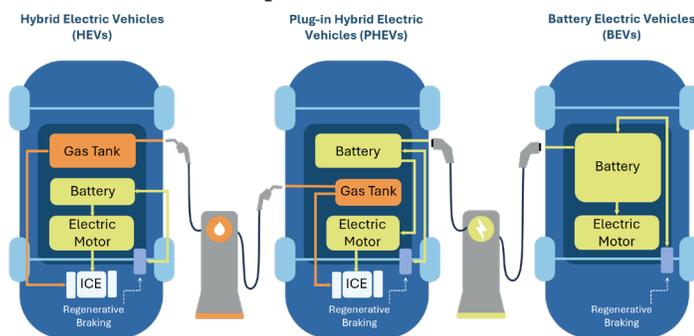


# Electric Vehicles

## Types of Electric Vehicles

- **Battery electric vehicles (BEVs)**, or all-electric vehicles, are powered exclusively by an electric motor and onboard battery that is usually recharged from the grid.<sup>1</sup> They perform best in moderate temperatures and offer better range in cities due to regenerative braking.<sup>2</sup> BEVs produce no tailpipe emissions, though their electricity source may still generate emissions.<sup>3</sup>
- **Plug-in hybrid electric vehicles (PHEVs)** use both an internal combustion engine (ICE) and an electric motor with a battery that can be charged from the grid, enabling the vehicle to run on liquid fuel and in all-electric mode. PHEVs can travel 20–40 mi on electricity before switching to gasoline.<sup>1</sup> In this factsheet, both PHEVs and BEVs are referred to as EVs.
- **Hybrid electric vehicles (HEVs)** use an ICE and one or more electric motors that use energy stored in a battery. Unlike in BEVs and PHEVs, an HEV battery is charged by the ICE and regenerative braking rather than by plugging in.<sup>1</sup>
- **Fuel cell electric vehicles (FCEVs)** convert energy stored as hydrogen into electricity using a fuel cell. Like BEVs, FCEVs produce no harmful tailpipe emissions—only water vapor, oxygen, and heat. Their environmental impact depends on the hydrogen production process.<sup>4</sup>
- Vehicles that produce no emissions from the onboard power source—including BEVs and FCEVs—are called zero emission vehicles (ZEVs).<sup>2</sup>

## Electric Vehicle Comparison<sup>13</sup>



## Electric Vehicle Technology

- Since BEVs run solely on electricity, they do not have ICEs, liquid fuel components, or exhaust systems.<sup>5</sup>
- Electric motors drive the wheels using energy from a traction battery pack, which stores electricity for this purpose. Some EVs use motors with both drive and regeneration functions.<sup>5</sup>
- Battery size, chemistry, and vehicle efficiency determine the vehicle’s range. New BEVs offer 114–450 mi on a full charge.<sup>2</sup>
- BEVs use three types of lithium-ion batteries: lithium iron phosphate (LFP), lithium manganese cobalt oxide (NMC), and lithium nickel-cobalt-aluminum oxide (NCA).<sup>2</sup> LFP is low-cost and prevalent in China. NMC is common in the U.S. and EU.<sup>6</sup>

- EVs can be charged using electric vehicle service equipment (EVSE) at varying speeds. Level 1 (standard outlet) can take 40+ hours to charge a BEV to 80%. Level 2 can charge in as little as 4 hours, while Direct Current Fast Charging (DCFC) can take as little as 20 minutes.<sup>7</sup>
- Level 2 and DCFC chargers are available at many public locations. In 2021, over 15% of public EVSE were DCFC.<sup>7,8</sup>

## Overview of EV Chargers<sup>7</sup>

Charging Type	Level 1	Level 2	DC Fast Charging
Voltage (Volts)	120 / AC	208 - 240 / AC	400 - 1000 / DC
Typical Power Output (kW)	1	7 - 19	50 - 350
Estimated PHEV Charge Time* (Hours)	5 - 6	1 - 2	N/A
Estimated BEV Charge Time* (Hours)	40 - 50	4 - 10	0.3 - 1
Estimated Electric Range (Miles/Charging Hour)	2 - 5	10 - 20	180 - 240
Locations	Home	Home, Workplace, and Public	Public

\*Charge time from 0 to 80%

## Current Market

### Market Leaders

- In Q1 2025, BEVs, PHEVs, and HEVs made up 22% of light-duty vehicle (LDV) sales in the U.S., up from 18% in 2024.<sup>9</sup>
- In 2024, 1.3M BEVs made up 7.9% of LDV sales, PHEVs were 1.9%, and HEVs were 10%. In 2010, BEVs accounted for only 0.002% of LDVs sold in the U.S.<sup>10</sup>
- In 2024, over 20% of new car sales globally were EVs, with 17M sold. The 3.5M increase in sales from 2023 surpassed total global EV sales in 2020. Almost 50% of China’s car sales in 2024 were EVs, representing 64% of global EV sales. Europe made up 20% and the U.S. 10%.<sup>6</sup> Norway neared total electrification of sales, with 88% being BEVs and 3% PHEVs.<sup>6</sup>
- Government spending on EVs declined from 10% in 2017 to 7% in 2024, as credits and incentives phased out. However, buyer spending on EVs grew, reaching \$560B in 2024.<sup>6</sup>

### Policies and Incentives

- In 2023, California approved a first-in-nation ZEV regulation, requiring 100% of new LDVs sold to be ZEVs by 2035.<sup>14</sup> By the end of 2023, 17 states and DC had adopted ZEV regulations.<sup>15</sup>
- Under the Inflation Reduction Act, eligible new EV purchases qualified for a federal tax credit of up to \$7,500 through 2032. Recent legislation reverts this to September 2025.<sup>11,16</sup>
- Taxpayers who purchase eligible used EVs from licensed dealers for \$25,000 or less in through September 2025 may qualify for a federal tax credit of up to \$4,000.<sup>11,17</sup>
- Caps on vehicle price and income are intended to prevent subsidizing purchases for high-income buyers.<sup>18</sup> From 2005–2012, the top 20% of income earners received 90% of EV tax credits.<sup>19</sup>

- Check [fueleconomy.gov](https://www.fueleconomy.gov) for vehicles eligible for the Clean Vehicle Credits.
- Businesses and tax-exempt organizations that purchase a qualified commercial vehicle through 2025 may qualify for a clean vehicle tax credit of up to \$7,500 for vehicles under 14,000 lbs and up to \$40,000 for larger vehicles.<sup>16,20</sup>
- The Alternative Fuel Vehicle Refueling Property Credit allows taxpayers to claim up to \$1,000 for EV charger and hardware installation through 2032.<sup>21</sup>
- In 2023, 14 state governments provided BEV incentives for buyers, with an average value of around \$2,000.<sup>15</sup> CA, CO, CT, MA, ME, OR, PA, and RI offered additional incentives to low-income buyers, or those living in air pollution districts.<sup>15,23</sup>
- The Infrastructure Investment and Jobs Act allocated \$7.5B to build a nationwide network of 500,000 EV chargers.<sup>24</sup>

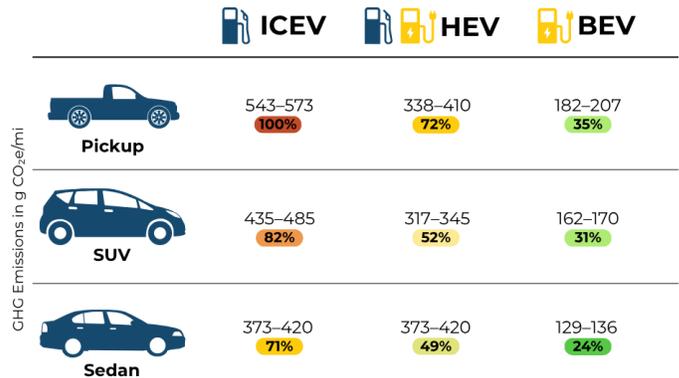
## Limitations and Barriers

- Most critical minerals used in BEVs are found in the electric motors (neodymium, praseodymium, and dysprosium) and batteries (lithium, cobalt, manganese, nickel, and graphite).<sup>25</sup>
- Permanent-magnet motors are the most common motor in electric vehicles. They can contain 0.06-0.35 kg of rare earth elements, 0.25-0.50 kg neodymium, 3-6 kg copper, 0.9-2 kg iron, and 0.01-0.03 kg boron per vehicle.<sup>25</sup>
- Lithium-ion batteries in BEVs consist of cells in modules within the battery pack, making up 70-85% of battery weight. These batteries contain minerals such as lithium, nickel, cobalt, manganese, graphite, and copper. As a result, BEVs contain about six times more minerals by mass than ICEVs.<sup>25</sup>
- Lithium recycling infrastructure could reduce supply chain pressure, but recovery remains challenging due to the lack of battery standardization, limited regulation, and high operational costs.<sup>26,27</sup>
- Low-income households face the highest EV energy burden; the share of income spent on charging costs.<sup>28</sup> Adopting EVs would reduce both GHGs and energy burden for over 90% of vehicle-owning U.S. households.<sup>28</sup>
- China and the EU have steadily expanded charging networks in line with EV growth. The U.S. and U.K. have lagged, with the U.S. reaching a ratio of 32 EVs per public charging point.<sup>6</sup>
- The Bipartisan Infrastructure Law allocated \$5B to develop fast charger networks. By 2024, only \$30M had been spent on operational charging points. A 2025 executive order paused further disbursements making future funding uncertain.<sup>6</sup>
- In 2023, the U.S. had 68,475 electric charging stations and 184,089 charging ports, double the number in 2018.<sup>29</sup>
- Demand for EVs is projected to reach 33M by 2030. This would require a national network of 28M charging ports, including 26.8M private and 1.2M public ports.<sup>30</sup>

## Solutions and Sustainable Actions

- On average, new BEVs across the U.S. have 57% lower total life cycle GHG emissions than comparable ICEVs (pickup, SUV, sedan). BEVs generate roughly twice the production phase emissions of ICEVs, largely during battery production.<sup>31</sup>
- BEVs do not directly emit PM, NOx, and other pollutants linked to air quality issues that disproportionately impact low income communities.

Vehicle Lifetime GHG Emissions as % of ICEV Pickup<sup>31</sup>



See the [Electric Vehicle Factsheet](#) online for an interactive figure to compare emissions by vehicle and powertrain.

- GHG emissions from driving EVs are dependent on charging location (temperature, grid fuel mix, etc.).<sup>31</sup>
- The U.S. DOE has committed to funding research on battery innovation for faster charging, increased efficiency, and improved resilience.<sup>32</sup>
- To maximize battery life, BEV owners should minimize time spent at 100% or 0% state of charge, and limit use of fast charging. Level 2 charging reduces battery degradation.<sup>33</sup>
- BEVs typically have higher purchase prices than ICEVs, but lower maintenance and fuel costs. Total cost of ownership is more favorable for smaller BEVs, especially for high-mileage drivers with access to home charging.<sup>34</sup>
- Despite prevailing range anxiety, 25-37% of vehicles could meet all their driver's trip needs using a smaller BEV paired with community charging.<sup>35</sup>
- Households best suited for EV adoption typically have multiple vehicles, access to home charging, and drive mostly urban, low-speed trips.<sup>36</sup>
- By 2050 ZEVs combined with clean power grids could lead to \$978B in public health benefits, prevent 89,300 premature deaths, 2.2M asthma attacks, and 10.7M lost work days.<sup>37</sup>