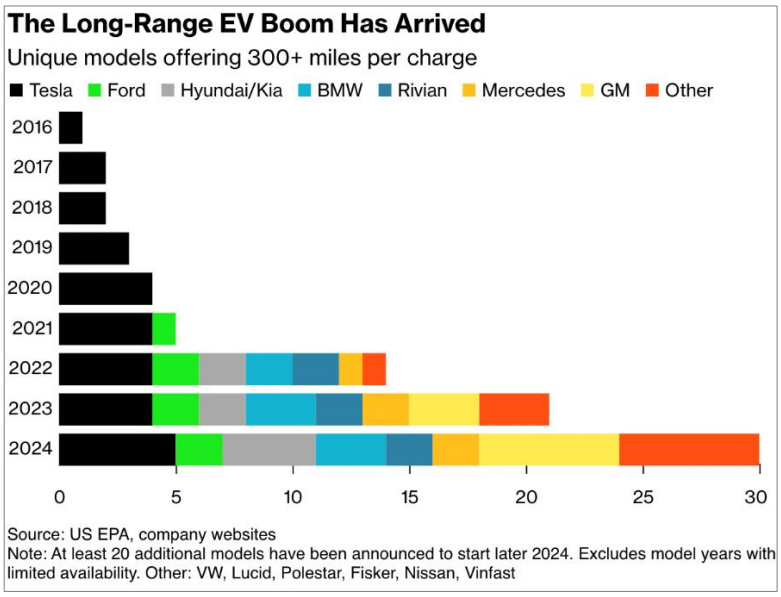
EV ranges

EPA-estimated ranges for EVs today vary from 115 to 516 miles. These ranges are more than adequate for most personal uses.

In the U.S., 95% of personal vehicle trips are under 31 miles. An EV with a 100-mile range that is charged daily would satisfy 87% of American daily driving needs and decrease U.S. gasoline consumption by 61%.

- In 2022, the average range for personal EVs in the U.S. was 300 miles, better than the global average of around 215 miles.
- In 2023, over 30 models of personal EVs were available in the U.S. with ranges at or over 300 miles.
- Over 20 more EV models are expected in the next model year.[1]

Plug-in hybrid EVs (PHEVs) in the U.S. offer ranges of 15 to over 60 miles per charge; more than adequate to meet most daily travel needs.[2]



Medium- and heavy-duty vehicles (MHDVs) offer ranges from 230 to 350 miles. Several major manufacturers offer MHDVs for the U.S. and North American markets, and more models are on the way.[3]

- Volvo anticipates that these EVs could completely replace urban diesel trucking fleets for a variety of uses and industries.
- Tesla is producing the Tesla Semi in California, which is anticipated to have a 500-mile range.
- Nikola Tre Bev produces an electric truck with a 350-mile range, and will soon produce a hydrogen truck with a reported 500-mile range and a next-generation fuel cell model with a 900-mile range for release in 2025.[4] [5] [6]

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[1] The Long-Range EV Boom Has Arrived. *Bloomberg*. March 6, 2024.
[2] 2024 U.S. Electric Car EPA Ranges Ranked Lowest To Highest. *Inside EVs.* Feb. 12. 2024.
[3] The obsession with EV range is all wrong. *The Washington Post*. July 7, 2023.
[4] Will Heavy Trucks Go Electric in North America? Mexicom Logistics. Feb. 27, 2024.
[5] The heavy-duty electric truck market could break out in 2024. *Charged EV Fleet & Infrastructure News.* Jan. 16, 2024.
[6] Volvo presents electric trucks with longer range. Volvo Trucks. June 20, 2023.

Charging speeds

The greatest issue facing the EV industry today is how long it takes to charge the battery to 85% (the recommended threshold).

Companies working to improve charging speeds include Group14, which is innovating a new type of anode and cathode that will allow batteries to accept lithium ions faster from the charger. Technological innovations such as these will greatly reduce charging times for EVs soon.[7] [8]

The three types of charging levels in the U.S. today are Level 1, Level 2, and DC Fast Charging (DCFC). The average time to charge an EV from empty to full is:

- **Level 1**: 2 to 5 miles per hour of charge (40 to 50 hours to full), typical of at-home chargers on 110 amp circuits.
- **Level 2**: 10 to 20 miles per hour of charge (4 to 10 hours to full), common at workplace charging stations, public stations, and some at-home chargers on 240 amp circuits.
- **DCFC**: 180 to 240 miles per hour of charge (20 minutes to 1 hour to full), offered in select public charging stations.

Charging networks

The current charging standards in the U.S. are the Combined Charging System (CCS) and the North American Charging Standard (NACS).

- CCS is used by almost every EV in the U.S. except for Tesla.
- Tesla uses the NACS system. This means that non-Tesla vehicles cannot use Tesla's extensive DCFC network.

Tesla is licensing the use of its NACS network to manufacturers in the U.S. so their vehicles can use the NACS network, but not all manufacturers are purchasing these licenses. Tesla also offers a NACS-to-CCS adapter so Tesla vehicle owners can use the CCS network.

NACS vs CCS

NACS currently has a lower failure rate than CCS and is available at a wider range of fast-charger stations. NACS also has an integrated payment system so the charging experience is quick and seamless compared to CCS.

Even though NACS currently offers more DCFC options, CCS has more stations throughout the U.S. In 2024, only CCS offers bidirectional charging but Tesla claims that NACS will be able to handle bidirectional charging by 2025. CCS also offers greater charging rate capabilities at 350 kW compared to NACS' maximum charging speed of 250 kW.[9] [10]

Charging in Washington

Washington has over 6,000 public EV charging ports, and the WA Dept. of Commerce has pledged $84 million to install 5,000 more Level 2 ports and 420 DCFC ports throughout

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[7] What Will It Take to Charge Electric Vehicles Faster? *Smithsonian Magazine*. May 24, 2023.

[8] Electric Vehicle Charger Levels and Speeds. U.S. Dept. of Transportation. Updated June 29, 2023.

[9] NACS vs. CCS: What's the Difference? *U.S. News & World Report*. Sept. 28, 2023.

[10] NACS vs CCS - which one is better? Lectron. April 11, 2024.

the state at multi-family housing buildings, workplaces, school districts, public agencies, and other public locations.[11] [12] [13]

In an August 2024 announcement from the Joint Office of Energy and Transportation, Washington communities were awarded over $29 million to install additional chargers across the state.

Battery weight

EV battery weight is a crucial component of EV performance. The battery is the single heaviest part of an EV, affecting its acceleration and braking, handling and cornering, and energy storage and power delivery. The average EV battery currently weighs about 1,000 pounds (compared to a 90-pound average weight for the battery in a gas-powered vehicle). The Nissan Leaf battery weighs 660 pounds and the Tesla Model Y battery weighs 1,700 pounds.

Heavier batteries can produce higher energy density and offer longer ranges, but there comes a point of diminishing returns when the infrastructure around the battery must be built stronger (and heavier) to support the battery. With this extra structural weight, the vehicle requires more energy to accelerate and slow down, and creates more stress on the suspension.

Balancing EV battery weight and range are crucial. The typical lithium-ion (Li-ion) battery offers 90 to 190 Wh/kg,[14] depending on battery components. Amprius Technologies recently announced a 500 Wh/kg Li-ion battery with reduced weight and increased capacity.[15] [16] [17] [18]

EV prices and costs

EV prices

EVs are still more expensive than internal combustion engine (ICE) vehicles but that difference is decreasing fast, especially as more tax breaks and incentives are available. Most EVs in the U.S. cost between $35,000 and $50,000 depending on range, accessory levels, and brand. The Nissan Leaf is the least expensive mass-produced EV available in the U.S., starting at about $29,000.

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[11] Surge of new EV charging stations coming to Washington state. KUOW website. Feb. 1, 2024.

[12] Find Charging Stations in Washington. ChargeHub. Undated.

[13] Electrification Statistics: EV Charging Stations in Washington State. Qmerit. Undated.

[14] Watt-hour per kilogram (Wh/kg) is a unit of specific energy used to measure the density of energy in batteries and capacitors.

[15] New EV Battery Developments Add Range, Reduce Weight. Engineering.com. June 27, 2023.

[16] What Affects Car Battery Weight? UFine Blog. April 22, 2024.

[17] Auto industry must halve EV battery weight over next decade, Stellantis CEO says. Reuters. April 3, 2024.

[18] A Complete Guide on Electric Car Battery Weight. EVGas Blog. July 6, 2023.

Charging costs

In 2023, the U.S. Dept. of Energy reported that every EV on the market cost less to recharge than gas-powered equivalents, and EVs were 2.6 to 4.8 times more efficient per mile than ICE vehicles. The recharge rate affects the overall time cost and efficiency, but if charged at home, an EV can save up to $600 a year compared to gasoline fueling costs. This is especially true in Washington, where we have some of the lowest electricity costs in the country thanks to hydroelectricity production.

Washington has the seventh lowest charging costs in the U.S. The average cost to charge a Tesla Model 3 is $5.25; Volvo XC 40 is $6.83; and Ford F-150 Lightning is $11.46. Charging costs may be lower if your local utility offers off-peak incentives and rates, and you charge overnight.

Maintenance costs

Batteries degrade very slowly and are often more reliable than skeptics indicate. All EV batteries are covered by mandatory federal warranties of 10 years or 100,000 miles.

The Natural Resources Defense Council released a report on the cost savings of EVs: [19] [20]

- Over the lifetime of the vehicle (seven years on average for new car buyers), savings were close to $11,000 compared to comparable ICE vehicles.
- On average, EVs are half as expensive to maintain as their ICE counterparts.

EV incentives

Incentives, rebates, and credits can help bring down these costs: [21]

- Federal tax incentives are available for eligible new, used, and leased EVs.
- WA Dept. of Commerce offers instant rebates to low-income households to purchase or lease eligible new and used EVs (from $2,500 to $9,000). [22] [23]
- Tax breaks are available for installing EV charging infrastructure including the Alternative Fuel Infrastructure tax credit [24] and Puget Sound Energy rebate (up to $2,600) for installing at-home charging.[25]

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[19] Plug-In Hybrid Electric Vehicles, Dept. of Energy EERE website, undated.

[20] Electric vs. Gas Cars: Is It Cheaper to Drive an EV? NRDC. March 21, 2024.

[21] Search for Incentives. Electric for All. Undated.

[22] Washington EV Instant Rebate Program. WA Dept. of Commerce. Undated.

[23] Ready, set, drive electric: State instant rebate program to help more consumers choose electric vehicles. WA Dept. of Commerce. April 23, 2024.

[24] Credits for new clean vehicles purchased in 2023 or after. Internal Revenue Service. Undated.

[25] Electric Vehicle Incentives. Puget Sound Energy Up & Go Electric. Undated.

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