Electric Vehicle Technologies and Selected Policy Issues for the 119th Congress

August 27, 2025

Congressional Research Service
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R48648

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SUMMARY

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August 27, 2025

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Electric vehicles (EVs) remain a focus of transportation and energy policy in the United States. EVs—comprising hybrid-electric vehicles (HEVs), plug-in hybrid-electric vehicles (PHEVs), and battery-electric vehicles (BEVs)—are alternatives to conventional internal combustion engine (ICE) vehicles powered by petroleum-based fuels. EVs are part of a broader effort to reduce greenhouse gas (GHG) emissions, decrease reliance on petroleum-based fuels, and promote domestic manufacturing. Light-duty EV sales have grown steadily since 2010, reaching 3.2 million units sold in 2024—approximately 20% of all U.S. light-duty vehicle sales.

The deployment of PHEVs and BEVs, collectively referred to as *plug-in electric vehicles*, is closely linked to the availability of charging infrastructure. EV charging technologies are categorized into three charging levels, differentiated by the voltage of the electrical source: Level 1 (120 volts alternating current [AC]), Level 2 (240 volts AC), and direct current (DC) fast charging (Level 3). Different applications are available for residential, workplace, and public use. Public and private investment, including federal support through grant programs and tax incentives, has contributed to an expanding national network of EV charging stations. Continued expansion of access to charging infrastructure remains a key factor for future EV adoption.

Federal policies supporting EVs and vehicle electrification have been shaped by laws such as the Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58) and the law commonly referred to as the Inflation Reduction Act (IRA; P.L. 117-169). These laws have created or expanded programs and other incentives to support EV adoption, charging infrastructure deployment, and vehicle and infrastructure production. Key programs and incentives include the National Electric Vehicle Infrastructure (NEVI) Formula Program, Charging and Fueling Infrastructure (CFI) Grants, and tax credits for purchases of new and used EVs, for installation of EV charging infrastructure, and for domestic production of EV components and critical minerals.

During the 119th Congress, executive actions and legislative proposals have signaled a shift in policy priorities, introducing uncertainty regarding the federal role in vehicle electrification. Executive Order 14154 ("Unleashing American Energy," signed January 20, 2025) directed federal agencies to pause IIJA and IRA grant program disbursements pending program reviews. Standards for vehicle fuel economy and emissions are under review. Reports of staffing reductions across federal agencies—including at the Departments of Energy (DOE) and Transportation (DOT), the Environmental Protection Agency (EPA), and the Internal Revenue Service (IRS)—could pose challenges for administering programs and incentives that support vehicle electrification. In Congress, legislation regarding EV-related programs has been introduced, including proposals to limit or repeal those programs established or modified by the IIJA or IRA. On July 4, 2025, the FY2025 reconciliation act, commonly referred to as the One Big Beautiful Bill Act (OBBBA), was signed into law (P.L. 119-21). It includes provisions that limit or repeal several EV-related programs that were modified or established in the IRA.

These policy developments are set to influence the pace and trajectory of vehicle electrification in the United States. While the extent of federal support is uncertain, private investments and state and local actions may continue to shape EV adoption and infrastructure deployment.

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Introduction

In the 119th Congress, more than a dozen bills have been introduced that would impact federal policies and incentives related to transportation electrification.[1] In particular, these bills concern programs and incentives enacted or modified in the Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58; signed into law November 15, 2021) and the law commonly referred to as the Inflation Reduction Act (IRA; P.L. 117-169; signed into law August 16, 2022). The FY2025 reconciliation act, commonly referred to as the One Big Beautiful Bill Act (OBBBA), signed into law July 4, 2025, as P.L. 119-21, includes provisions that limit or repeal several EV-related programs that were modified or established in the IRA.

Since the late 20th century, interest has grown in the use of electric vehicles (EVs) and other vehicles as alternatives to petroleum-fueled internal combustion engine (ICE) vehicles predominantly to address environmental concerns about petroleum consumption and greenhouse gas (GHG) emissions in transportation.[2] Broadly, "electric vehicles" refers to three types of light-duty vehicles with electric motors and traction battery packs ("traction batteries"):[3]

- **Hybrid-electric vehicles (HEVs).** In an HEV, the internal combustion engine supplies primary power to the wheels. The electric motor and traction battery provide supplemental power to the wheels. The traction battery is charged by the engine and regenerative braking.[4]
- **Plug-in hybrid-electric vehicles (PHEVs).** Depending on the PHEV model, the internal combustion engine and/or the electric motor and traction battery supply primary power to the wheels. The traction battery is charged by an external source of electricity, as well as by the engine and regenerative braking.[5]
- **Battery-electric vehicles (BEVs; also called *all-electric* or *fully electric vehicles*).** In a BEV, power to the wheels is supplied entirely by the electric motor and traction battery. The traction battery is charged by an external source of electricity and by regenerative braking.[6]

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[1] As of the date of this report, the following bills have been introduced: H.R. 973 and S. 389, H.R. 1052, H.R. 1253 and S. 536, H.R. 1513 and S. 651, H.R. 1892, H.R. 1982 and S. 913, H.R. 3972 and S. 1066, H.R. 3097, S. 2653.

[2] Charles Jeantaud is credited with the development of the first "electric vehicle" in 1881. This battery-powered carriage was part of a global shift to motorize road transportation. The first "internal combustion engine vehicle" was developed a few years later. Prior to this, streetcars were electrified through the use of underground or overhead cables. Early electric vehicles quickly gained popularity as a personal means of transportation, but were edged out of the market by early internal combustion engine vehicles, led by the Ford Model T (introduced in 1908). Gijs Mom, *The Electric Vehicle: Technology and Expectations in the Automobile Age*, trans. Jenny Wormer (Johns Hopkins University Press, 2004), pp. 17, 30-31; and U.S. Department of Energy (DOE), "The History of the Electric Car," September 15, 2014, https://www.energy.gov/articles/history-electric-car.

[3] "Light-duty" includes passenger cars, pickup trucks, sport utility vehicles (SUVs), and minivans. A *passenger car* or *passenger motor vehicle* is "a motor vehicle with motive power designed to carry not more than 12 individuals, but does not include—(A) a motor cycle; or (B) a truck not designed primarily to carry its operator or passengers." 49 U.S.C. §32101. A *light-duty vehicle* is "a passenger car or passenger car derivative capable of seating 12 passengers or less." 40 C.F.R. §86.1803-01.

[4] In certain contexts, hybrid-electric vehicles (HEVs) are not included when referring to electric vehicles (EVs). Alternative Fuels Data Center (AFDC), "Hybrid Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-hev.

[5] AFDC, "Plug-In Hybrid Electric Vehicles [PHEVs]," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-phev.

[6] AFDC, "All-Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-ev.

PHEVs and BEVs are often collectively referred to as *plug-in electric vehicles* ("plug-in EVs") to distinguish these as a subset of EVs that can connect to an external power source.

In the United States, the transportation sector accounted for 28% of GHG emissions in 2022, the most of any sector.[7] Light-duty vehicles contributed 57% of total transportation emissions. Sources that contributed to the remainder included medium- and heavy-duty trucks, aircraft, trains, and ships and boats.[8]

EVs may help decrease transportation sector emissions of GHGs, particulate matter, and other air pollutants by reducing the use of petroleum-based fuels. BEVs and PHEVs (during electric operation) emit zero tailpipe emissions. Instead, emissions are attributable to the electricity generation associated with vehicle charging.[9] Consequently, a plug-in EV's per-mile emissions depend on the sources used to generate electricity. Electricity sources vary hourly, seasonally, and by region.[10] In the long run, a plug-in EV's per-mile emissions can also be expected to change as generation sources change.[11]

This report provides a primer on the U.S. electric vehicle market, starting with a discussion of the three types of light-duty electric vehicles and related technology. A discussion of federal policies affecting EV adoption follows.

Vehicle Technologies

The primary characteristic that distinguishes an ICE vehicle from an EV is the source of propulsion. In an ICE vehicle, propulsion comes entirely from an internal combustion engine. In an EV, propulsion is supplied entirely by, or in conjunction with, an electric motor and a traction battery comprising numerous battery cells.[12] The sources of propulsion for ICE vehicles and the three types of EVs are summarized in **Figure 1**.

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[7] Emissions from transportation sources include from two- and three-wheel vehicles, light-duty vehicles, buses and minibuses, heavy trucks, shipping, and aviation. U.S. emissions from electric power accounted for the second-largest portion (25%) of total U.S. greenhouse gas (GHG) emissions in 2022, followed by emissions from industry (23%). Emissions from the agriculture, commercial, and residential sectors and the U.S. territories combined for 24% of GHG emissions. Environmental Protection Agency (EPA), *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2022*, EPA 430-R-24-004, April 11, 2024, Table ES-5, "U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (MMT CO2 Eq.)," https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

[8] An "other" category included buses, motorcycles, pipelines, and lubricants. EPA, "Fast Facts on Transportation Greenhouse Gas Emissions," June 6, 2025, https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions.

[9] Emissions are also attributable to vehicle production and fuel extraction and production. For more information, see CRS Report R46420, *Environmental Effects of Battery Electric and Internal Combustion Engine Vehicles*, by Richard K. Lattanzio and Corrie E. Clark.

[10] AFDC, "Emissions from Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-emissions; U.S. Energy Information Administration (EIA), "Hourly Electricity Consumption Varies Throughout the Day and Across Seasons," *Today in Energy*, February 21, 2020, https://www.eia.gov/todayinenergy/detail.php?id=42915; and EIA, "U.S. Electricity Generation by Energy Source 8/8/2025-8/15/2025," accessed August 26, 2025, https://www.eia.gov/electricity/gridmonitor/expanded-view/electric_overview/US48/US48/GenerationByEnergySource-4.

[11] EPA, "Power Sector Evolution," updated June 3, 2025, https://www.epa.gov/power-sector/power-sector-evolution.

[12] The traction battery packs found in EVs are distinct from the smaller 12-volt batteries, typically of a lead-acid chemistry, that supply power to various vehicle electronics and assist with start-up processes in both ICE vehicles and EVs. Andrei Nedelea, "12-Volt Batteries on Electric Cars: Everything You Need to Know," *InsideEVs*, June 28, 2024, https://insideevs.com/features/724785/ev-12-volt-battery-explained/; and Automotive Cells Company, "Battery Cell, Module or Pack. What's the Difference?," June 30, 2022, https://www.acc-emotion.com/stories/battery-cell-module-or-

(continued...)

Figure 1. Differences in Propulsion Sources

Technology	Internal combustion engine vehicle	Hybrid-electric vehicle	Plug-in hybrid-electric vehicle	Battery-electric vehicle
Internal combustion engine	✓	✓	✓	
Electric motor & traction battery pack		✓	✓	✓
Plug-in electric charging			✓	✓

Source: CRS graphic with information from Alternative Fuels Data Center (AFDC), "How Do Gasoline Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-gasoline-cars-work; AFDC, "Hybrid Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-hev; AFDC, "Plug-In Hybrid Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-phev; AFDC, "All-Electric Vehicles," accessed August 26, 2025, https://afdc.energy.gov/vehicles/electric-basics-ev.

Light-duty ICE vehicles (**Figure 2**) rely primarily on petroleum-based fuel (typically gasoline or diesel), which is injected into a small chamber in the internal combustion engine where a spark ignites the fuel to produce the power that propels the vehicle.[13] Between the engine, the transmission, and various other components, the ICE vehicle powertrain can comprise more than 100 moving parts.[14] These parts require regular maintenance to ensure the vehicle is in good working order. A typical ICE vehicle has a driving range of approximately 400 miles and a combined fuel economy rating of 22 miles per gallon (mpg).[15]

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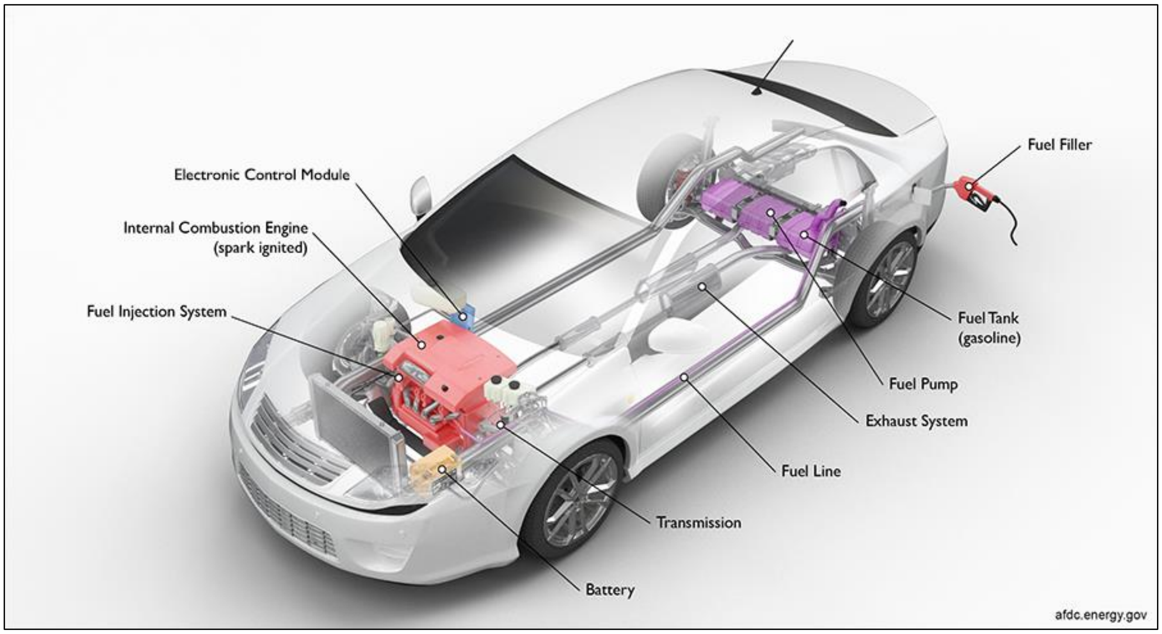
pack-whats-difference-infographics; and AFDC, "How Lithium-Ion Batteries Work," February 28, 2023, https://www.energy.gov/energysaver/articles/how-lithium-ion-batteries-work.

[13] AFDC, "How Do Gasoline Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-gasoline-cars-work.

[14] DOE, Idaho National Laboratory, *How Do Gasoline and Electric Vehicles Compare?*, accessed August 26, 2025, https://avt.inl.gov/sites/default/files/pdf/fsev/compare.pdf; and UBS Limited, *UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, May 18, 2017, p. 27. The teardown identified 167 moving and wearing parts in the Volkswagen Golf powertrain, parts that would require servicing or replacement over the lifetime of the vehicle.

[15] Fuel economy is a rating of how far a vehicle can travel with a specified amount of fuel, typically measured in miles per gallon (mpg) or miles per gallon of gasoline equivalent (mpge). The latter is a translation of fuel economy in kilowatt-hours (kWh) per 100 miles for battery-electric vehicles (BEVs) and PHEVs (during electric operation). Median driving range for model year 2021; median combined fuel economy for model year 2024. DOE Vehicle Technologies Office (VTO), "FOTW #1221, January 17, 2022: Model Year 2021 All-Electric Vehicles Had a Median Driving Range About 60% That of Gasoline Powered Vehicles," *Fact of the Week Newsletter*, https://www.energy.gov/eere/vehicles/articles/fotw-1221-january-17-2022-model-year-2021-all-electric-vehicles-had-median. Median combined fuel economy calculated by CRS with data from DOE and EPA, *Fuel Economy Guide, Model Year 2024*, data file, https://www.fueleconomy.gov/feg/download.shtml. In contrast to fuel economy, fuel efficiency is an estimate of how well a vehicle converts fuel into motion, typically reported as a percentage of energy. BEV efficiency can range from 77% to 100%, depending on the drive cycle, compared to 24% to 38% for HEVs and 12% to 30% for ICE vehicles. DOE and EPA, "Where the Energy Goes: Electric Cars," accessed August 26, 2025, https://www.fueleconomy.gov/feg/atv-ev.shtml.

Figure 2. Internal Combustion Engine (ICE) Vehicle



Source: U.S. Department of Energy, Alternative Fuels Data Center, "How Do Gasoline Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-gasoline-cars-work.

HEVs, PHEVs, and BEVs all feature regenerative braking, an energy conservation design that captures otherwise-wasted friction energy from deceleration to charge the traction battery. Certain hybrid models feature an additional energy conservation design. Following an idle stop, these vehicles can delay reignition of the internal combustion engine and use the electric motor and traction battery to resume motion.[16]

HEVs (**Figure 3**) bear the most similarity to ICE vehicles. HEVs rely primarily on an internal combustion engine to propel the vehicle.[17] Once running, however, an HEV's electric motor and traction battery provide supplemental propulsion power. HEVs cannot be charged via external electricity; rather, the traction battery is charged by the engine while the vehicle is in use or through regenerative braking. These features contribute to a generally higher average fuel economy rating compared to ICE vehicles.

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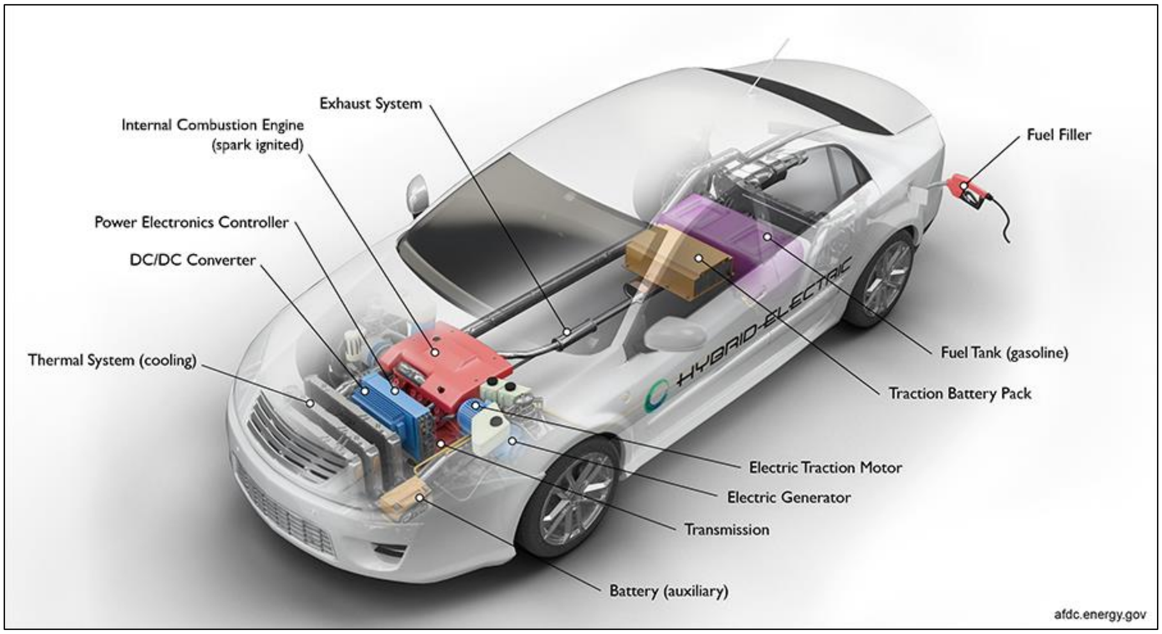
[16] An idle stop or stop-start system shuts off the internal combustion engine at complete stops (e.g., at stoplights), which conserves fuel and can increase fuel economy by up to 5%. DOE and EPA, *Fuel Economy Guide, Model Year 2025*, p. 7, https://www.fueleconomy.gov/feg/pdfs/guides/FEG2025.pdf. In certain hybrid vehicles, the internal combustion engine is set to reignite once the vehicle achieves a certain speed.

[17] AFDC, "Hybrid Electric Vehicles."

Figure 3. Hybrid-Electric Vehicle (HEV)



Source: U.S. Department of Energy, Alternative Fuels Data Center, "How Do Hybrid Electric Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-hybrid-electric-cars-work.

PHEVs (**Figure 4**) also feature a hybrid design that includes an internal combustion engine and an electric motor paired with a traction battery.[18] PHEV traction batteries typically have a greater electricity storage capacity than HEV traction batteries, and they can be charged via an external source of electricity. The greater battery capacity makes it possible for PHEVs to operate relying on either the electric motor or the engine, or on a combination of the two.

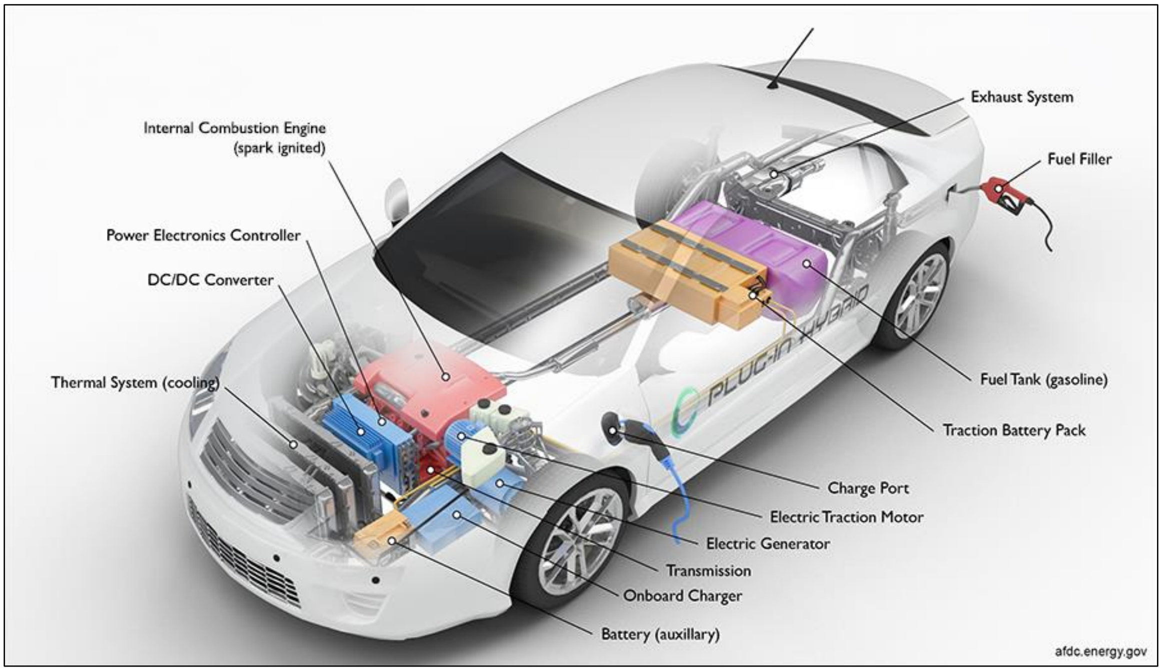
In PHEV models with a *parallel configuration*, the internal combustion engine and the electric motor can each provide direct propulsion power to the vehicle. In PHEV models with a *series configuration*, only the electric motor provides direct propulsion power to the vehicle, while the engine generates electricity for the electric motor. Some models are able to switch between parallel and series configurations.

PHEVs usually have higher average fuel economy ratings than HEVs or ICE vehicles. A typical PHEV has a combined fuel economy of 47 miles per gallon of gasoline equivalent (mpge) and a driving range of 430 miles.[19]

[18] AFDC, "Plug-In Hybrid Electric Vehicles."

[19] Model year 2024. Median combined fuel economy based on composite fuel economy ratings representing gasoline and electric operation. Median driving range based on total driving range with both gasoline and electric operation. Calculated by CRS with data from DOE and EPA, *Fuel Economy Guide, Model Year 2024*.

Figure 4. Plug-In Hybrid-Electric Vehicle (PHEV)



Source: U.S. Department of Energy, Alternative Fuels Data Center, "How Do Plug-In Hybrid Electric Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-plug-in-hybrid-electric-cars-work.

BEVs (**Figure 5**) operate entirely on electricity stored in a large traction battery, which must be charged via an external source of electricity.[20] The electric powertrain of a BEV features fewer moving and wearing parts and more electronic components compared to an ICE vehicle.[21] Because BEVs have different components than ICE vehicles, BEV manufacturing relies on distinct supply chains.

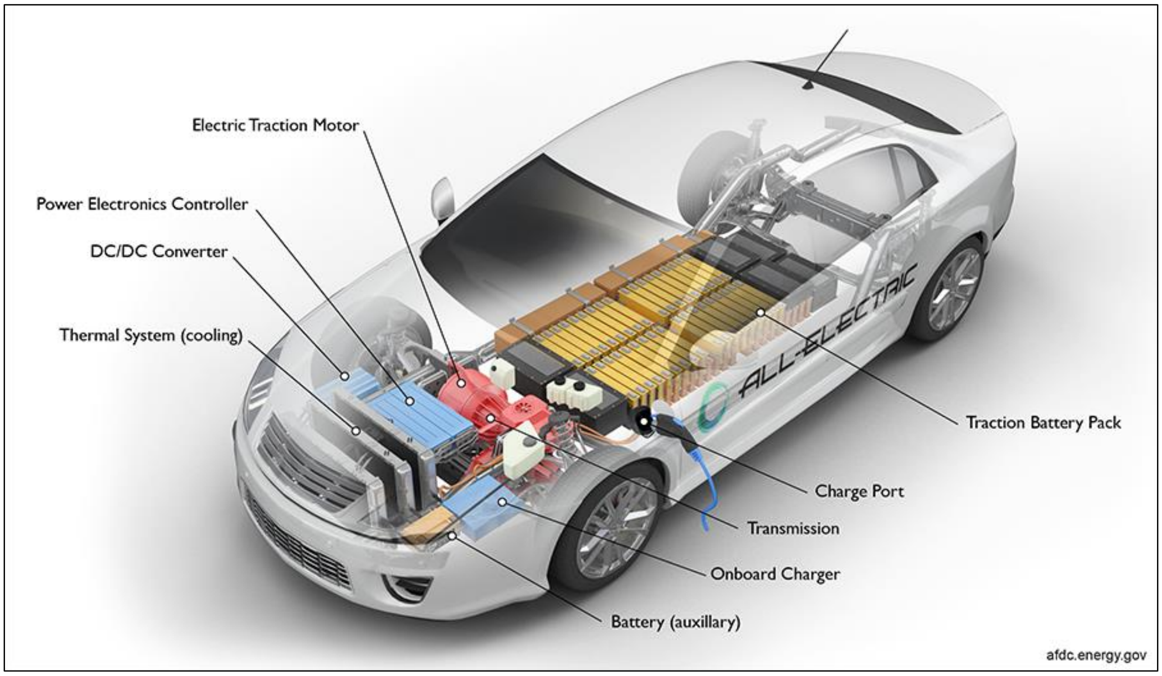
BEVs tend to have the highest average fuel economy among the vehicle types discussed in this report. A typical BEV has a combined fuel economy of 87 mpge and a driving range of 283 miles.[22]

[20] AFDC, "All-Electric Vehicles."

[21] UBS Limited, *UBS Evidence Lab Electric Car Teardown*, pp. 5 and 27. Analysts identified 35 moving and wearing parts in the Chevrolet Bolt compared to 167 parts for the Volkswagen Golf; analysts chose these models for their comparable sizes and features. In addition to having fewer parts in its powertrain, the Bolt was found to contain $4,000 more electronic content than the Golf.

[22] Median combined fuel economy calculated by CRS with data from DOE and EPA, *Fuel Economy Guide, Model Year 2024*. Driving range from DOE VTO, "FOTW #1375, December 30, 2024: Median EV Range in Model Year 2024 Reached a Record High of 283 Miles Per Charge," *Fact of the Week Newsletter*, https://www.energy.gov/eere/vehicles/articles/fotw-1375-december-30-2024-median-ev-range-model-year-2024-reached-record.

Figure 5. Battery-Electric Vehicle (BEV)



Source: U.S. Department of Energy, Alternative Fuels Data Center, "How Do All-Electric Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work.

EV Market Trends

Model year 2025 offerings in the U.S. vehicle market include 274 light-duty EV models—108 BEV models, 26 PHEV models, and 140 HEV models—from more than 30 automakers.[23] Overall EV sales in the United States (**Figure 6**) have increased from approximately 274,900 in 2010 to 3,167,904 in 2024; in 2024, EV sales made up 20% of all light-duty vehicle sales.[24] A similar trend was observed for the subset of plug-in EVs: Sales of PHEVs and BEVs (**Figure 7**) have increased from approximately 300 in 2010 to 1,561,511 in 2024, making up 9.9% of all 2024 light-duty vehicle sales. In 2023, BEVs, PHEVs, and HEVs accounted for 4.3% of all vehicle registrations.[25]

[23] Includes "electric," "plug-in hybrid electric," and "hybrid-electric" vehicles classified as "sedan/wagon," "pickup," "SUV," or "van" from a light-duty vehicle manufacturer for model year 2025. AFDC, "Alternative Fuel and Advanced Vehicle Search," accessed August 26, 2025, https://afdc.energy.gov/vehicles/search. See also AFDC, *Model Year 2025, Alternative Fuel and Advanced Technology Vehicles*, https://afdc.energy.gov/vehicles/search/download.pdf.

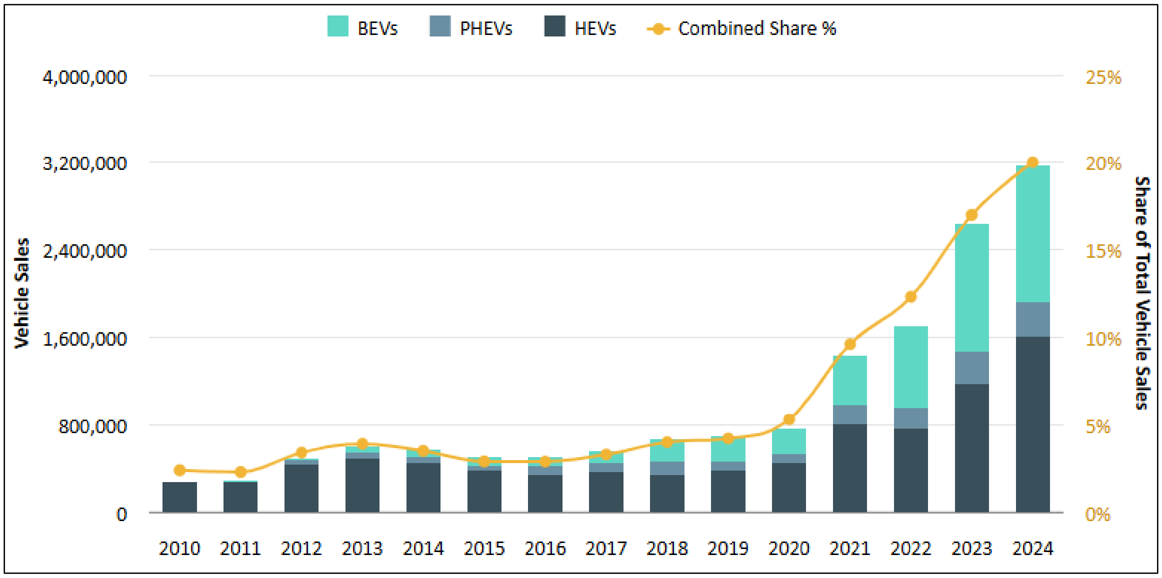
[24] Data for 2010 from Oak Ridge National Laboratory (ORNL), *Transportation Energy Data Book: Edition 40*, updated June 2022, Table 6.2, "Hybrid and Plug-In Vehicle Sales, 1999-2021," https://tedb.ornl.gov/wp-content/uploads/2022/03/TEDB_Ed_40.pdf#page=182. ORNL figures are rounded to the nearest 100 vehicles, except total sales, which are rounded to the nearest 1,000 vehicles. Data for 2024 from Wards Intelligence, *U.S. Light Vehicle Sales*, December 2024.

[25] Light-duty vehicle registrations totaled 287,096,500 in 2023, rounded to the nearest 100 vehicles, including 3,555,900 BEVs, 1,307,200 PHEVs, and 7,392,300 HEVs. Vehicles with these fuel types were also registered: gasoline, diesel, ethanol/flex (E85), biodiesel, compressed natural gas, propane, hydrogen, and unknown fuel. Fuel type designations are based on vehicle identification numbers and do not reflect any aftermarket conversions. AFDC, "Vehicle Registration Counts by State," 2023, https://afdc.energy.gov/vehicle-registration.

Figure 6. U.S. Electric Vehicle Sales

Sales and share of total annual U.S. light-duty vehicle sales, by vehicle type

Figure is interactive in the HTML version of this report.



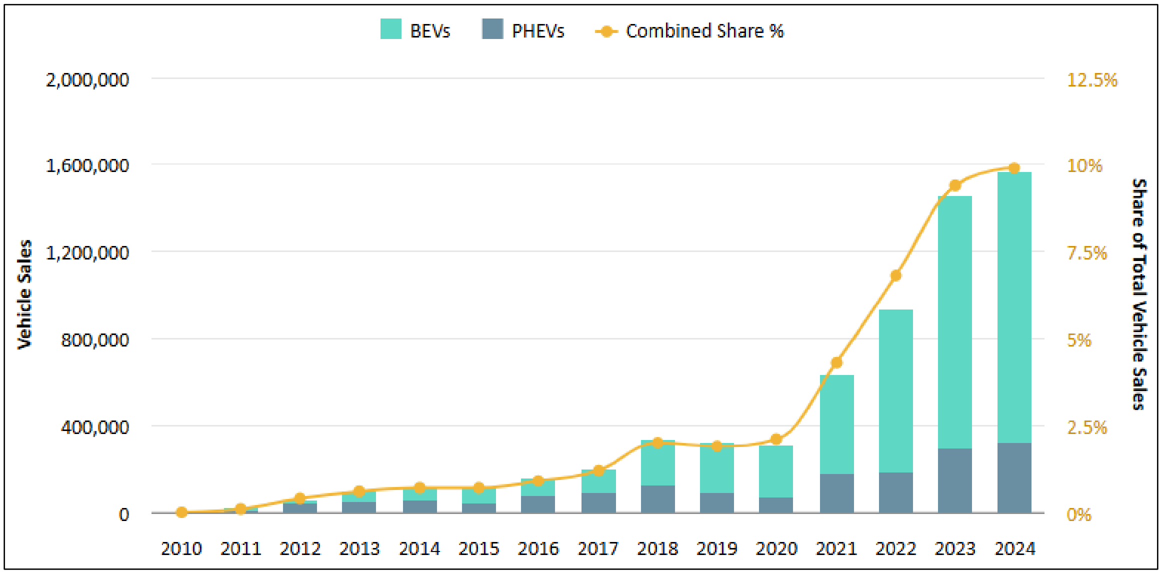
Source: CRS graphic with data from Oak Ridge National Laboratory (ORNL) and Wards Intelligence (Wards). ORNL, *Transportation Energy Data Book: Edition 40*, updated June 2022, Table 6.2, "Hybrid and Plug-In Vehicle Sales, 1999-2021," https://tedb.ornl.gov/wp-content/uploads/2022/03/TEDB_Ed_40.pdf#page=182; Wards, *U.S. Light Vehicle Sales*, December 2024; Wards, *U.S. Light Vehicle Sales*, December 2023; Wards, *U.S. Light Vehicle Sales*, December 2022; and Wards, *U.S. Light Vehicle Sales*, December 2021.

Notes: Sales data are for hybrid-electric, plug-in hybrid-electric, and battery-electric light-duty vehicles, which include cars and trucks with a gross vehicle weight of up to 10,000 pounds, such as passenger cars, pickup trucks, SUVs, and minivans.

Figure 7. U.S. Plug-in Electric Vehicle Sales

Sales and share of total annual U.S. light-duty vehicle sales, by vehicle type

Figure is interactive in the HTML version of this report.



Source: CRS graphic with data from Oak Ridge National Laboratory (ORNL) and Wards Intelligence (Wards). ORNL, *Transportation Energy Data Book: Edition 40*, updated June 2022, Table 6.2, "Hybrid and Plug-In Vehicle Sales, 1999-2021," https://tedb.ornl.gov/wp-content/uploads/2022/03/TEDB_Ed_40.pdf#page=182; Wards, *U.S. Light Vehicle Sales*, December 2024; Wards, *U.S. Light Vehicle Sales*, December 2023; Wards, *U.S. Light Vehicle Sales*, December 2022; and Wards, *U.S. Light Vehicle Sales*, December 2021.

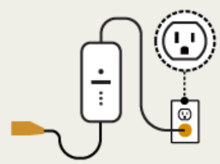
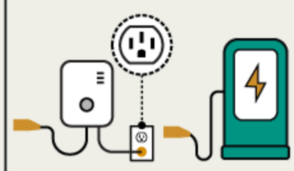
Notes: Sales data are for plug-in hybrid-electric and battery-electric light-duty vehicles, which include cars and trucks with a gross vehicle weight of up to 10,000 pounds, such as passenger cars, pickup trucks, SUVs, and minivans.

Electric Vehicle Charging Technologies

PHEVs and BEVs have large traction batteries that must be charged by connecting to an external source of electricity via a charging port.[26] Each charging port can charge one EV at a time, though it may have multiple connectors for vehicle compatibility. Charging ports may be portable (e.g., cordsets) or stationary (e.g., mounted on a wall or pedestal). Plug-in EVs may be charged at home or at nonresidential (e.g., workplace, public) charging stations. In the United States, charging infrastructure is categorized into three charging levels, differentiated by the voltage of the electrical supply. **Figure 8** summarizes key characteristics of the different charging levels.

[26] The term "charger" is also commonly used to refer to charging ports and sometimes used to refer to charging stations.

Figure 8. Plug-In Electric Vehicle Charging Equipment

Charging level	Level 1	Level 2	DC Fast/Level 3
AC - alternating current DC - direct current kW - kilowatt V - volt			
Outlet type	Standard residential outlet	Clothes dryer or stove outlet; public charging stations	Public charging stations
Electric supply requirement	120 V AC	208/240 V AC	Three-phase 480 V AC
Typical power output	1 kW	2-19 kW	50-350 kW
Typical range per hour of charging	5 miles	25 miles	200-400 miles
Types of vehicle connectors	SAE J1772	SAE J1772 NACS	SAE J1772 CCS CHAdeMO NACS
Typical equipment costs	$0-$900	$380-$3,500	$38,000-$90,000

Source: CRS graphic with information from Alternative Fuels Data Center (AFDC), "Electric Vehicle Charging Stations," accessed August 26, 2025, https://afdc.energy.gov/fuels/electricity-stations; U.S. Department of Transportation, *Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure*, February 2022, pp. 8, 45, https://www.transportation.gov/sites/dot.gov/files/2022-01/Charging-Forward_A-Toolkit-for-Planning-and-Funding-Rural-Electric-Mobility-Infrastructure_Feb2022.pdf; and AFDC, "Procurement and Installation for Electric Vehicle Charging Infrastructure," accessed August 26, 2025, https://afdc.energy.gov/fuels/electricity-infrastructure-development.

Notes: The information in this figure represents typical characteristics of charging infrastructure for plug-in EVs (i.e., plug-in hybrid-electric and battery-electric vehicles) in the United States. The J1772 CCS (Combined Charging System) features an adapter that adds two bottom pins for DC fast charging. NACS (North American Charging Standard) refers to the formerly proprietary design exclusive to Tesla's Supercharger network. CHAdeMO is used by some Japanese automakers. Typical equipment costs per charging port for each charging level can vary based on power output, mounting options, and smart capabilities, among other factors. Equipment costs do not reflect potential savings from incentives, tax credits, or rebates from governments or other entities. Installation costs are not included and can vary based on labor rates, physical distance to electricity source, electrical upgrades, permit costs, and number of charging ports installed.

Level 1 charging infrastructure uses 120 volts alternating current (AC) electricity, the voltage supplied by standard electrical outlets in the United States.[27] Most plug-in EVs come with a

[27] Alternating current (AC) refers to an electrical current that reverses direction regularly. In the United States, AC (continued...)

Level 1 cordset featuring a standard plug on one end (for use with a 120-volt outlet) and a charging connector on the other end to plug into the vehicle.[28] Due to its low voltage, Level 1 charging is relatively slow and may take many hours to achieve a full charge. Level 1 charging requires no additional installation if the selected outlet is served by a dedicated circuit.[29]

Level 2 charging infrastructure uses 208 volts AC or 240 volts AC electricity, the voltage supplied by high-voltage outlets typically used by electric ranges and other home appliances.[30] Plug-in EV owners may choose to upgrade to Level 2 portable or mounted charging equipment, which offers faster charging rates compared to Level 1 charging. Level 2 charging infrastructure is commonly used in nonresidential (e.g., workplace and public) applications.

Direct current (DC) fast, or Level 3, charging refers to any charging infrastructure that directly charges an EV's traction battery with DC electricity.[31] DC fast charging infrastructure converts electricity from the grid—typically three-phase 480 volts AC electricity—to DC electricity, which facilitates electrical power output in excess of 50 kilowatts (kW).[32] Because of its high voltage, DC fast charging infrastructure is available only for nonresidential (e.g., workplace and public) applications.

Plug-in EV ownership, in particular BEV ownership, relies on access to public and private charging infrastructure in places where vehicles are registered and where they are operated. Some charging stations have been built without federal funds. Federal investment has promoted the deployment of charging infrastructure to areas that lacked prior investment, and it has promoted certain standards for those charging stations. The availability of charging infrastructure has increased, though challenges remain to expanding the national network of EV charging stations. For more information about EV charging infrastructure, see CRS Report R47675, *Federal Policies to Expand Electric Vehicle Charging Infrastructure*, by Melissa N. Diaz and Corrie E. Clark.

frequency is typically 60 Hertz (i.e., 60 cycles per second). AC lends itself to repeated conversion to different voltages. Allison Lantero, "The War of the Currents: AC vs. DC Power," DOE blog, November 18, 2014, https://www.energy.gov/articles/war-currents-ac-vs-dc-power.

[28] AFDC, "Charging Electric Vehicles at Home," accessed August 26, 2025, https://afdc.energy.gov/fuels/electricity-charging-home.

[29] Electricity is distributed throughout a home from the service panel. Some circuits distribute electricity to more than one outlet in the home. A dedicated circuit serves a single outlet. Electrical Safety Foundation International, "Understanding Your Home Electrical System," accessed August 26, 2025, https://www.esfi.org/understanding-your-home-electrical-system/.

[30] A voltage of 208 volts AC is typical in commercial applications, and 240 volts AC is typical in residential applications. AFDC, "Charging Electric Vehicles at Home."

[31] Direct current (DC) refers to an electrical current that flows constantly in a single direction. Batteries and many distributed generation systems supply DC electricity, and many electronic devices and appliances (including plug-in EVs) operate with DC electricity. Lantero, "The War of the Currents: AC vs. DC Power." When using Level 1 and Level 2 charging, plug-in EVs use onboard equipment to convert AC electricity from the grid to DC electricity. AFDC, "How Do All-Electric Cars Work?," accessed August 26, 2025, https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work.

[32] According to the Department of Transportation (DOT), "three-phase circuits have three live wires, each with its own alternating current signal, and are capable of delivering substantially more power to the charging system." The 120-volt AC, 208-volt AC, and 240-volt AC circuits are single-phase circuits "which have a single 'live' wire and a neutral wire." DOT, *Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure*, February 2022, p. 47, https://www.transportation.gov/sites/dot.gov/files/2022-01/Charging-Forward_A-Toolkit-for-Planning-and-Funding-Rural-Electric-Mobility-Infrastructure_Feb2022.pdf.

Policy Landscape in the 119th Congress

Federal EV policies have historically been shaped by multiple goals, including reducing reliance on foreign sources of petroleum-based fuels, promoting domestic manufacturing, addressing environmental concerns, and maintaining competitiveness with other countries. A number of provisions established by the IIJA and the IRA support domestic adoption of EVs and other alternative fuel vehicles, manufacturing of advanced vehicle technologies (including EVs), and expansion of EV charging and other alternative fuel infrastructure.[33] In the 119th Congress, some Members support these provisions and others seek to limit or repeal them. The effects of the OBBBA on certain EV-related programs are noted below.

As for the Administration's priorities, Executive Order 14154 established a policy to "eliminate the 'electric vehicle (EV) mandate'" and ordered an immediate 90-day pause of IIJA and IRA grant program disbursements.[34] Tariffs announced by the Administration in early 2025 will likely affect prices and profit margins for both EVs and ICE vehicles, though implications for EV adoption remain uncertain.[35]

The Administration's priorities raise questions about the extent of federal support for vehicle electrification. Furthermore, reports of staff reductions across federal agencies—including at the Departments of Energy (DOE) and Transportation (DOT), the Internal Revenue Service, and the Environmental Protection Agency (EPA)—could pose additional challenges for administering these programs in the future, depending on how such reductions occur.[36]

A range of federal programs have provided funding, technical assistance, and incentives for EV-related activities such as research and development, manufacturing, and infrastructure deployment. Some programs have been specifically affected by recent executive or legislative actions—as noted below—and some have been generally affected due to the pause on IIJA and IRA disbursements and other actions. Key programs include the following:

- **National Electric Vehicle Infrastructure (NEVI) Formula Program.**[37] The IIJA established NEVI, a $5 billion formula grant program, to support the deployment of publicly accessible EV charging infrastructure along designated alternative fuel corridors. In addition to the pause on disbursements, DOT

[33] See also CRS Report R47675, *Federal Policies to Expand Electric Vehicle Charging Infrastructure*, by Melissa N. Diaz and Corrie E. Clark, and CRS Report R42566, *Alternative Fuel and Advanced Vehicle Technology Incentives: A Summary of Federal Programs*, by Lynn J. Cunningham et al.

[34] Executive Order 14154 of January 20, 2025, "Unleashing American Energy," 90 *Federal Register* 8353, January 29, 2025, https://www.federalregister.gov/documents/2025/01/29/2025-01956/unleashing-american-energy.

[35] See CRS Insight IN12519, *Expanded Section 232 Tariffs on Steel and Aluminum*, by Kyla H. Kitamura and Keigh E. Hammond, and CRS Insight IN12545, *Section 232 Automotive Tariffs: Issues for Congress*, by Kyla H. Kitamura.

[36] Camila Domonoske, "This Office Was Meant to Bridge Divides in Government. Now It's Empty," NPR, May 1, 2025, https://www.npr.org/2025/05/01/nx-s1-5382546/joint-office-electric-vehicles-shrinking-government; David Shepardson, "US Auto Safety Agency Shedding More Than 25% of Employees," Reuters, July 17, 2025, https://www.reuters.com/business/world-at-work/us-auto-safety-agency-shedding-more-than-25-employees-2025-07-17/; Zack Colman, "'Set Up for Failure': Trump's Cuts Bring Climate and Energy Agencies to a Standstill, Workers Say," *Politico*, June 17, 2025, https://www.politico.com/news/2025/06/17/trumps-energy-cuts-means-agencies-failure-00406526; and Meryl Kornfield et al., "IRS Plans to Bring Back Workers It Pushed Out but Now Needs," *Washington Post*, August 22, 2025, https://www.washingtonpost.com/politics/2025/08/22/irs-workers-rehire-buyouts/. For more on mechanisms for reducing the federal workforce, see CRS Insight IN12505, *Federal Workforce Downsizing: Voluntary and Involuntary Mechanisms*, by Taylor N. Riccard.

[37] Division J of the Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58); AFDC, "National Electric Vehicle Infrastructure (NEVI) Formula Program," accessed August 26, 2025, https://afdc.energy.gov/laws/12744.

rescinded program guidance. Several states filed a lawsuit challenging these actions.[38] On August 11, 2025, DOT issued revised program guidance.[39]

- **Charging and Fueling Infrastructure (CFI) Grants.**[40] The IIJA established CFI, a $2.5 billion competitive grant program, to support the deployment of publicly accessible infrastructure for alternative fuels (electricity, hydrogen, propane, and natural gas).
- **Clean School Bus Program.**[41] The IIJA appropriated $5 billion to provide competitive grants and rebates for the replacement of existing school buses with alternative fuel (natural gas, propane) or zero-emissions (electric, hydrogen fuel cell electric) buses and related infrastructure.
- **Clean Heavy-Duty Vehicles.**[42] The IRA appropriated $1 billion to EPA to implement a grant and rebate program for zero-emissions heavy-duty vehicles. The OBBBA rescinded unobligated balances.[43]
- **Domestic Manufacturing Conversion Grants.**[44] The IRA appropriated $2 billion to provide grants to establish manufacturing facilities for HEVs, PHEVs, BEVs, and hydrogen fuel cell electric vehicles.
- **United States Postal Service (USPS) Clean Fleets.**[45] The IRA appropriated $3 billion for USPS to acquire zero-emissions delivery vehicles (e.g., plug-in EVs, fuel cell electric vehicles) and install requisite infrastructure at USPS facilities.

Other incentives include tax credits established or modified by the IRA to promote plug-in EV adoption, deployment of EV charging and alternative fuel infrastructure, and production of technologies, including EV batteries, and production of critical minerals. The OBBBA modified the following tax credits:

- **Clean Vehicle Credit (26 U.S.C. §30D).**[46] This credit provides taxpayers up to $7,500 for purchases of qualifying plug-in EVs and fuel cell electric vehicles. This credit will no longer apply after September 30, 2025.

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[38] For more information, see CRS Insight IN12556, *Status of Federal Implementation of EV Charging Infrastructure*, by Melissa N. Diaz and Corrie E. Clark.

[39] DOT, "President Trump's Transportation Secretary Sean P. Duffy Unveils Revised NEVI Guidance to Allow States to Actually Build EV Chargers," August 11, 2025, https://www.transportation.gov/briefing-room/president-trumps-transportation-secretary-sean-p-duffy-unveils-revised-nevi-guidance.

[40] Section 11401 of the IIJA (23 U.S.C. §151 note); AFDC, "Charging and Fueling Infrastructure Grants," accessed August 26, 2025, https://afdc.energy.gov/laws/12732.

[41] Section 71101 of the IIJA (42 U.S.C. §16091); AFDC, "Clean School Bus," accessed August 26, 2025, https://afdc.energy.gov/laws/323.

[42] Section 60101 of the law commonly referred to as the Inflation Reduction Act (IRA; P.L. 117-169; 42 U.S.C. §7432); AFDC, "Heavy-Duty Zero Emission Vehicle (ZEV) and Infrastructure Grants," accessed August 26, 2025, https://afdc.energy.gov/laws/13063.

[43] Section 60001 of the One Big Beautiful Bill Act (OBBBA; P.L. 119-21).

[44] Section 50143 of the IRA (42 U.S.C. §16062); AFDC, "Electric Vehicle and Fuel Cell Electric Vehicle Manufacturing Grants," accessed August 26, 2025, https://afdc.energy.gov/laws/13366.

[45] Section 70002 of the IRA. For more information on IRA incentives for "clean" transportation, see CRS Insight IN12003, *Inflation Reduction Act of 2022: Incentives for Clean Transportation*, by Melissa N. Diaz. For more on the U.S. Postal Service fleet, see CRS Report R47820, *U.S. Postal Service Fleet Modernization*, by Melissa N. Diaz.

[46] Section 13401 of the IRA. The credit amount applies in two equal sub-amounts: half requires a minimum percentage of the critical minerals in the vehicle's battery to be recycled in North America or extracted or processed in the United States or by a country with which the United States has a free trade agreement; half requires a minimum percentage of (continued...)

- **Credit for Previously Owned Clean Vehicles (26 U.S.C. §25E).**[47] This credit provides taxpayers up to $4,000 for purchases of certain used plug-in EVs or used fuel cell electric vehicles. This credit will no longer apply after September 30, 2025.
- **Credit for Qualified Commercial Clean Vehicles (26 U.S.C. §45W).**[48] This credit for purchases of qualifying commercial plug-in EVs or fuel cell electric vehicles provides up to $7,500 for vehicles with a gross vehicle weight rating less than 14,000 pounds, or $40,000 otherwise (e.g., for school buses, heavy-duty municipal vehicles). This credit will no longer apply after September 30, 2025.
- **Alternative Fuel Vehicle Refueling Property Credit (26 U.S.C. §30C).**[49] This credit provides up to 30% of installation costs for qualifying alternative fuel refueling property (e.g., EV charging) with a maximum amount of $1,000 for residential property and $100,000 for business property. This credit will no longer apply after June 30, 2026.[50]
- **Advanced Manufacturing Production Credit (26 U.S.C. §45X).**[51] This credit is for certain goods produced in the United States, including battery components and critical minerals, which may be used to produce EV traction batteries. The OBBBA modified the phase-out of this credit and introduced restrictions.[52]
- **Qualifying Advanced Energy Project Credit (26 U.S.C. §48C).**[53] The IRA provided $10 billion of new funding for qualifying projects that reequip, expand, or establish industrial or manufacturing facilities, including those for producing or recycling plug-in EVs, fuel cell electric vehicles, and associated infrastructure,

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the battery's components to be manufactured or assembled in North America. Both minimum percentages change by year. Vehicles meeting one of the two requirements qualify for a half-credit of $3,750. AFDC, "Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit," accessed August 26, 2025, https://afdc.energy.gov/laws/409. Additional restrictions apply to both the vehicle being sold and to the individuals purchasing the vehicle in question. For additional information, see CRS In Focus IF12600, *Clean Vehicle Tax Credits*, by Donald J. Marples and Nicholas E. Buffie.

[47] Section 13402 of the IRA. The credit applies a maximum sale price of $25,000 and limits the income of the taxpayers to $150,000 for joint returns, $112,500 for heads of households, and $75,000 for all others. AFDC, "Pre-Owned Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit," accessed August 26, 2025, https://afdc.energy.gov/laws/13038.

[48] Section 13403 of the IRA. The credit is claimed by businesses and certain organizations traditionally exempt from taxation, including nonprofits and state and local governments. The amount of the credit is equal to the lesser of a percentage of the vehicle cost (30% for BEVs and FCEVs, 15% for PHEVs) or the incremental cost relative to a comparable ICE vehicle. AFDC, "Commercial Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit," accessed August 26, 2025, https://afdc.energy.gov/laws/13039. CRS In Focus IF12603, *The Tax Credit Exception for Leased Electric Vehicles*, by Nicholas E. Buffie.

[49] Section 13404 of the IRA. For business property, the credit rate is 30% for property that meets prevailing wage and registered apprenticeship requirements and is 6% otherwise. AFDC, "Alternative Fuel Infrastructure Tax Credit," accessed August 26, 2025, https://afdc.energy.gov/laws/10513.

[50] Section 70504 of the OBBBA.

[51] Section 13502 of the IRA. The credit amount is up to 10% of the costs incurred to produce critical minerals or electrode active materials, up to $35 per kWh for a battery cell, and up to $10 per kWh for a battery module. Double-claiming with the Advanced Energy Project Credit (26 U.S.C. §48C) is not allowed. See also CRS In Focus IF12809, *The Section 45X Advanced Manufacturing Production Credit*, by Nicholas E. Buffie.

[52] Section 70514 of the OBBBA. For more information, see CRS In Focus IF13052, *H.R. 1 Provisions Affecting Renewable Energy*, by Morgan Smith.

[53] Section 13501 of the IRA. AFDC, "Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Manufacturing Tax Credit," accessed August 26, 2025, https://afdc.energy.gov/laws/13087. Double-claiming with the Advanced Manufacturing Production Credit (26 U.S.C. §45X) is not allowed.

or for processing, refining, or recycling critical minerals. The OBBBA introduced restrictions.[54]

Regulatory actions have also influenced EV market dynamics. EPA and DOT's National Highway Traffic Safety Administration (NHTSA) are responsible for promulgating fuel economy standards and GHG emissions standards for vehicles.[55] These standards have influenced the fleet of vehicles available to consumers:[56]

- **Corporate Average Fuel Economy (CAFE) standards.**[57] NHTSA regulates the average fuel economy for each model year of new vehicles. In a January 2025 memorandum, Transportation Secretary Sean Duffy directed NHTSA to review existing CAFE standards for potential replacement or rescission.[58]
- **GHG emissions standards for motor vehicles.**[59] EPA regulates the average emissions for each model year of new vehicles. In a March 2025 press release, EPA Administrator Lee Zeldin announced plans to review vehicle emissions standards for potential modification or elimination, including a regulation for light- and medium-duty vehicles promulgated in March 2024.[60]

Concluding Observations

The evolving landscape of the 119th Congress introduces opportunities and uncertainties for the EV market. The pause and potential repeal of IIJA and IRA programs would reduce federal investment in EV charging infrastructure, vehicle incentives, and fleet electrification. This may contribute to a slower overall pace of market adoption, hesitant private-sector planning, and disparities in charging availability across regions and states. Alternatively, private-sector investments may increase, and industry leaders may strengthen their commitment to vehicle

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[54] Section 70515 of the OBBBA.

[55] AFDC, "Vehicle Fuel Economy and Greenhouse (GHG) Emissions Standards," accessed August 26, 2025, https://afdc.energy.gov/laws/385.

[56] California has adopted emissions standards under the Clean Air Act, as amended (CAA; P.L. 91-604) that mandate increased adoption of zero-emissions technologies. Under Section 209(b) of the CAA, California is authorized to seek waivers from EPA to establish vehicle emissions standards that are more stringent than federal requirements. Other states may adopt California's standards if certain conditions are met. For example, EPA granted a waiver to California for Advanced Clean Cars II (ACC II) in 2024. ACC II includes a 100% ZEV sales mandate by 2035. Executive Order 14154 called for termination of state waivers that effectively limit the sale of gasoline-powered vehicles. The ACC II waiver was subsequently overturned with the enactment of H.J.Res. 88 (P.L. 119-16) on June 12, 2025. For more information on California and the CAA's waiver authority, see CRS Report R48168, *California and the Clean Air Act (CAA) Waiver: Frequently Asked Questions*, by Benjamin M. Barczewski, Richard K. Lattanzio, and Emily N. Peterson.

[57] Section 301 of the Energy Policy and Conservation Act (P.L. 94-163), as amended (49 U.S.C. §§32901-32919). For more information, see CRS In Focus IF10871, *Vehicle Fuel Economy and Greenhouse Gas Standards*, by Richard K. Lattanzio. Corporate Average Fuel Economy (CAFE) standards for EVs rely on a calculation of petroleum-equivalent fuel economy, which is regulated by DOE. For more information, see CRS Report R48086, *Petroleum-Equivalent Fuel Economy of Electric Vehicles: In Brief*, by Corrie E. Clark and Richard K. Lattanzio.

[58] DOT, "Fixing the CAFE Program," secretarial memorandum of January 28, 2025, https://www.transportation.gov/sites/dot.gov/files/2025-01/Signed%20Secretarial%20Memo%20re%20Fixing%20the%20CAFE%20Program.pdf.

[59] Title II of the CAA. 42 U.S.C. §7401 et seq.

[60] EPA, "EPA Launches Biggest Deregulatory Action in U.S. History," press release, March 12, 2025, https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history; EPA, "Final Rule: Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles," March 12, 2025, https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-multi-pollutant-emissions-standards-model.

electrification for business reasons. The near-term trajectory of vehicle electrification efforts may depend on ongoing legislative developments and the outcomes of program and regulatory reviews.

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