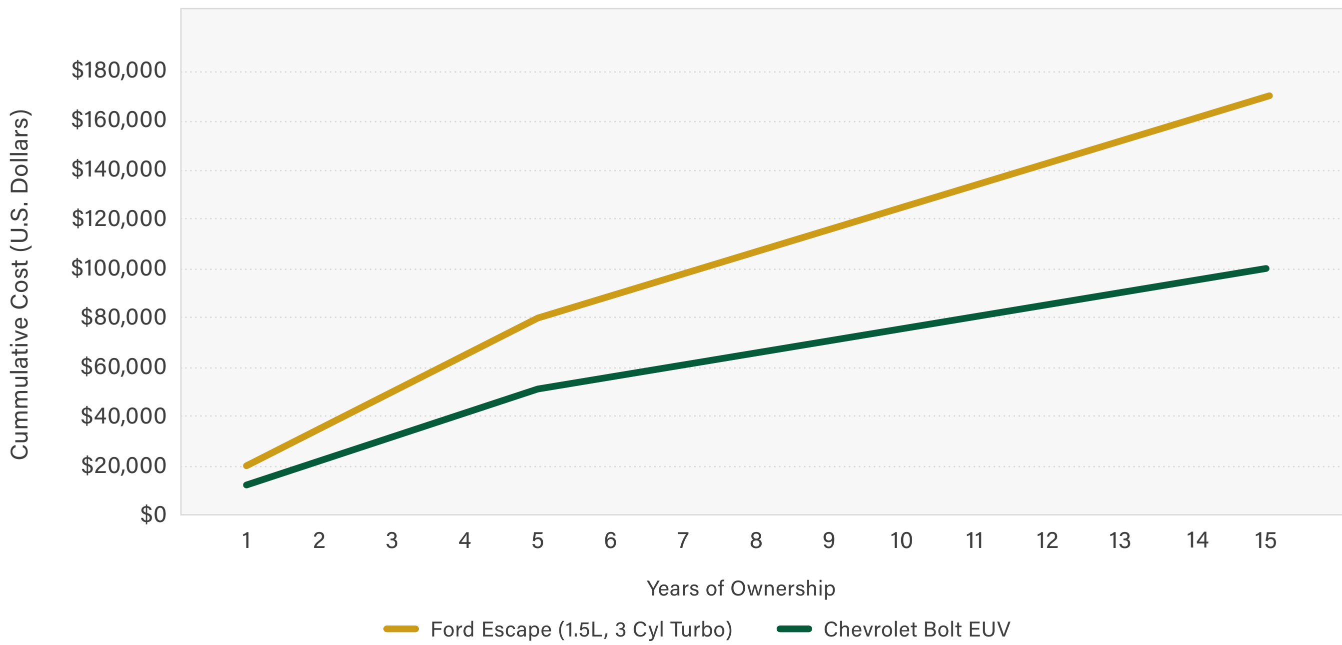
Table 18: Delivery Total Cost of Ownership: Ford Escape versus Chevrolet Bolt EUV

Profile	Ford Escape	Chevrolet Bolt EUV
MSRP + Delivery Fees	$30,140	$28,795
5-Year TCO including Resale Value of Trade-In (2023 dollars)	$66,183	$42,186
MPG/MPGe(City/ Highway)	27/34	125/104
Federal Tax Credits	N/A	$3,750 Federal Tax Credit
Washington Sales Tax Exemption	N/A	$1,020
Home Charger Installation Incentives	N/A	Federal Tax Credit: 30% of Charger and Installation Cost (up to $1,000) Washington Utility Incentives: $350
Annual VMT Required to Use 1,000 gallons of Fuel	**15,000 miles**	

Fleet vehicles are vehicles owned by an organization or government agency that are driven frequently by multiple drivers, resulting in above-average VMT. These types of vehicles may include small SUVs/crossovers that offer some cargo space to fulfill a wide range of roles; however, it is not necessarily a primary capability. Rather, a primary attribute of Fleet vehicles is that they are relatively inexpensive to acquire and maintain while still fulfilling the needs of the organization.

The Ford Escape (1.5L, 3 cylinder turbo), used as an example here, has a higher MSRP than the Chevrolet Bolt EUV, a small crossover version of the Bolt EV hatchback. Additionally, because the Bolt EUV qualifies for full $7,500 federal clean vehicle tax credit as well as the Washington EV state sales tax exemption, it is nearly $10,000 cheaper to own than the Ford Escape within the first year of ownership when including taxes and destination fees. Because the Bolt EUV is cheaper to operate than the Ford Escape, its 5-year TCO is $24,000 less than that of the Escape.

Figure 38: Fleet High-Consumption Fuel User Cumulative Cost of Ownership by Year



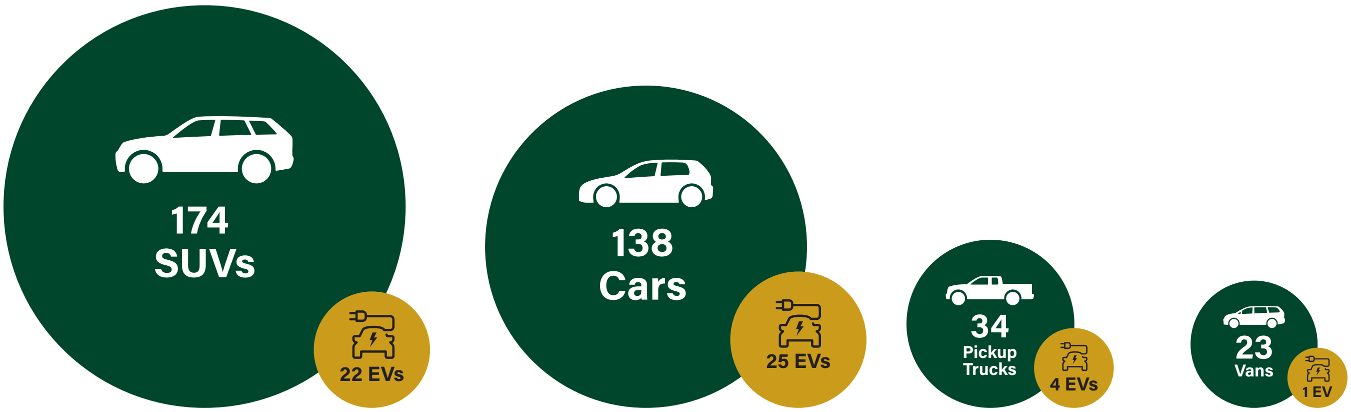
2.5 Identifying Electric Vehicles That Can Meet the Needs of High-Consumption Fuel Users

There are two factors related to the availability of EVs for each of the six identified segments: (1) whether there are sufficient model types currently under production that are reasonable substitutes for the gas-powered version and, if so, (2) whether adequate retail supply of these model types exists to meet demand for these vehicles.

Based on automakers' pronouncements about their plans to bring new models to market, the first factor will be addressed before the end of this decade (2030). The second factor—an imbalance between the current demand for certain model types and current availability of these model types in the marketplace—should abate within the next few years. However, until production is increased, wait times for vehicles in highest demand will likely persist, and purchase prices for these models may continue to exceed the MSRP, potentially impacting whether switching to EVs pencils out, from a TCO perspective.

EV Models currently available for sale, relative to Gasoline version models

Overlap represents number for EVs that are within 10% MSRP of comparable gas models

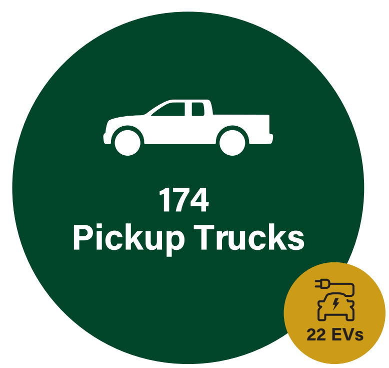


2.5.1 Work Horse Market Segment Model Availability

Functional Specifications

- Cargo capacity: 4x8 plywood, tools, equipment, materials, etc.
- Higher ground clearance
- Four-passenger capacity
- Separate bed with tailgate
- Four-wheel or all-wheel drive; traction tires
- Above-average horsepower

Washington HCFU Vehicles in Work Horse Market Segment	Gas-powered Models in Production	Similar model EVs in Production
Pickup Trucks: 62,400	34	4



2.5.2 Lifestyle Market Segment Model Availability

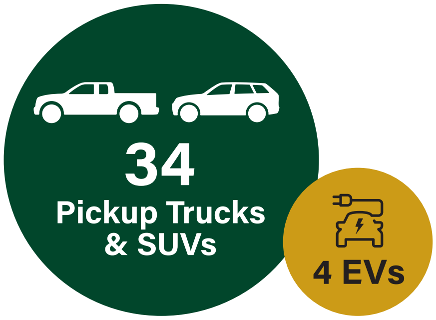
This segment includes "lifestyle" vehicles that, in addition to providing everyday transportation, also support leisure activities.

SUVs make up the highest number of vehicles falling under the Lifestyle profile, followed by pickup trucks not otherwise used for work purposes.

Functional Specifications

- Tow hitches and 3,500+ lb towing capacity
- Higher ground clearance
- Traction tires, four-wheel or all-wheel drive preferred
- Above-average horsepower

	Washington HCFU Vehicles in Lifestyle Market Segment	Gas-powered Models in Production	Similar model EVs in Production
	SUVs: 136,600	174	22
	Pickup Trucks: 106,900	34	4



2.5.3 Super-Commuters Market Segment Model Availability

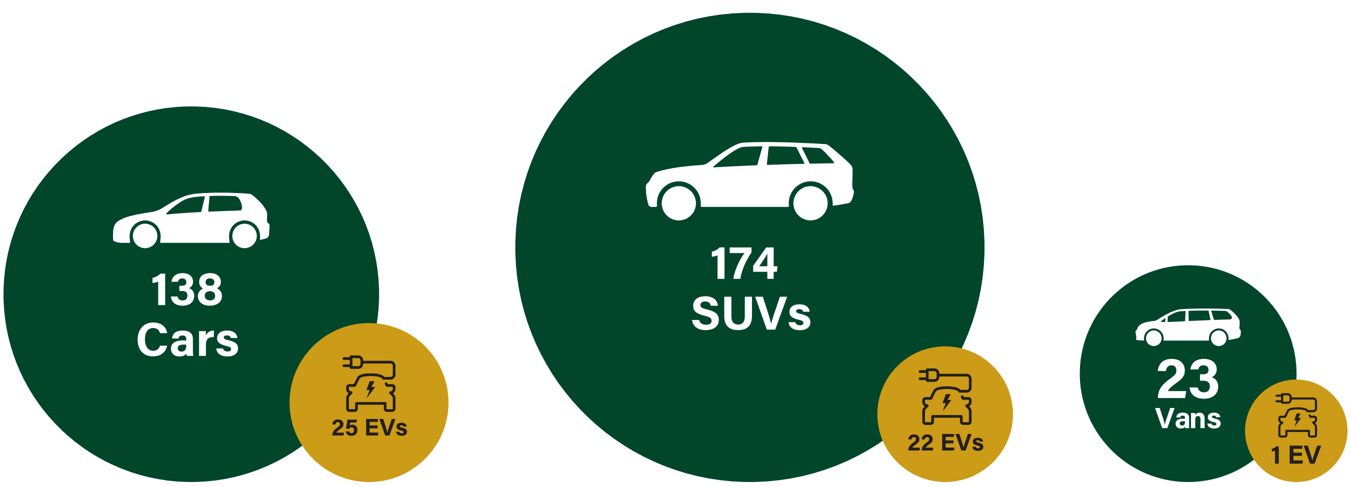
This market segment includes vehicles driven a high number of miles in a year. While some Super-Commuter vehicles might achieve better-than-average fuel economy, the sheer number of miles traveled in a year (e.g., more than 25,000 miles) would still result in fuel usage of 1,000 gallons or more per year.

From a functional perspective, almost any vehicle model could be used as a high-mileage driving vehicle; no special performance, configuration, or equipment specifications are required. Section 2.3.4 provides more details about this market segment.

Functional Specifications

- Reliability
- Driving range (travel distance on a full tank)
- Affordable ownership costs
- Low operating costs (including fuel)
- Track record for vehicle longevity
- In-vehicle infotainment, other comfort features

	Washington HCFU Vehicles in Super-Commuter Market Segment	Gas-powered Models in Production	Similar model EVs in Production
	Passenger Cars (sedans): 43,200	138	25
	SUVs: 136,600	174	22
	Passenger Vans: 13,600	23	1



2.5.4 Ride-Sharers Market Segment Model Availability

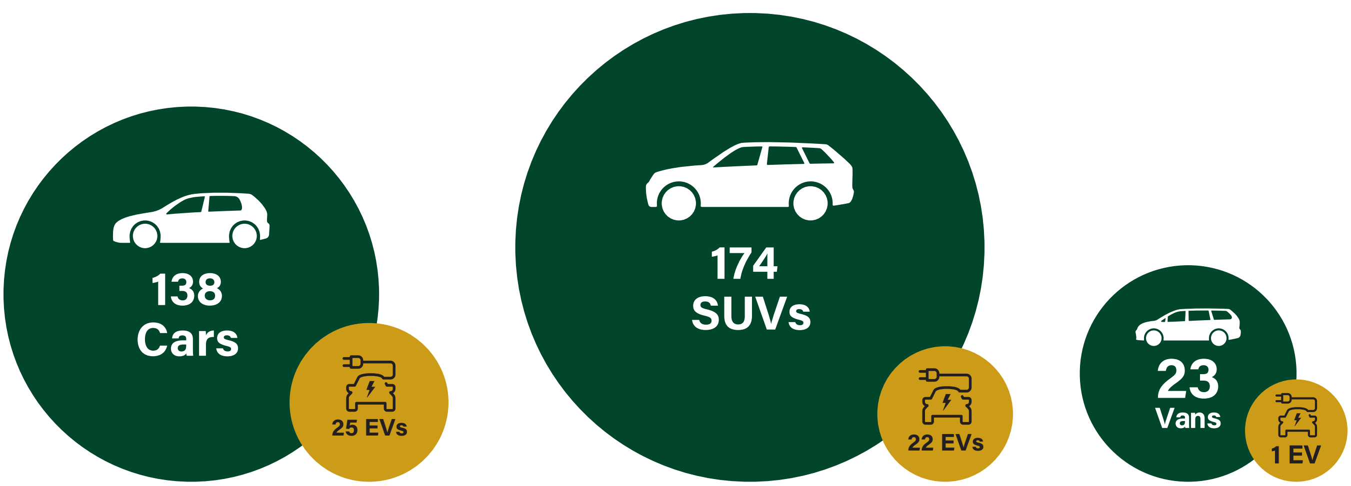
This market segment includes vehicles used to transport passengers (or for personal food delivery) as a regular activity. These vehicles are typically used for personal transport when not in service.

This Ride-Sharer segment resembles the Super-Commuter segment: primarily passenger cars, with some SUVs and minivans also serving as Ride-Sharer (or food delivery) vehicles.

Functional Specifications

- Reliability
- Low operating costs (especially fuel)
- Four-door vehicle with trunk or hatchback
- Newer vehicles, with climate control
- Driving range (travel distance on a full tank)
- Track record for vehicle longevity

	Washington HCFU Vehicles in Ride Sharers Market Segment	Gas-powered Models in Production	Similar model EVs in Production
	Passenger Cars (sedans): 17,400	138	25
	SUVs: 9,400	174	22
	Passenger Vans: 13,900	23	1



2.5.5 Delivery Market Segment Model Availability

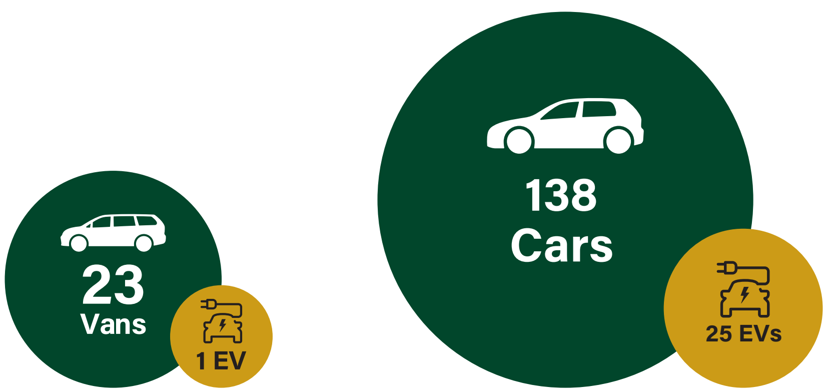
This segment includes vehicles used for small- and medium-sized parcel and goods delivery. While the type of vehicle required depends on the size (and type) of goods delivered, transport of larger parcels or goods may depend on a van.

While a small percentage of vehicles in this market segment may include passenger cars and/or SUVs, the main type of vehicle is likely a light-duty van.

Functional Specifications

- Configurable for packages
- Favorable vehicle life-cycle costs (acquisition, operating, depreciation) compared to alternatives

	Washington HCFU Vehicles in Delivery Market Segment	Gas-powered Models in Production	Similar model EVs in Production
	Passenger Vans: 10,100	23	1
	Passenger Cars (sedans): 1,200	138	25



2.5.6 Fleets Market Segment Model Availability

Since this market segment encompasses all light-duty vehicle model types, the model availability mirrors the results in all of the previous market segments. Section 2.3.5 provides more information on how the Fleet market segment fundamentally differs from the other market segments.

2.6 Summary

Based on data collected from the Washington DOL, the NHTS, the American Community Survey, and sources, analysis points to defining HCFUs as drivers of vehicles that consume more than 1,000 gallons of fuel per year. The main purpose of Chapter 2 is to better understand the potential of HCFU vehicles to transition to EVs, the economic benefits of such a switch, and the volume of fuel that could be displaced.

A deep dive into vehicle data reveals that the top 10% of Washington's drivers account for 26% of fuel consumption, while the bottom half only use 24%. As of 2022, there were 434,270 HCFU vehicles in Washington, representing 6.3% of the state's total vehicle fleet. HCFUs travel, on average, two and a half times as many miles annually as the average Washington driver, mostly in larger, less fuel-efficient vehicles, with the majority being SUVs and pickup trucks.

The Central Puget Sound region has the highest number of HCFUs (because it is the most populous region of the state and is home to over half of all registered vehicles). However, Eastern and Central Washington have the highest concentration of HCFUs on a per capita basis.

HCFU drivers tend to drive larger, less fuel-efficient vehicles than the rest of the vehicle fleet. While SUVs are both common among HCFUs and the overall Washington vehicle fleet, there are significantly more pickup trucks driven by HCFUs. Combined, 78% of HCFU vehicles comprise trucks and SUVs, while vans make up another 8%. Only 14% of fuel superusers drive cars (sedans, coupes, etc.).

Market segmentation based on vehicle usage and characteristics helps identify which types of HCFUs are best suited to switch to EVs. These segments include Work Horses, Lifestyle, Super-Commuters, Ride-Sharers, Delivery vehicles, and Fleets. Each segment has different functional requirements and suitability for EV transition. For example, Super-Commuters and Ride-Sharers are currently better-suited to transition to EVs, while the others face challenges because of the current limited model variety and pricing.

TCO is a crucial metric for decision-making, particularly for fleet managers. TCO covers all costs of owning and operating a vehicle, including fuel, maintenance, insurance, and depreciation. However, the effectiveness of TCO as a decision-making tool varies between segments because of diverse functional requirements of drivers and the economic feasibility of EVs within different market segments.

Regarding Fleet operations, factors like cost, ease of operation, maintenance, fueling availability, and vehicle replacement policies influence decision-making. Policies and directives from authorities or corporations also may dictate EV purchases, potentially bypassing fleet managers' individual discretion.

The transition from gas vehicles to EVs depends on the availability of economically feasible replacement vehicles. Currently, limited variety and availability of specific models, such as pickup trucks, SUVs, and vans, pose significant challenges. Production increases and new model introductions expected by 2030 should help address these issues. However, until then, longer wait times and comparatively higher prices may continue to impact the economic viability of HCFU's switch to EVs.

CHAPTER 3

Consumer Research Results: Identifying What Matters Most to High-Consumption Fuel Users

Section 3: Consumer Research Results: Identifying What Matters Most to High-Consumption Fuel Users

This section describes the consumer market research effort led by public opinion research firm, Ipsos, to identify the most salient factors among Washington drivers that influence the willingness of various market segments to purchase electric vehicles. The methodology focuses on the factors that motivate high-consumption fuel users (HCFUs) and compares differences in how those factors motivate the general driving population in Washington.

3.1 Overall Results

After identifying the extent, geographic location, and usage characteristics of HCFUs in Washington, an in-depth online survey tool was developed and deployed to target HCFUs in Washington and test their beliefs, behaviors, and preferences. The survey, which ran in late April and early May 2023, featured 173 structured questions, deployed information acceleration and MaxDiff techniques, took the typical participant between 20 and 30 minutes to complete, and yielded 450 completed surveys, of which 36% qualified as HCFUs, and 15% as HCFUs whose vehicles consuming 1,500 or more gallons per year.

Four main categories of insights emerged: characteristics of HCFUs, knowledge of EVs, perceived barriers to EV adoption, and interest in vehicle purchasing.

Characteristics of HCFUs and Driving Habits

Pickup truck drivers were underrepresented in the study, although they account for 20% of Washington's drivers and 37% of HCFUs. The distance driven was a significant determinant of high fuel consumption rather than the lower mpg of certain vehicles. HCFUs, who typically have higher incomes than non-HCFUs, drive significantly more miles than average, including for work commutes.

HCFUs' Knowledge of EVs

HCFUs and non-HCFUs had a similar level of familiarity with EVs, challenging the initial hypothesis that lack of knowledge about EVs and their fuel-efficiency benefits could be causing high fuel consumption. Additional information about EVs might encourage drivers of higher fuel-consuming vehicles (1,500+ gallons annually) to consider switching.

Perceived Barriers to EV adoption

Purchase price was not the top concern for HCFUs. Given their higher income levels, though, there was some price sensitivity among HCFUs using closer to the 1,000-gallon threshold. HCFUs had similar views as non-HCFUs about EV driving range limitations, with higher fuel-consuming drivers expressing more concern about home charging. Interestingly, HCFUs were more willing to tolerate longer EV charging times. The key distinction between HCFUs and other drivers was their concerns about EV performance characteristics, particularly those important for pickup trucks, SUVs, and vans.

Interest in Purchasing a Vehicle

HCFUs are more open to purchasing new vehicles than non-HCFUs. They also showed a higher willingness to lease new vehicles, a promising sign for encouraging EV adoption because leasing shifts long-term ownership risk to the dealer.

3.2 Methodology

Ipsos fielded an online market research survey of Washington drivers between late April and early May 2023. The survey included screening questions about demographics (age, ethnicity, household income, number of vehicles in household, etc.), vehicle characteristics (e.g., fuel economy, body type), and vehicle use (e.g., annual vehicle miles traveled [VMT], trip purposes). Based on responses to questions about fuel economy and annual VMT of the survey taker's primary vehicle, the survey calculated total annual fuel consumption in gallons. This information was used to categorize each respondent as an HCFU or non-HCFU. Within the HCFU category, respondents were further broken into categories for HCFUs' vehicles consuming at least 1,000 gallons but less than 1,500 gallons versus those consuming 1,500 gallons or more.

Unlike traditional public opinion surveys that favor rapid response, this survey is better characterized as a web-based engagement, requiring 20 to 30 minutes of time and careful consideration of maps, graphics, and new information to respond to 173 structured questions. As a result, many respondents who started the survey failed to complete it, and their results were screened out. Once in the field, the survey initially focused on attracting HCFUs. Given the scarcity of HCFUs in Washington (just over 6 percent [%] of registered light-duty vehicles), the survey initially ejected many who began the survey to achieve a reasonable number of HCFU responses.

In the end, the survey attracted 450 complete responses. Of those, 160 (36%) respondents qualified as HCFUs, meaning they consume an estimated 1,000 gallons or more per year in their primary vehicle. Of the 450 total complete surveys, 69 (15%) respondents reported their vehicles consumed 1,500 gallons or more of fuel annually.

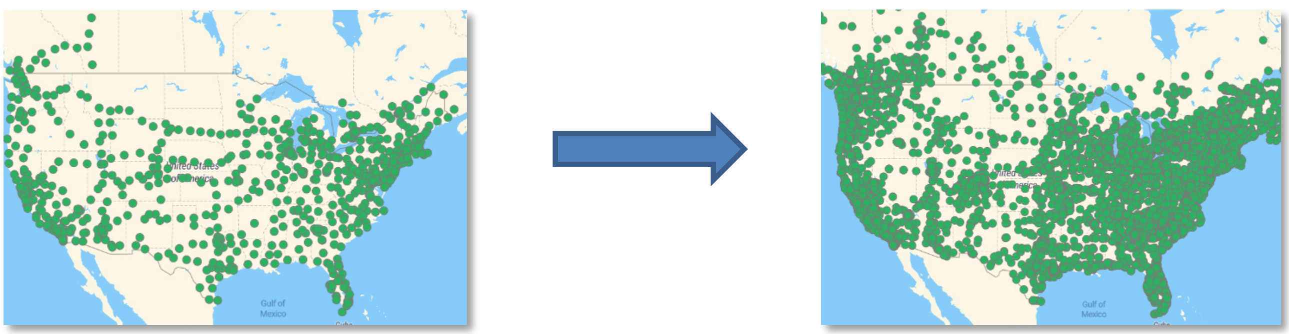
The core of the online engagement, which averaged between 20 and 30 minutes to complete, featured questions about familiarity with electric vehicles (EVs), perceived barriers to EV adoption, and interest in purchasing an EV. Appendix A contains the full list of survey questions. The following subsections describe the techniques used to explore these topics with survey takers.

3.2.1 Information Acceleration

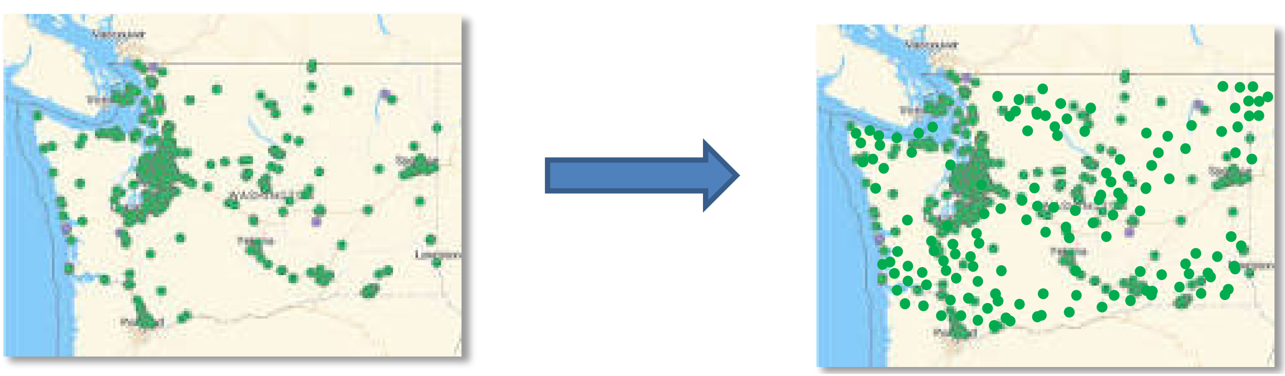
After probing baseline understanding and opinions about EVs, the survey included information designed to educate participants about the benefits of EV ownership such as lower operating costs, vehicle improvements, and environmental benefits. It also provided information about the growing network of public charging stations nationally and in Washington, and improvements in direct current (DC) fast charging and "super-fast charging." This tactic of interspersing information in between survey questions, known as information acceleration, allows observation of any changes from baseline sentiments toward EVs based on the information supplied. One example of information acceleration, shown in Figure 39, illustrates the location and quantity of public EV chargers in Washington and nationally both today and as planned over the next five to seven years. This graphic is designed to educate survey takers about the expected rapid near-term growth in availability of public charging facilities.

Figure 39: Example of Information Shared with Respondents during Online Engagement

The ***number of public EV chargers*** in the US is expected to grow from the current 160,000 to 500,000 by 2030 per the Biden Infrastructure Law. This is well beyond the number of gas stations today.



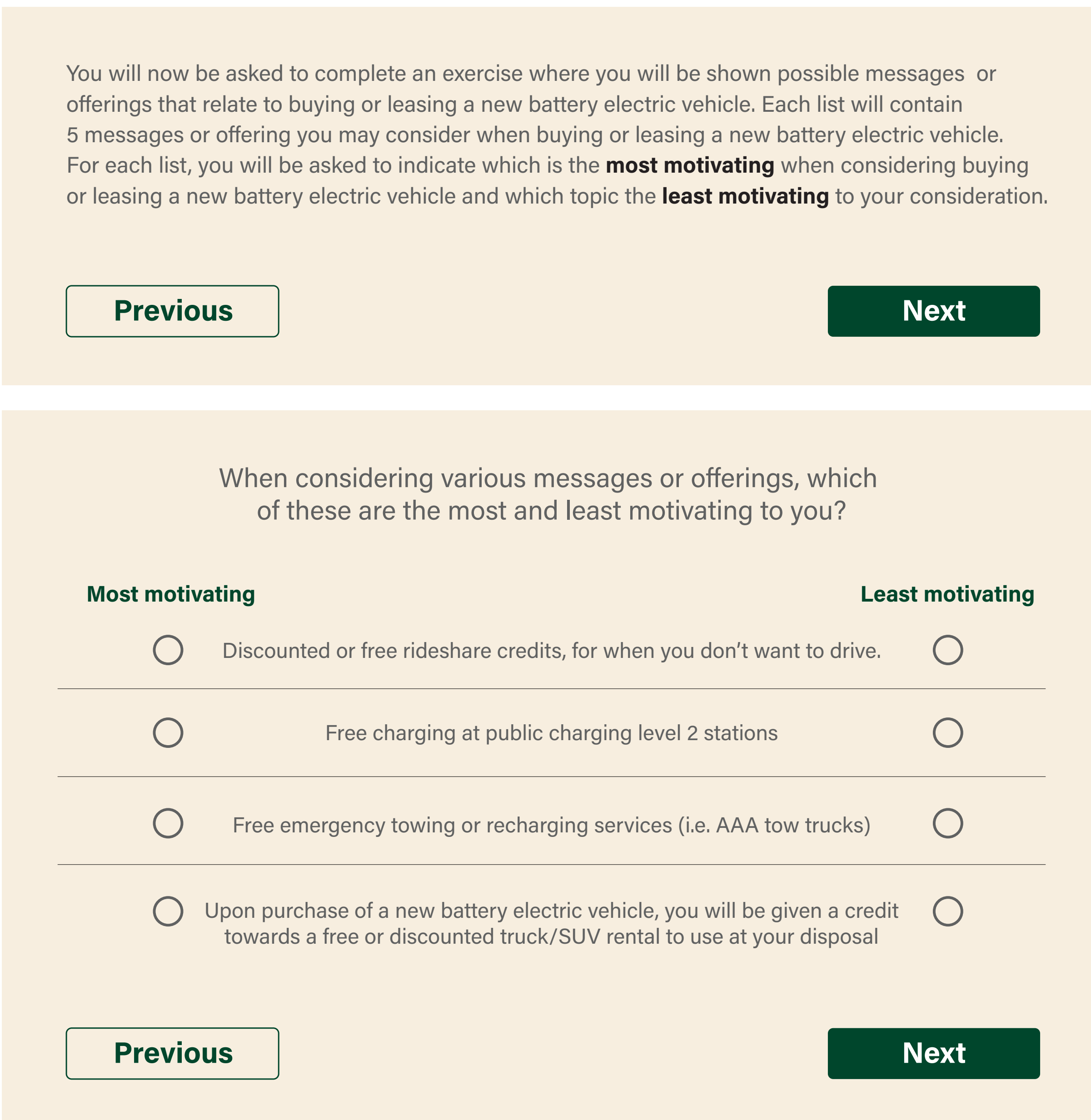
And, there are currently 3,765 public charging ports in the state of Washington today, that number is expected to increase by 3x to over 10,000 in the next 5 years.



3.2.2 MaxDiff Analysis of Incentives and Messaging

In addition to information acceleration, the survey incorporated the MaxDiff technique. MaxDiff relies on "mathematical psychology" in presenting randomly selected options to survey takers and asking them to select which options are most and least compelling. Their preferences for most and least compelling allow inferences to be made about the relative importance of the other options. In this case, the options presented included policy incentives related to the purchase of a new EV. Each survey taker was presented a small list of rotating choices from a menu of 16 policies. Participants were asked to indicate which would be the most and least motivating when considering the purchase of a new EV. Figure 40 illustrates one example of how MaxDiff was deployed in this section of the survey.

Figure 40: Online Engagement Measuring Consumers' Motivations



By collecting responses from many participants, the research team can analyze the data to identify the relative rankings of options overall. Section 3.2 presents the options presented and participants' preferences.

3.3 Policies Tested with High-Consumption Fuel Users

The project team developed a series of hypothetical policies (incentives) designed to encourage the purchase of a new EV. The MaxDiff technique allowed the research team to observe the relative effectiveness of each policy, and to rank them from most to least motivating when considering buying or leasing a new EV among the drivers surveyed.

Table 14 shows all 16 of the policies presented to the survey participants as well as the relative preference for each among the non-HCFUs, HCFUs, and HCFUs whose vehicles consume 1,500 or more gallons of fuel annually. Higher scores reflect greater importance or effectiveness at moving a consumer toward an EV when purchasing a new vehicle. Items with an index of 120 or greater are viewed most favorably by survey participants, while items with values under 80 are relatively less important.

Table 19: Relative Value of Electric Vehicle Policies and Incentives to Consumers in Washington

Policy/Incentive	Non-HCFU (less than 1,000 gallons)	HCFU (1,000 gallons – 1,499 gallons)	HCFU (1,500 gallons or more)
Fast chargers available at existing gas stations (i.e., charge to gain 200 miles of range within 30 minutes of charging time)	158	136	143
Up to $1,470 sales tax exemption for purchase of a new EV	163	137	137
Free charging at public Level 2 (medium-speed) charging stations	150	127	132
Free Level 2 (medium-speed) home charging equipment, with 20% installation costs	153	127	129
5 cents per mile for every mile driven in an EV (capped at $3,000 per year maximum incentive)	157	144	121
Public DC fast charging stations along key highway corridors	148	138	116
"Loaner program" that allows monthly free use of any gas vehicle when needed (e.g., pickup truck)	66	87	104
Free toll road use for EVs	59	80	104
Free or discounted pickup, van, or sport utility vehicle (SUV) rental upon purchase of a new EV	58	72	98

Policy/Incentive	Non-HCFU (less than 1,000 gallons)	HCFU (1,000 gallons – 1,499 gallons)	HCFU (1,500 gallons or more)
Free emergency towing or recharging services (e.g., American Automobile Association [AAA] towing/recharging assistance)	103	109	90
Discounted electricity rates for charging an EV during off-peak hours	122	89	85
Free public parking for EV owners between 7:00 a.m. to 6:00 p.m.	75	73	84
Free Level 2 (medium-speed) charging at work places	72	89	76
Preferred parking spots for EVs	48	62	63
Free coffee and/or discounted food at businesses that provide EV charging stations	31	71	62
Discounted or free rideshare credits	37	59	55

Among all groups (HCFUs and non-HCFUs), the policies and incentives viewed most favorably included charging (fast charging at existing gas stations, fast charging along key highway corridors, free public Level 2 charging), tax exemptions and discounts on the purchase of an EV or home charger, discounts on electricity when charging an EV, and rebates for EV miles driven.

Discounted or free rideshare credits, loaner programs for occasional internal combustion engine (ICE) vehicle use, preferred parking for EVs, free toll road use, free towing, free Level 2 charging at workplaces, and free or discounted food or coffee at businesses co-located with EV charging stations were not considered to be particularly persuasive incentives for purchasing an EV by any of the survey takers, including HCFUs and non-HCFUs.

Some of the policy initiatives viewed most favorably are more feasible than others. For example, the number of public charging stations in Washington is already expected to nearly triple from approximately 3,800 to 10,000 over the next five years. Additionally, there are existing federal and state tax incentives for the purchase of an EV depending on the manufacturer's suggested retail price (MSRP) and where the components are assembled, or for a home charging unit.

Other hypothetical incentives, like a 5-cent per EV mile driven annual rebate, are less plausible given the high cost of such a program. For example, at 25,000 miles driven, a typical HCFU would earn a mileage driving rebate of $1,250 per year. Scaled up to several hundred thousand vehicles would cost more than $100 million per year in rebate values alone, which could prove cost-prohibitive

Most of the policies performed equally well or better among non-HCFUs than HCFUs. In other words, what works for HCFUs works just as well for the average driver. Perhaps more interesting are the proposed policies that scored above 80 among HCFUs and performed strongest relative to non-HCFUs. The policies in this category (i.e., that HCFUs place a higher value on than the average driver) included, in decreasing order of relative performance: a loaner program that allows monthly free use of any gas vehicle when needed (e.g., pickup truck); free toll road use for EVs; and free or discounted pickup, van, or SUV rental upon purchase of a new EV; and free Level 2 (medium-speed) charging at work places.

3.4 Results of Consumer Research: Information and Insights Gained

Following are the four categories for information and insights from the online engagement:

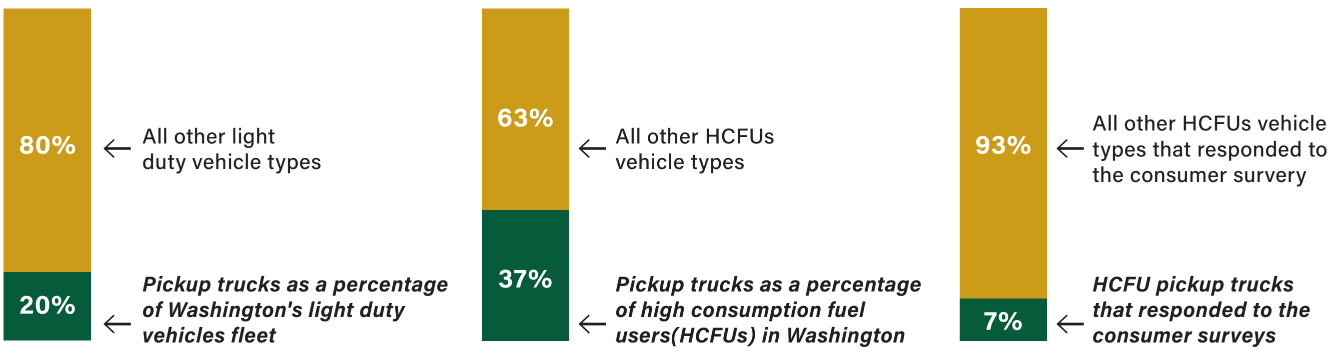
- Characteristics of HCFUs and how they drive their vehicles
- HCFUs' knowledge of EVs
- Perceived barriers to EV adoption
- Interest in purchasing a vehicle

3.4.1 Characteristics of High-Consumption Fuel Users and How They Drive Their Vehicles

Pickup truck drivers were more reluctant to participate in the online engagement.
Survey respondents geographically and demographically represented Washington's population as a whole. However, there was one key segment that did not participate in numbers reflective of the broader state population: pickup truck owners.

As discovered through the analysis covered in Chapter 2, pickup trucks represent 20% of Washington's registered light-duty vehicles, but 37% of all HCFUs. This difference is not surprising, because trucks have lower miles per gallon (mpg) ratings on average than other passenger cars and SUVs (especially crossovers); therefore, they are more likely to be represented among HCFUs.

Figure 41: Pickup Trucks are Under-Represented In Consumer Survey of HCFUs



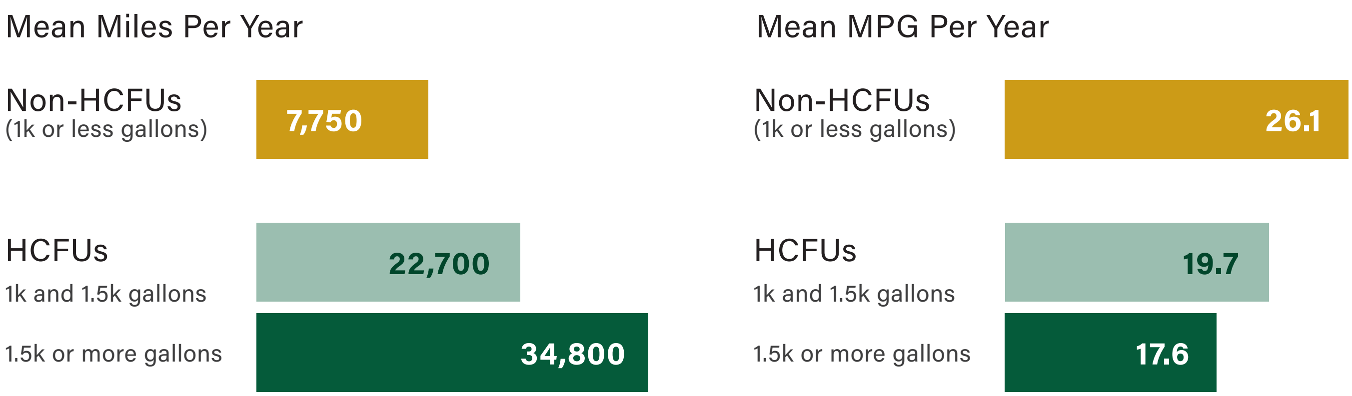
Of the completed surveys (both HCFUs and all other Washington drivers), only 6% came from pickup truck drivers, or less than one-third of their relative statewide proportion (20% of all vehicle types). Among completed survey responses from HCFUs, pickup drivers made up only 7%, or less than one-fifth of their relative statewide proportion among HCFUs. The difference between the known population of HCFU pickup truck drivers and those choosing to participate in the online engagement serves as an important caveat to how broadly this study's findings can be applied to this segment of Washington drivers.

Both high total miles driven and low fuel economy contribute significantly to determining whether a driver is an HCFU.

The highest threshold HCFUs (1,500 gallons or more per year) drive 53% more miles than HCFUs using between 1,000 and 1,499 gallons. The latter, in turn, drive nearly triple the miles of non-HCFUs. Meanwhile, HCFUs between 1,000 and 1,499 gallons average 19.7 miles per gallon, 25% lower than non-HCFUs. Despite driving nearly triple the number of miles per year as non-HCFUs (22,700), an HCFU could achieve non-HCFU status if their vehicle had the same mpg as the average non-HCFU vehicle (26.1).

Of the completed surveys (both HCFUs and all other Washington drivers), only 6% came from pickup truck drivers, or less than one-third of their relative statewide proportion (20% of all vehicle types). Among completed survey responses from HCFUs, pickup drivers made up only 7%, or less than one-fifth of their relative statewide proportion among HCFUs. The difference between the known population of HCFU pickup truck drivers and those choosing to participate in the online engagement serves as an important caveat to how broadly this study's findings can be applied to this segment of Washington drivers.

Figure 42: HCFUs Drive More Miles and Have Lower MPG Vehicles



The higher the reported household income, the higher the level of fuel consumption.

The online engagement revealed that HCFUs have higher household incomes than non-HCFUs. This finding may help explain why HCFUs do not view the upfront purchase price of an EV as their top concern, and why HCFUs indicate a willingness to pay more than 10% above the purchase price of a comparable gasoline vehicle when considering EVs.

Figure 43: Mean Household Income

	Sample Size	Mean Income
Total	n=450	$96,660†
Non-HCFUs (Under 1k/gallons per year)	n=290	$90,310†
HCFUs (1,000 to 1,499 gallons per year)	n=91	$104,400†
HCFUs (1,500+ gallons per year)	n=69	$111,780†

3.4.2. Knowledge of Electric Vehicles

HCFUs and non-HCFUs have similar levels of familiarity with EVs.

The survey revealed that contrary to initial hypotheses, HCFUs were just as knowledgeable as non-HCFUs about EVs. See Figure 43.

The initial hypothesis held that one reason HCFUs use so much fuel is because they may be unaware of the fuel-efficiency gains (and resulting fuel cost savings) of switching to an EV. However, the results of the consumer research demonstrated that HCFUs were just as knowledgeable about EVs as other drivers.

There was some evidence that additional information related to EVs may improve HCFUs' willingness to switch to an EV, but only for the drivers who use the most fuel (more than 1,500 gallons per year). See Figure 44.

Figure 44: Familiarity with Electric Vehicles

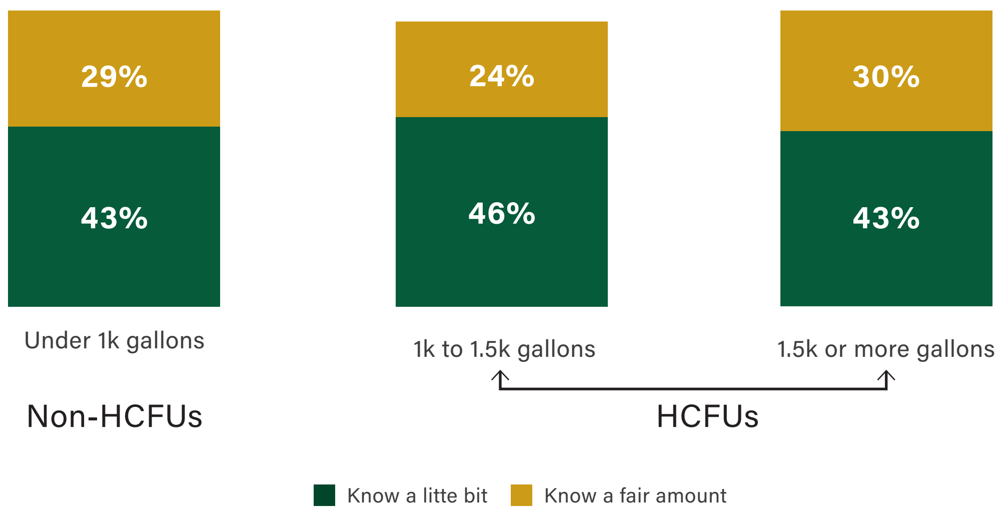
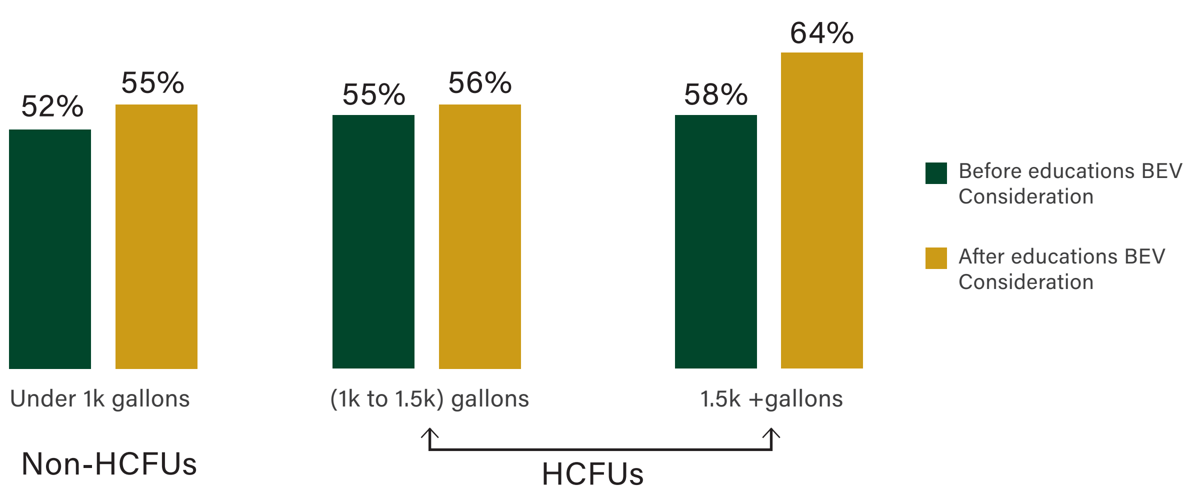


Figure 45: Additional Information Improves EV Acceptance only for Highest Consumption Fuel Users.



3.4.3. Perceived Barriers to Electric Vehicle Adoption

Purchase Price of EVs is not the top concern for HCFUs.

HCFUs were less likely to identify purchase price as the top barrier to purchasing an EV. This result is consistent with the fact that HCFUs have higher household income levels than non-HCFUs, and thus may be less price-sensitive.

There were differences, however, between the very highest level of HCFUs (1,500+ gallons per year), and the 1,000 to 1,499-gallon HCFUs. Drivers closer to the 1,000-gallon threshold were less price-sensitive than drivers using the highest levels of fuel.

Figure 46: Percentage of Washington Drivers that Cited Affordability as a Barrier to EV Adoption

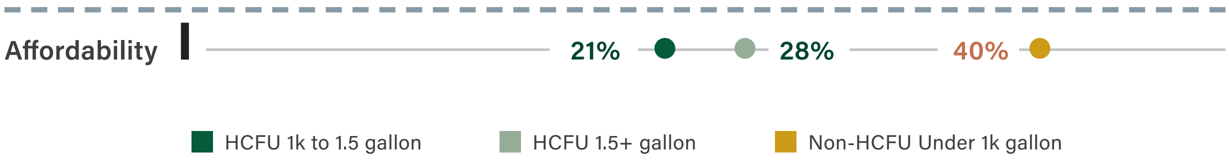
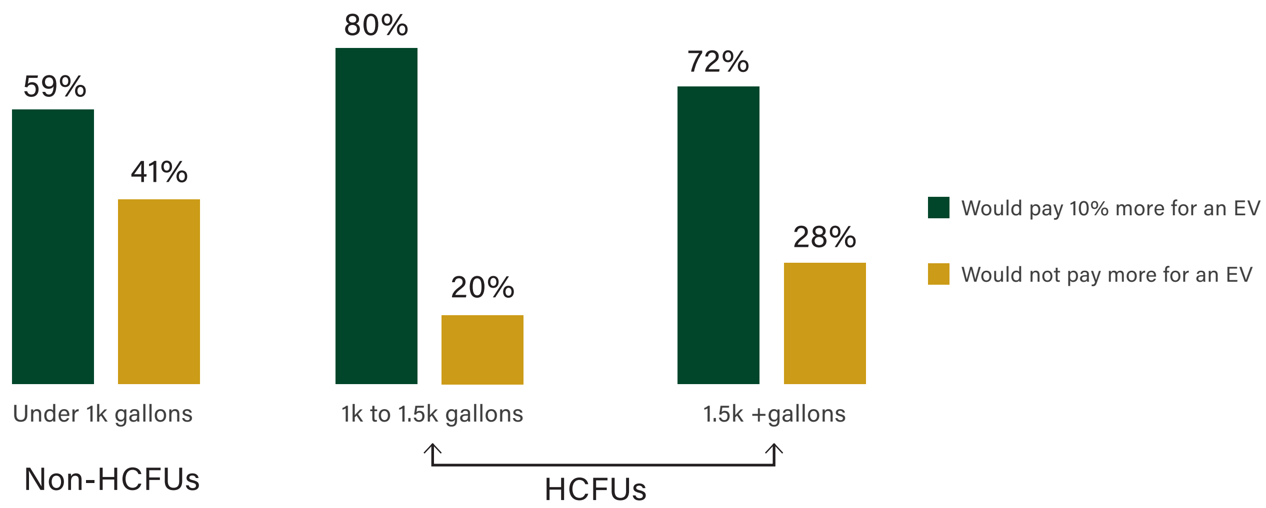


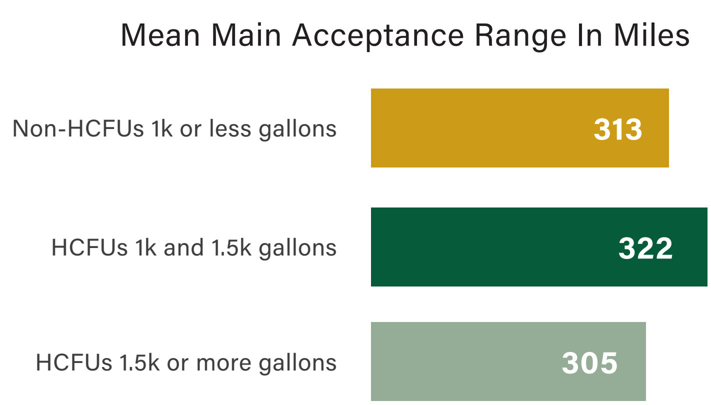
Figure 47: Percentage of Washington drivers willing to pay at least 10% more for an EV



HCFUs and non-HCFUs hold similar views and expectations for the driving range of EVs.

Since HCFUs travel so many more miles than non-HCFUs (Figure 41), it was hypothesized originally that HCFUs would be more concerned about the range limitations of an EV. The results from the online engagement did not support this hypothesis. HCFUs and non-HCFUs viewed limited EV driving range similarly.

Figure 48: Minimum Acceptable Range for Electric Vehicles (in miles)



The highest fuel consumption users are more concerned about how to charge at home.

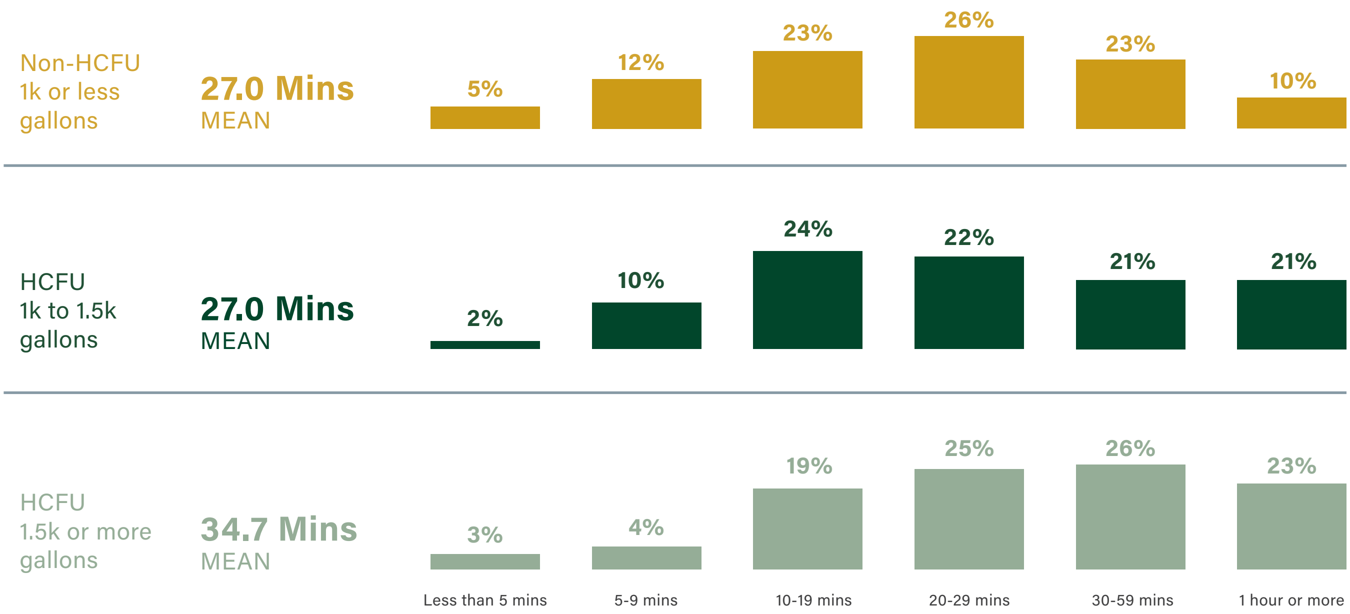
HCFUs and non-HCFUs held similar concerns about the ability to charge an EV at home, except for the highest fuel-consuming drivers (1,500+ gallons), who were more concerned about how to charge their EVs at home.

Figure 49: Percentage of Drivers with Concerns About Home-based Charging

HCFUs are more willing than non-HCFUs to tolerate longer EV charging times.

HCFUs are more willing to wait longer for an EV to charge, even beyond a one-hour wait time. It is unclear whether this willingness to wait is related to the sheer number of miles HCFUs are on the road (i.e., such wait times are "expected" for high-mileage drivers) or related to an acceptance of the trade-off between fuel cost savings for EVs versus longer wait times to recharge, or some other factor. In light of the findings related to HCFU's relative concerns about home-based charging, perhaps they view public charging as the remedy for obstacles to home charging and are more accepting of longer waits.

Figure 50: Willingness to Wait for EVs to Charge (in minutes)



Biggest difference in barriers to purchase are the performance characteristics of EVs.

The most telling difference between HCFUs and other drivers is their concerns about the performance characteristics of EVs. Since 86% of all HCFUs drive pickup trucks, SUVs, or vans, and since there is currently a scarcity of economically feasible electrified pickup trucks, large SUVs, and vans, it makes sense that HCFUs would identify "performance characteristics" of EVs as a significant barrier. The current number of available EV models that can effectively haul (workhorse segment), tow (Lifestyle segment), or carry packages for delivery (delivery segment) is very limited.

Figure 51: HCFUs More Concerned About Performance of EVs than Average Drivers

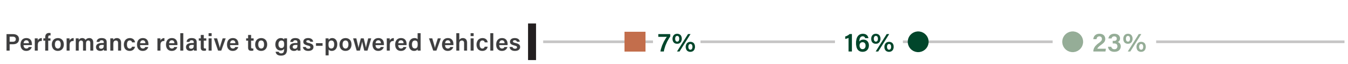
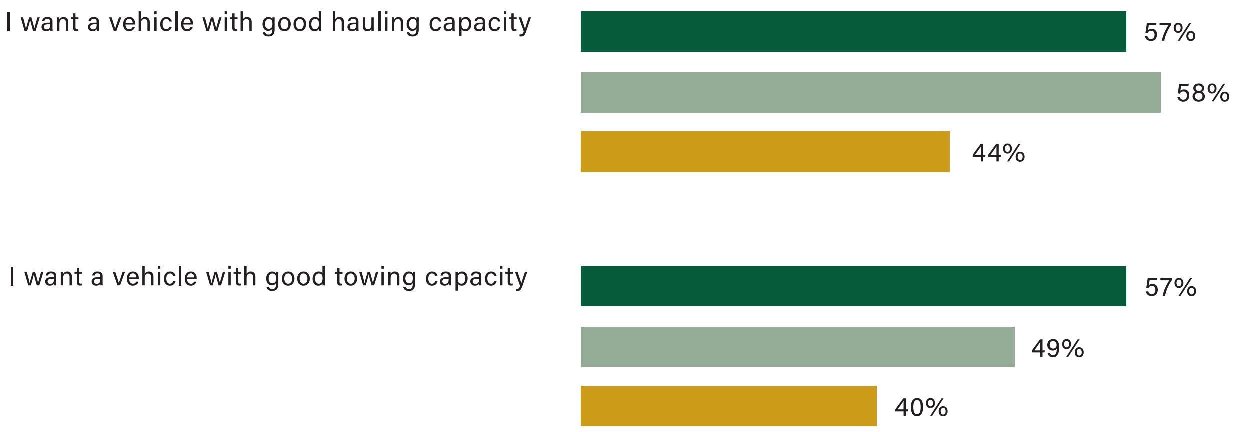


Figure 52: HCFUs Want Vehicles with Towing and Hauling Capability



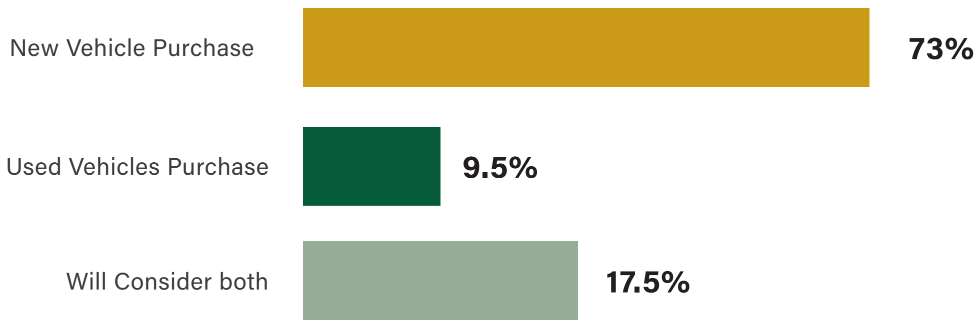
3.4.4 Interest in Purchasing a Vehicle

HCFUs are more likely to purchase a new vehicle than non-HCFUs, who are equally as likely to buy a used vehicle.

Earlier research found that on a national level, 68% of all vehicle purchases are used vehicles, not new vehicles. When asked about their next purchase, the consumer survey revealed that Washington drivers intend to purchase new vehicles (56%), somewhat contradicting national data on actual purchase transactions that favored used vehicles.

Compared to the average Washington driver, HCFUs are even more interested in buying a new vehicle than a used one.

Figure 53: HCFU Interest in New versus Used Vehicle Purchase

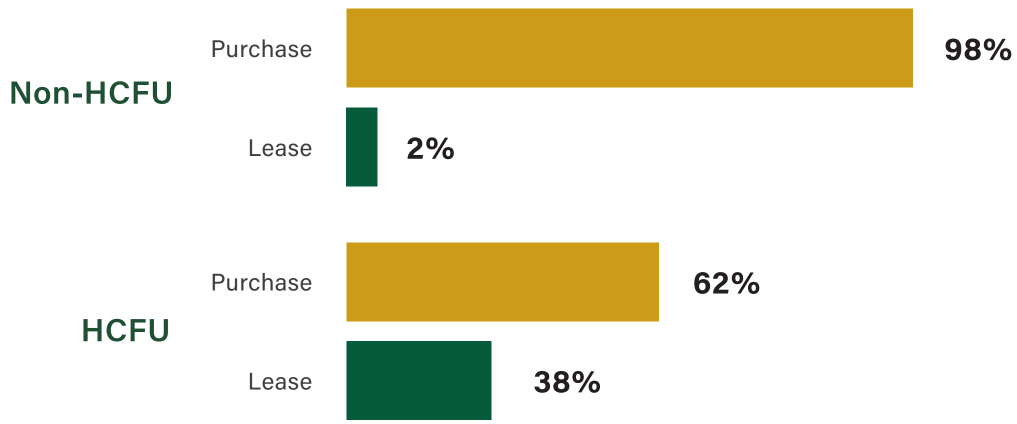


HCFUs are more likely to lease their next vehicle than non-HCFUs.

The online engagement results show that HCFUs are more likely to lease their next vehicle than non-HCFUs, who are significantly more likely to purchase. HCFUs' openness to lease their next vehicle (rather than outright purchase) is an important tool for encouraging EV adoption, because leases allow drivers to shift the long-term ownership risk (e.g., technological obsolescence) to the dealer, who will take back the vehicle after the lease period if the driver does not want to continue owning it.

A secondary benefit of leasing is that if EVs are not purchased outright by the driver at the end of the lease term, the vehicle can enter the resale market as a used EV, of which there is a current shortage relative to demand for used vehicles.

Figure 54: Intention to lease versus purchase a new vehicle



CHAPTER 4

Opportunities and Strategies to Encourage High-Consumption Fuel Users to Switch to Electric Vehicles

Section 4: Opportunities and Strategies to Encourage High-Consumption Fuel Users to Switch to Electric Vehicles

Chapter 3 presents results of the consumer research into high-consumption fuel users (HCFUs), their attitudes toward electric vehicles (EVs), their purchase preferences, and barriers to transitioning to EVs. Chapter 4 distills the insights gained from Chapter 3 to present a range of public policies and messaging opportunities to persuade HCFUs to shift to transition to EVs.

4.1 Policies that Performed Equally Well for All Drivers (High-Consumption Fuel Users and non-High-Consumption Fuel Users)

Several of the policies proposed as part of the consumer research were persuasive with HCFUs and non-HCFUs alike. Among the top four performing policies or incentives, three of them—fast chargers "available at gas stations," sales tax exemptions for purchases of EVs, and free Level 2 (medium speed) public charging stations—already exist (or are being implemented) in Washington.

Table 20: Top Scoring Electric Vehicle Incentives or Policies – All Washington Drivers

Rank Among HCFUs	EV Incentive or Policy	Non-HCFUs	HCFU (1,000 to 1,500 gallons)	HCFU (1,500 or more)
1	Fast chargers available at existing gas stations	158	136	143
2	Up to $1,470 sales tax exemption for new EV purchases	163	137	137
3	Five-cent annual rebate for every electric mile driven, capped at $3,000 per year	157	144	127
4	Free charging at Level 2 (medium speed) public charging stations	150	127	132

The fact that three of the top four proposed EV incentives have been implemented (or are underway) can be interpreted in a few different ways. First, Washington is already addressing consumers' most-desired conditions for purchasing an EV. Fast-charging stations are being deployed throughout Washington now and are expected to increase threefold within the next five years. The state currently offers a sales and use tax exemption on EV purchases, although the amount of the exemption varies based on the manufacturer's suggested retail price (MSRP) of the vehicle and when the purchase is made.1 Free Level 2 (medium speed) charging exists at many public charging locations; although, it is now more common for EV drivers to have to pay for those services than it is to receive them for free. Washington's existing EV incentives are already well-aligned to what consumers are seeking before purchasing an EV.

A second observation is that even though these incentives already exist in law, they are not available uniformly, nor to the full extent proposed as part of the consumer survey. While fast-charging stations are interspersed along major highways in Washington, they are not as ubiquitous and visible as gas stations, leaving much room to expand the rollout of the EV charging network. Similarly, the state sales tax exemption for EV purchases has been scaled back in recent years and is due to expire entirely in 2025. Perhaps the current exemption amount is less than needed to persuade consumers to purchase an EV and should be reconsidered in light of the consumer survey results. Finally, free Level 2 public charging is much less common today than it has been in past years, because more public charging stations are fully networked, provide point-of-sale capabilities, and are operated on a for-profit basis. Taken as a whole, consumers may be viewing these top-requested EV incentives as insufficiently robust to spur purchase of an EV.

A third observation is that Washington consumers simply may not be aware that these EV policies, incentives, and programs are available today. If this is the case, then opportunities exist to help fill the gap in knowledge or awareness of EV-supportive policies. This can be improved through improved public messaging (Section 4.2).

4.2 Messaging Opportunities

4.2.1. Improve Communications about Washington's Existing Incentives, Policies, and Programs Intended to Support Electric Vehicle Adoption.

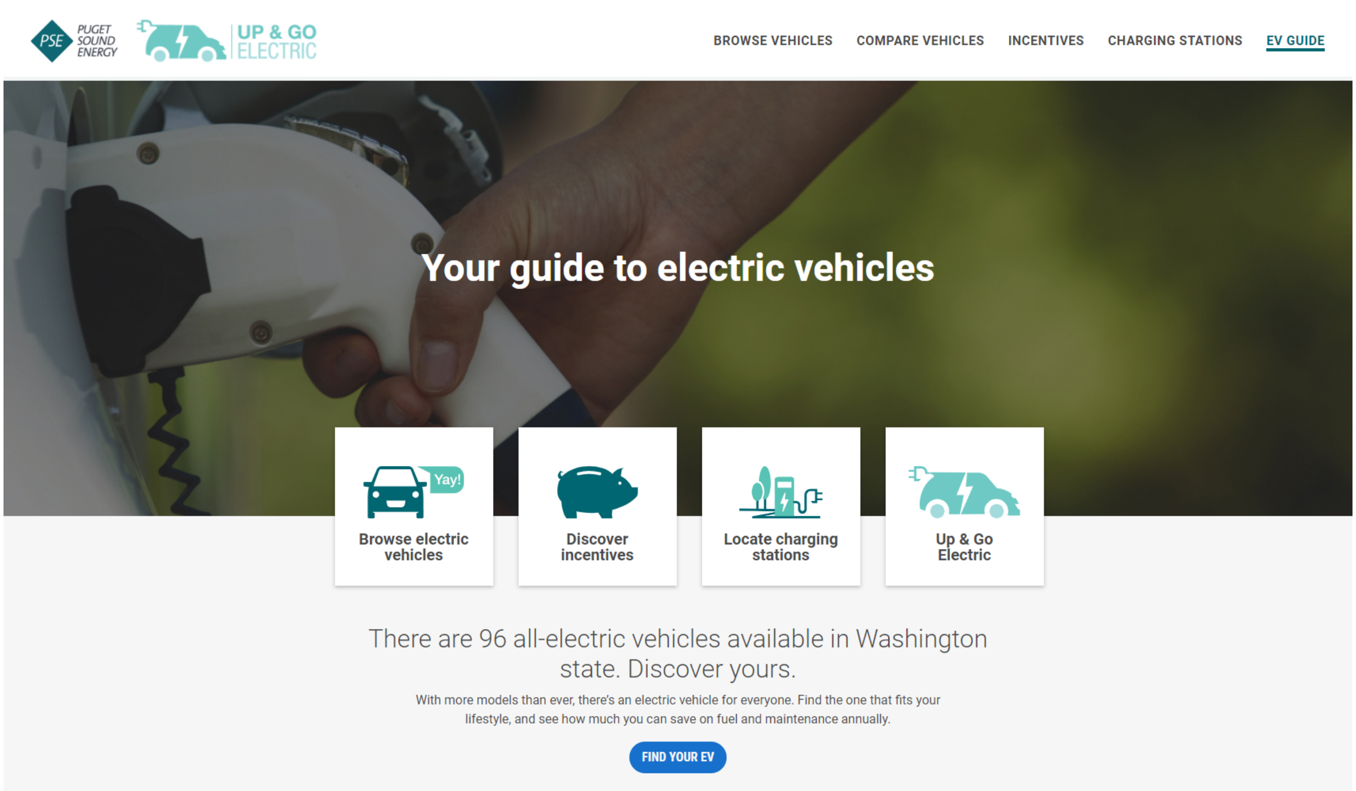
The simplest, least-cost strategies for encouraging HCFUs to transition to EVs is to improve public awareness of Washington's current EV tax incentives, existing public charging networks, and forthcoming expansion of direct-current (DC) fast-charging stations throughout the state.

Results from the consumer survey support the proposition that consumer adoption of EVs would likely increase if they better understood the programs and incentives already available under current Washington law.

One area for improved communications is in the design of the policies and programs themselves—in other words, how the policies and programs are structured (Section 4.2.2). But another opportunity exists to improve the communication modes and channels—how information is shared with consumers.

There are countless internet sites and web-based tools intended to communicate the benefits of driving an EV, available makes and models, expected costs, purchase incentives, and supporting services (such as EV charging stations). An example of an excellent comprehensive web portal for consumers searching for their next vehicle is Puget Sound Energy's Up & Go Electric web site. The site provides all essential information to support consumer decision-making about EVs.

Figure 55: Puget Sound Energy's Up & Go Electric EV Guide



Experts should conduct additional research into how to improve dissemination of relevant EV information in public communications, marketing, and human-centered design. Following are some areas for further consideration:

- On the very first "splash" page of a web site, allow consumers to select their own functional needs for a vehicle, based on their own driving habits, preferences, and common uses, to help sort and target relevant content as they begin their website exploration.
- Enhance the EV model availability sections to show used vehicles as well as new; models that are not yet available but have been announced or are widely reported to be available within 12 months; and a real-time (or at least frequently updated) indicator of specific make and model availability within the consumer-selected geographic region.
- Compile all relevant financial and operational incentives based on the consumer's principal residence, any mapped routes (such as work commutes or other common travel origins and destinations), and real-time (or frequently updated) electricity and gasoline prices based on zip code.
- Develop web sites specifically around driver profiles, similar to the HCFU market segmentation and profiles created as part of this report.

4.2.2. Simplification of the Design of Electric Vehicle Purchase Incentives to Enhance Consumer Understanding and Confidence

While improving the methods of communication might help close the consumer knowledge gap, a key insight gained from the research is that the specific policies, programs, and requirements related to EV incentives—and especially tax incentives for the purchase of an EV—are confusing for consumers. Depending on where an EV is purchased, several tiers of incentives may be available: federal, state, local electric utility, auto manufacturers, and more. Adding to the confusion is the staggering number of conditions, restrictions, and ever-changing effective dates and phase-out dates for these financial incentives.

There is an inherent trade-off between (a) the precision of the underlying tax policy and (b) how effective the policy is in persuading consumers to purchase an EV. The more complex the policy, the more difficult it is to communicate the financial incentive to consumers.

The most recent data on EV purchases as of Spring 2023 shows sales of new EVs slowing, rather than increasing, since the latest enactment of federal tax incentives. Market research firms report that would-be EV purchasers are in a wait-and-see mode because of the confusing regulations around federal tax incentives, which vehicle models qualify for incentives, the value of the incentive available to purchasers, and when the incentives phase out.

The State of Washington's current sales and use tax incentive is also complicated and changing. The current sales and use tax exemption available to consumers has changed twice during the pendency of this study; the tax exemption is scheduled to end altogether in July 2025.

As the implications of a highly complex federal EV tax scheme are now being felt in the EV sales numbers for 2023, it is hoped that Congress might streamline or simplify the tax incentives so would-be purchasers can move forward with EV purchases with confidence.

At the Washington state level, at minimum, more clear information and messaging is needed about the state-level financial incentives available to consumers, particularly in light of the scheduled phase-out of the sales and use tax exemption for EV purchases.

4.3 Policies and Programs Specifically Designed to Incentivize High-Consumption Fuel Users to Transition to Electric Vehicles

This section focuses on policies that are specifically aimed at persuading the highest gasoline consumers to switch to EVs. The premise underlying this section, if not the entire research into HCFUs, is that per capita, the greatest emissions reductions can be achieved if this small segment (6.3 percent [%]) of Washington drivers would transition to zero-emission vehicles. The four policy options highlighted in this section are designed specifically for HCFUs.

One challenge in developing policies that exclusively apply to HCFUs is how to identify this small subset of drivers. Mathematically qualifying vehicles that HCFUs use based on past usage is straight-forward: miles driven per year divided by the average fuel economy of the vehicle (measured in miles per gallon, or mpg) yields the number of gallons of gasoline consumed during the year.

However, when trying to design an incentive program for this segment of drivers, this simple formula only measures past consumption. Without collecting mileage data at least annually, it is much more difficult to assess whether a current vehicle owner currently is a HCFU.

4.3.1 Electric Vehicle Lease Incentives for High-Consumption Fuel Users

As noted in the introduction to Section 4.3, there is no current mechanism in state law that requires vehicle owners to report odometer mileage, except when a vehicle's title is transferred as part of a sales (or scrappage) transaction. However, auto dealerships that lease vehicles have both an interest and a contractual right to record a leased vehicle's mileage, since most leasing agreements cap the allowable number of miles that can be driven during the lease period, or an additional charge for every mile over the allowance must be paid by the lessee at the end of the lease.

There are several reasons why EV leases can be a powerful tool for accelerating EV adoption:

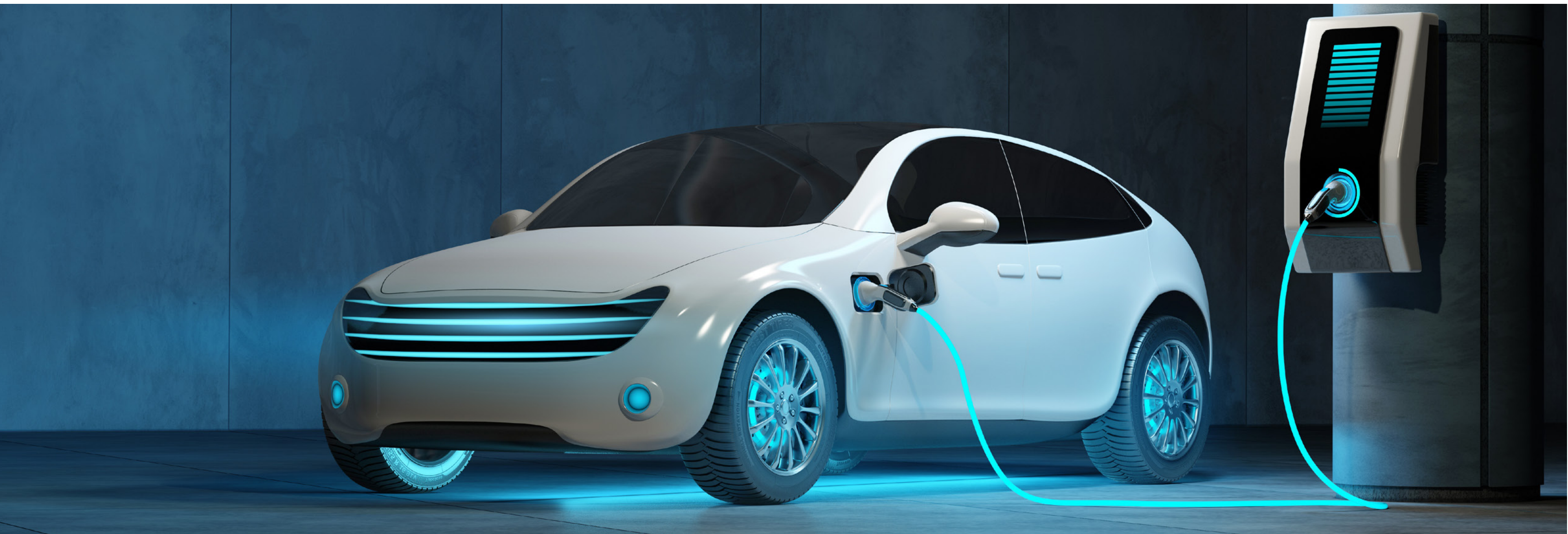
- **Lease periods act as an extended test drive.** Unless a driver decides to purchase the EV at the end of the lease period, leases allow drivers an extended "test drive" period, with lease periods typically ranging from 12 to 48 months, allowing the driver to decide whether the EV meets his or her driving needs. If it does not, the driver can return the vehicle to the dealership at the end of the lease period.
- **Technology risk is shifted to the dealer.** Even though EV sales in Washington represent about 15% of all new vehicles, EVs are still in an early phase of the technology adoption curve. Although there have been many advancements in battery range, charging speeds, performance characteristics, and model variety, vehicle improvements are still accelerating. The ability of a driver to return an EV at the end of the lease period shifts the risk of technological obsolescence to the dealer, providing a greater degree of assurance to the consumer.

- **Leasing an EV may be the simplest way to capture tax incentives.** The federal $7,500 tax credit for the purchase of a new EV is subject to restrictions: the vehicle must be made in North America, and the EV must contain certain percentages of battery components and materials from the United States or countries with which it has a trade agreement. Currently, only 10 EV models for sale in the United States meet these requirements. Because the Treasury Department classifies leased vehicles as "commercial vehicles," these restrictions on the $7,500 tax credit do not apply, because commercial vehicles are exempt from the North America manufacturing and battery-content requirements. As a result, consumers are now leasing EVs 41% of the time—four times greater than before the federal tax credit rules took effect.
- **Leases may help bolster the supply of used EVs quicker than purchases.** In 2022, 74% of U.S. vehicle sales were used vehicles. Yet, there is a relative shortage of used EVs available for sale in the marketplace. As sales of new EV increase, eventually this will result in more EVs that enter the used car market. However, the latest data show that people are keeping their new vehicles even longer, an average of 8.4 years. In contrast, the most common lease term is 36 months, which means that lease-return EVs will likely enter the used vehicle market much sooner than newly purchase EVs. An influx of leased EVs would help improve the supply of used EVs for the 74% of consumers who decide to buy a used vehicle.

A new state financial incentive for leased EVs could be tailored specifically for Washington HCFUs. Such a policy could be designed in a way that resembles the 5-cent-per-electric-mile rebate concept that was tested during consumer research. It was among the top EV incentives favored by both HCFUs and non-HCFUs alike.

Primary elements of an HCFU electric miles lease incentive could include the following:

- Rebates would accrue to dealers for every mile driven by an EV above 12,000 miles per year. With the average number of vehicle miles traveled in Washington at 9,992 miles, setting a floor of 12,000 miles incentivizes drivers to shift their daily driving to their newly leased EV, instead of relying on a second (presumably, gas-powered) vehicle.
- In return for receiving rebates from the HCFU electric miles lease incentive program, dealers must agree to two provisions: to not charge drivers for miles in excess of 12,000 miles per year and to keep the lease terms offered to drivers the same as for other 36-month leases of the same make and model. Specifically prohibited is requiring a larger upfront payment from lease customers that opt for the HCFU electric miles lease incentive program or adjusting the residual value of the leased EV in an amount that attempts to charge drivers for depreciation caused by the excess miles.



- HCFUs especially might benefit from such an incentive program, because they drive an average of about 25,000 miles per year. Currently, typical lease agreements charge 10 to 20 cents per mile for mileage in excess of 12,000 miles. Assuming an excess mileage rate of 15 cents per mile, an HCFU would owe $5,850 for excess mileage in a typical three-year lease agreement. Under an HCFU electric miles lease incentive program, that amount would instead be "paid" by the state to the dealer in the form of a rebate, with the HCFU driver owing nothing for the additional miles.
- At minimum, the leased electric miles rebate provided to dealers must cover the expected depreciation resulting from the HCFU driver exceeding 12,000 miles. The rebate amount must be enough to cover any change in the value of the returned lease vehicle resulting from the excess mileage.
- Currently, dealers may earn a small profit from excess mileage charges under lease agreements. An HCFU electric miles lease policy should similarly incentivize dealers to enter into leases with their HCFU clients. Additional research is needed to determine the best form and appropriate amount for a dealer incentive. For example, options could include a flat incentive of $1,000 per leased EV that exceeds 36,000 miles over the three-year lease term, or 2.5 cents for each electric mile in excess of the mileage allowance, etc.
- There should be an upper bound placed on the maximum amount of incentive available to dealers and HCFUs, to provide more budget certainty around the cost of such an incentive program. The mileage rebate available to dealers under a 36-month lease could be capped at a maximum of 40,000 electric miles. This mileage cap approximates the number of excess miles the average Washington HCFU drives over a 36-month period. Figure XX illustrates the formula.
- The HCFU electric miles incentive program lease period could be fixed at 36 months. This would provide more certainty around the budgetary costs of the program and help keep lease agreements simpler for dealers, consumers, and incentive program administrators.

Figure 56: Example of an High-Consumption Fuel User Electric Miles Lease Incentive

Assumptions

Average miles driven per year by Washington:	**25,000 miles/year***
Standard mileage allowance for 36-month vehicle leases:	**– 12,000 miles/year***

HFCU Electric Miles Lease Incentive Rebate from State of Washingtion = 13,000 miles/year

HFCU Electric Miles Lease Rebate, per mile 15 cents mileage rebate

Total 36-month HCFU Electric Miles Lease Rebate(15cents x 13,000 miles x 3 years) = $5,580 total rebate

(Option) Dealer incentive for leasing to HCFUs:

+ $1,000 for each 36-month lease return with mileage in excess of 36,000 miles

*Rounded. Actual average mileage for HCFUs in Washington is 25,375.

4.3.2. Electric Vehicle Purchase Incentives for Trading in a Low-/High-Mileage (High-Consumption Fuel Users) Vehicle

State and federal purchase incentives already exist for new and used EVs. Survey results indicate that such incentives serve as a strong motivator to HCFUs and non-HCFUs alike, with both groups scoring them similarly relative to other possible incentives. However, the existing incentives do nothing to differentiate between HCFUs and non-HCFUs. Federal income tax credits are conditioned upon the location of the vehicle manufacturer and sourcing of battery components and materials. State sales tax credits focus on the MSRP of the vehicle, a proxy for income of the vehicle buyer, with incentives available only for vehicles purchased below a certain price threshold.

To optimize the emissions-reducing power of purchase incentives for EVs, the state could add new incentives and/or adjust the existing sales tax credit in one of several ways. Given that HCFUs and non-HCFUs are similarly motivated to purchase EVs, and given a finite pool of incentive dollars under any state-funded program, each of the adjustment concepts presented below aims to encourage HCFUs to purchase EVs relative to non-HCFUs. All else being equal, an HCFU purchasing an EV to replace their existing gasoline vehicle displaces more greenhouse gas (GHG) emissions than a non-HCFU purchasing an EV to replace their existing hybrid sedan, for example.

Concept A: Dealer incentives for selling EV miles. The first concept is to create an auto dealer EV mileage incentive program that rewards dealers for the EV miles driven by the vehicles they sell over a period such as one year. Similar to the EV-leased mileage incentive program, this concept would leave the marketing and promotion of EVs to dealers, and it would encourage dealers to sell EVs to those customers who log the most miles.

A variation of this program could create a category of "displaced fuel" computed by dealers based on the mpg of a traded-in vehicle and the miles consumed by the vehicle purchased. Either concept would require dealers to collect miles driven data from the EVs they sell and the state (or its chosen third-party vendor) to reliably verify the data reported by dealers. Dealers achieving a certain number of miles driven by EVs sold or gallons displaced by EVs sold would be eligible for cash incentives provided by the state at various thresholds. Dealers' disposition of any reward funds would be at their individual discretion, with the presumption that the existence of the reward itself would motivate at least stronger EV marketing if not also pass-through savings to end customers.

Concept B: HCFU vehicle trade-in incentives. The second concept is more direct to the end consumer rather than the dealer and involves providing EV rebates and/or sales tax credits (each at point of sale) that scale based on the displaced fuel consumption of a vehicle being traded in. Similar to the federal Car Allowance Rebate System (CARS) from 2009, popularly known as "cash for clunkers," this concept would provide direct rebates to customers who trade in or scrap a high-mile/low-mpg qualifying vehicle (i.e., an HCFU's vehicle) for an EV, potentially with various tiers of rebate for increasing degrees of fuel displacement. To calculate fuel displacement, the customer and/or dealer would record the model year and odometer of the vehicle at sale, calculate average annual miles driven, and divide by the vehicle's combined U.S. Environmental Protection Agency (EPA) mpg rating to determine average annual gallons burned. Customers would then earn a rebate or sales tax credit to apply toward the purchase of an EV. The higher the avoided gallons burned, the higher the incentive. The following scenario illustrates an extreme example of how such a program could optimize displacement of fuel consumption.

- **Policy scenario:** Rebates available for all trade-ins: A flat rebate program, budgeted by the state at $1 million, which provides $5,000 toward the purchase of an EV when trading in a gas-powered vehicle, would support the purchase of 200 EVs. Since HCFUs and non-HCFUs are similarly motivated to purchase an EV, suppose the vehicles scrapped or traded, in exchange for new EVs, represented the statewide average, or 427 gallons per year. This program would lead to a total displacement of 85,400 gallons of fuel consumption.
- **Policy scenario:** Rebates only for HCFU vehicle trade-ins: A targeted rebate program could expend the same $1 million budget and provide the same incentive per vehicle, only aimed at HCFUs who consume an average of 1,328 gallons per year. This would result in a displacement of more than triple the amount of fuel, or 265,600 gallons. Given that HCFUs represent only 6.3% of the fleet, it is possible the incentive may need to be higher simply to attract this relatively more scarce consumer profile. Even doubling the incentive to $10,000 in this scenario, however, still results in fuel displacement of 132,800 gallons, or more than 50% the displacement under a flat rebate program.

Operating a targeted rebate or incentive program would be more costly and complex than a simple, flat rebate program. Dealers are already required to report vehicle identification number (VIN) and odometer mileage upon title transactions for vehicles less than 10 years old. To participate in and benefit fully from the program, dealers would likely need to report odometers for older vehicles as well. The specific incentive levels (rebates, sales tax credits) would need to be calculated based on available state funding levels and/or desired fuel displacement targets. In addition, the state would need to collect, monitor, and verify (or spot check) mileage credit claims to minimize the potential for fraud or abuse. Such administrative costs would need to be weighed against the expected additional benefits of targeted rebates.

4.3.3 Loaner Program Pilot Project Allowing Use of Gas-Powered Towing/Hauling Vehicle for Those Trading in Similar Vehicle for an Electric Vehicle

One of the perceived barriers to EV adoption among HCFUs, particularly drivers of pickup trucks, sport utility vehicles (SUVs), and vans, is the performance characteristics of EVs (Section 3.4.3). Currently, there are relatively few electric pickup trucks, third-row SUVs, and vans on the market that have the capability to effectively haul (workhorse segment), tow (Lifestyle segment), or carry packages for delivery (delivery segment).

While the total cost of ownership of Ford's EV variant of the F-150, the F-150 Lightning, compares favorably to its internal combustion engine (ICE) variants, vehicle range is greatly reduced when towing trailers (Section 2.4.1.1). According to a Motor Trend test using the top trip of the F-150 Lightning and trailers ranging in weight from 3,100 to 7,200 pounds, the Lightning's range was reduced from 300 to 115 miles (a 62% reduction) when hauling the lightest trailer in the test and 90 miles (a 70% reduction) when hauling the heaviest trailer in the test.[2] Moreover, many truck-owning HCFUs may not be in the market for a new truck if an older model with similar hauling and towing capabilities suits their needs for work (construction, landscaping, etc.).

Larger SUVs such as Rivian's R1S is a higher-end vehicle marketed toward early adopters and an enthusiast market that carries a significant price-premium over more utilitarian ICE SUVs, such as the Toyota 4Runner (Section 2.4.1.1). However, the Rivian R1S also suffers similar reductions in range when towing boats, campers, or trailers.

Drivers of these vehicles, particularly those in the Lifestyle segment, may only use the full capability of these vehicles a handful of times per year, while most of the time the vehicle is being used for routine commuting and errand running. As of 2021, 52% of all trips across all modes of transportation were under 3 miles, while only 2% of all trips were greater than 50 miles.[3]

One potential way to incentivize HCFUs to transition to EVs is to pilot a loaner program that would allow access to an ICE vehicle for the occasional trip that requires capabilities beyond what is offered by EVs currently on the market. As an example, if an HCFU in the Lifestyle segment needed to tow a trailer or go on a long road trip in an area with limited public charging access, they could be reimbursed for the occasional rental of an ICE vehicle to make these trips, while using an EV for the bulk of their everyday driving.

Rather than establishing a state-run rental program, the most cost-effective implementation strategy may be to leverage existing vehicle rental agencies (e.g., Enterprise, U-Haul) and reimburse HCFUs for renting an ICE vehicle. Additionally, standard rates negotiated between the state and rental agencies could reduce the administrative burden for the state agency running the program. Given many rental agencies forbid towing with at least some of their rental vehicles, the state could simultaneously provide incentives to rental agencies in select geographies to offer rental policies that allow towing.

This type of arrangement would also simplify the user experience for HCFUs because vehicle owners could simply submit a voucher or post-trip receipt for the rental of an ICE vehicle at a standard rate they already know is pre-approved.

To minimize the potential for fraud and abuse, the state may consider limiting the number of vouchers or reimbursed rentals per EV owner per year—for example, to a fixed number of rental days or miles driven. This limit would also conserve the amount of benefit accrued by a limited number of HCFUs, ensuring state incentive funds are dispersed among many drivers.

Such a program could begin as a pilot for a fixed duration or with an allotted budget to measure its effectiveness at incentivizing HCFUs to switch to EVs before committing to a permanent or larger-scale program.

4.3.4 Free Home Charger Incentive Program

Based on the results of the consumer engagement, HCFUs—and especially the highest-consuming fuel users among them, who use more than 1,500 gallons of gasoline per year—are more concerned about home charging capabilities than the average Washington driver. To help HCFUs overcome their concerns, and as a way to further minimize the need to rely on public charging stations, the State of Washington could provide free Level 2 home charging, plus a rebate equivalent to 20% of the expected installation costs (i.e., electrician to wire the charging station to the house's electrical panel). Similar offers and programs exist in different states, including a California Air Resources Board program that provides new EV purchasers with a choice between a free home charger with installation (capped at $2,000 value) or a simpler home charger along with an EVGo (public charging station operator) account and charge card pre-loaded with $1,000 worth of charging sessions at their stations. For more information, the California Air Resources Board Clean Vehicle Assistant Program.

While the State of Washington already provides a sales tax exemption on the purchase and installation of home chargers, the value of that exemption (say, 9.6% sales tax exemption on a total installed price of $2,000) is less than $200. While helpful, based on the concerns raised by HCFUs in the consumer survey, it does not appear to be compelling enough to help the highest-consuming fuel users to overcome their concerns.

As with the other HCFU-specific incentive options, the biggest challenge is how to identify whether prospective EV purchasers are currently driving enough miles, with low-mpg vehicles, to meet the adopted HCFU threshold for gallons consumed.

4.4 Summary

The online engagement conducted with Washington drivers revealed those policies that performed well for both HCFUs and non-HCFUs: fast chargers at gas stations, sales tax exemptions for EV purchases, and free Level 2 public charging stations. While these incentives already exist in Washington, they are not uniformly available or well-known to consumers.

An opportunity exists to improve communication about these existing incentives and programs that support EV adoption. This can be achieved through enhanced web portals and online tools that provide comprehensive information about EVs, including benefits, available models, costs, incentives, and charging infrastructure. The design of these platforms should allow users to customize their EV purchaser profile by sharing their driving habits and preferences so that the sites tailor the content they receive. Additionally, financial and operational incentives based on the area in which they live, and real-time fuel prices (both gasoline and electricity), could be compiled for consumers' convenience.

The complexity of current EV purchase incentives, especially tax incentives, has been identified as a barrier to consumer understanding and confidence in purchases. Simplifying the design of these incentives can only help to enhance consumer comprehension. The most recent federal tax incentives, in particular, are reported to be confusing, leading to a wait-and-see approach among potential EV purchasers, as evidenced by slowing EV adoption rates the first quarter of 2023. Streamlining these incentives at the federal level and providing clearer information about state-level incentives, such as the sales and use tax exemption in Washington, is an opportunity to improve EV adoption more broadly.

The main purpose of this study is to identify policies specifically targeted at incentivizing HCFUs to transition to EVs. Section 4.3 highlights four HCFU-specific policy options. One proposed policy is an EV lease

incentive for HCFUs, where rebates would be provided to dealers for every electric mile driven by an EV above 12,000 miles per year. This encourages HCFUs to shift their daily driving to EVs and offers both dealers and HCFU drivers financial benefits if their high-mileage driving is shifted to a leased EV.

Another policy option is to provide an EV purchase incentive for trading in low-mpg/high-mileage vehicle (that is, a vehicle most often driven by HCFUs). By providing direct rebates or sales tax credits based on the displaced fuel consumption of a traded-in vehicle, this incentive program differentiates between HCFUs and non-HCFUs. This policy approach also aims to optimize emissions reductions by encouraging HCFUs to purchase EVs that displace more GHG emissions.

A third policy option that seems favored by HCFUs would be piloting a vehicle loaner program that allows HCFUs to use gas-powered towing/hauling vehicles for occasional trips that require capabilities beyond what current EVs offer. This program would provide vouchers or reimburse HCFUs for renting gas-powered vehicles when needed, while they continue to use their new EVs for everyday driving. By addressing the performance limitations of EVs for certain driving needs (e.g., towing a boat), this program aims to incentivize those HCFUs who rely on pickups and larger SUVs.

The fourth HCFU-specific policy option proposes creation of a free home charger incentive program for HCFUs. This program would provide free Level 2 home chargers and rebates for installation costs. It aims to address the concerns of HCFUs regarding home charging capabilities and minimize reliance on public charging stations. The California Air Resources Board created a similar state-level program as their Clean Vehicle Assistance Program. While the State of Washington already offers a sales tax exemption on the purchase and installation of a home-based charger, the value of this exemption (about $192) is far less than the value of a free home charger with subsidized installation costs (about $2,000).

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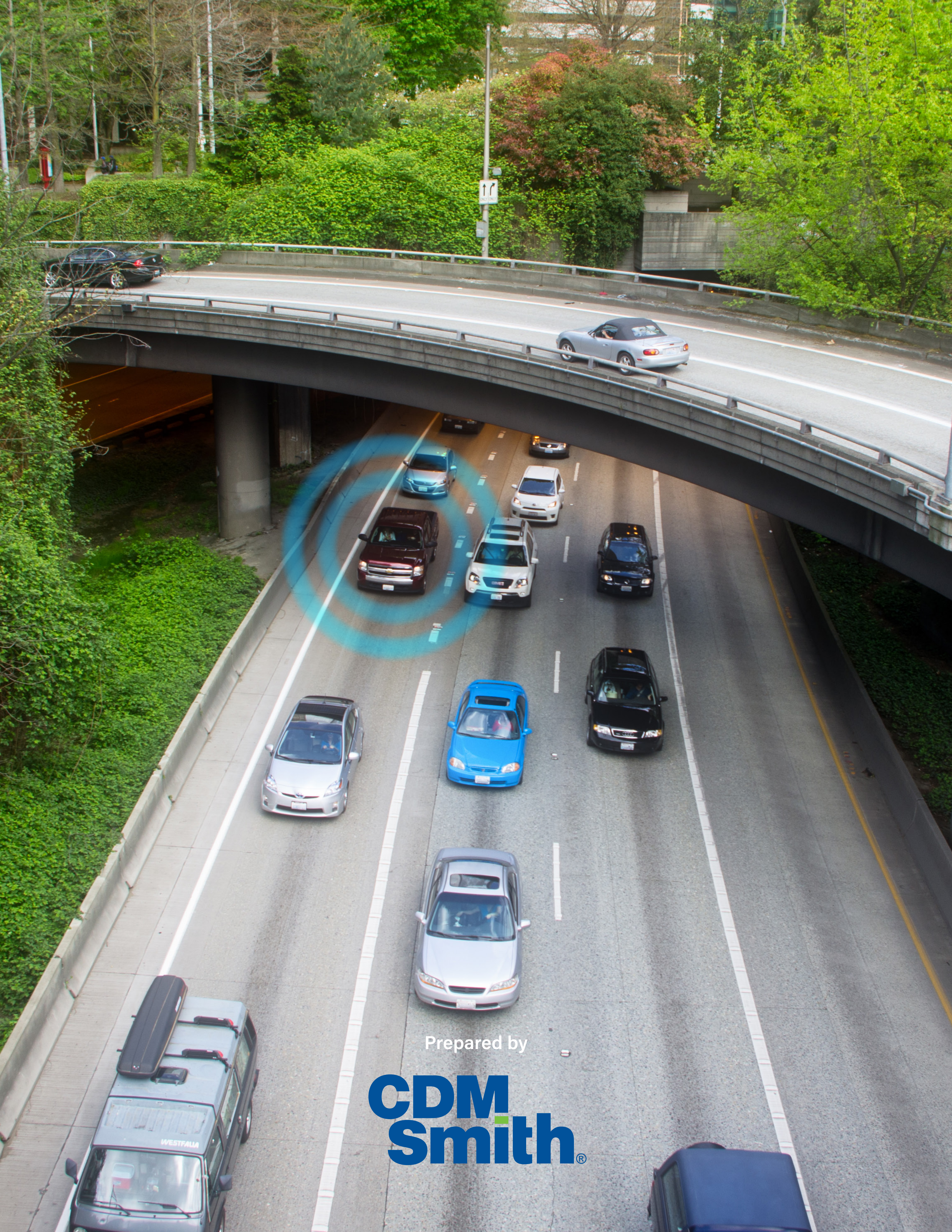

Prepared by

CDM Smith