2025 Alternatively Fueled Vehicles White Paper

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Prepared by the Western Connecticut Council of Governments (WestCOG)

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Contents

Disclaimer

This report has been prepared utilizing funding sourced from the U.S. Department of Transportation through the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The opinions, findings and conclusions are intended for use by the Western Connecticut Council of Governments (WestCOG) member communities and are those of the authors and do not necessarily reflect the official views or policies of WestCOG.

TITLE VI COMPLIANCE

The WestCOG 2025 Alternatively Fueled Vehicles White Paper fully complies with Title VI of the Civil Rights Act of 1964 and related nondiscrimination statutes and regulations. Translation of this document between English, Spanish, and multiple other languages can be made available, if requested.

List of Acronyms

AAA	American Automobile Association
ACT	Advanced Clean Trucks
AFDC	Alternative Fuels Data Center
APTA	American Public Transportation Association
BEB	Battery Electric Bus
BEV	Battery Electric Vehicle
CALTRANS	California Department of Transportation
CESER	Office of Cybersecurity, Energy Security, and Emergency Response
CHEAPR	Connecticut Hydrogen and Electric Automobile Purchase Rebate
CNG	Compressed Natural Gas
CSE	Center for Sustainable Energy
CSI	Customer Satisfaction Index
CTA	Chicago Transit Authority
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTDOT	Connecticut Department of Transportation
DART	Des Moines Area Regional Transit Authority
DCFC	Direct Current Fast Charging
DER	Distributed Energy Resources
EV	Electric Vehicle
EPR	Extended Producer Responsibility
FHWA	Federal Highway Administration
FPL	Federal Poverty Level
FTA	Federal Transit Administration
GaN	Gallium Nitride
GBT	Greater Bridgeport Transit Authority
GHG	Greenhouse Gas
HARTransit	Housatonic Area Regional Transit
HOV	High-Occupancy Vehicle
HTF	Highway Trust Fund
HVAC	Heating, Ventilation and Cooling
HVMPO	Housatonic Valley Metropolitan Planning Organization
ICE	Internal Combustion Engine
IER	Institute for Energy Research
IRS	Internal Revenue Service
MAGI	Modified Adjusted Gross Income
MAP	Metropolitan Area Planning Forum
MCS	Megawatt Charging System

MSRP	Manufacturer's Suggested Retail Price
NEVI	National Electric Vehicle Infrastructure
NGV	Natural Gas Vehicle
NREL	National Renewable Energy Laboratory
NTD	Norwalk Transit District
NYMTC	New York Metropolitan Transportation Council
OEM	Original Equipment Manufacturer
PANYNJ	Port Authority of New York and New Jersey
PG&E	Pacific Gas and Electric
PHEV	Plug-In Hybrid Vehicle
SEPTA	Southeastern Pennsylvania Transit Authority
SiC	Silicon Carbide
STIP	Statewide Transportation Improvement Program
SUV	Sport Utility Vehicle
SWRMPO	South Western Region Metropolitan Planning Organization
TCO	Total Cost of Ownership
TriMet	Tri-County Metropolitan Transportation District of Oregon
USB	Useful Life Benchmark
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
V2G	Vehicle to Grid
VMT	Vehicle Miles Traveled
WestCOG	Western Connecticut Council of Governments
WRTA	Worcester Regional Transit Authority
ZEB	Zero-Emission Bus

Executive Summary

In 2017, WestCOG released its first Electric Vehicle Study. That study utilized data from the Connecticut Office of Policy and Management, the Connecticut Department of Motor Vehicles, and an in-house literature review. Its goals were to:

- Synthesize background information on the electric vehicle (EV) market and usage patterns from a literature review,
- Provide baseline information on the use of EVs and related charging station locations for the WestCOG region's eighteen municipalities, and
- Identify potential infrastructure gaps and policy recommendations to increase the use of EVs.

WestCOG has released this updated Study to inform its chief elected officials and staff of the current environment of electric vehicles and how it may pertain to their municipalities. The Study is intended to inform their decision-making processes. It can also serve as a resource for the region's residents and businesses. The content is broader than in 2017 and covers EV policies, manufacturing, policy/planning, performance, and a wide range of important considerations for decision-making. More than ever, electric vehicles are being developed, marketed, and consumed based upon assumptions of:

- Benefits to the environment
- Performance characteristics
- Competitive life-cycle costs
- Suitability for transporting people, freight, and for other purposes (i.e. fleets, municipal use, public safety)

Also, this study highlights EV risks and challenges that are relevant to municipalities, the utility and transportation industries, and consumers.

Key Takeaways:

- EVs are currently best suited to light- and medium-duty applications
- EVs work well for short and modest trip distances
- Transit usage is gaining momentum, but cost, supply, and durability challenges exist
- Technology for supporting long-distance and heavy transport requires further development, and
- Crash repair costs and highway safety infrastructure need improvement

Introduction

Electric vehicles were first developed at the dawn of the automobile age (early 1900s), with several manufacturers offering passenger and utility models to the public. These early vehicles, while innovative, failed in the marketplace in favor of internal combustion engine (ICE) equipped vehicles. Interest in EVs was rekindled in the 1970s during the first fuel crisis, and periodically after that, owing principally to increased environmental concerns. Most recently (2000-present) EV interest has accelerated in the wake of public concern for climate change and related greenhouse gas (GHG) emissions.

This Study is intended to take stock of current electric vehicle policies and technologies and the applications and use of EVs. The information contained in this Study is divided chiefly into analyses of electrified passenger vehicles, freight vehicles and associated port equipment, public service, and transit.

Parties interested in exploring the use of EVs should perform a lifecycle benefit-cost analysis using some of the concepts discussed in this study. This will allow the reader to customize various inputs including acquisition and operation costs, specific to their area and needs.

Methodology

WestCOG staff consulted a wide variety of information sources, chiefly those that were accessible through the Internet. Transportation industry sources were prioritized. Reports produced by nationally recognized consultants such as J.D. Power and McKinsey & Company were also consulted. WestCOG also obtained regional and state data from public agency websites (i.e. Connecticut Department of Energy and Environmental Protection) and transportation non-profit organizations. As this topic is dynamic, sources were chosen that were as recent to the writing of this Paper as possible. Readers are encouraged to review the sources used in this Paper, and to conduct additional research, to obtain updated information as it is made available.

Technology

EVs are rapidly evolving. WestCOG's analysis indicates that the industry's current focus is on improving battery technology, to create products that are more environmentally sound, and that can perform better in extreme temperatures while requiring less frequent charging. Some EV manufacturers also emphasize development advances in:

- **Battery Cooling:** EVs use different methods to keep batteries at optimal temperatures: phase change materials, air management, and liquid. As of now, liquid cooling systems are the most common; they circulate coolants through the battery pack. While effective, their downsides are added weight, components and potential leaks.[1] Most recently, Hyundai introduced a new 'Pulsating Heat Pipe (PHP) technology which is expected to reduce charging times and improve battery safety.[2] Note that cooling system leaks have been a contributing factor in some transit bus fires.
- **Autonomous Vehicles:** Self-driving technology is often associated with EVs, although autonomous operation and vehicle propulsion technology are not necessarily linked, and it is unclear when fully self-driving vehicles will become commercially available. A recent American Automobile Association survey showed that the enhancement of vehicle safety systems was a higher priority than self-driving.[3] Nonetheless, some manufacturers do offer these technologies. Highly publicized examples include products made by General Motors, Ford and Tesla for individual consumers, and vehicles developed to a high level of autonomy for use as taxis or rideshare (Waymo).
- **Onboard Electronics:** An EV Magazine contributor recently highlighted three areas in which such electronics are evolving: 1) traditional EV powertrains featured separate components for different functions, but manufacturers are increasingly combining elements to reduce complexity, weight and space requirements; 2) as power densities increase with each generation of EV, thermal management needs have increased; removing heat efficiently from these systems is essential for maintaining performance and ensuring longevity; and 3) silicon carbide (SiC) and gallium nitride (GaN) have emerged as the primary materials driving the next generation of EV power electronics. These materials allow for operation at higher temperatures, voltages, and frequencies than traditional silicon, leading to more efficient and compact systems. However, cost and manufacturing complexity are concerns. [4]

[1] https://www.midtronics.com/blog/ev-battery-cooling-technologies-affect-vehicle-servicing/
[2] https://evmagazine.com/charging-and-infrastructure/hyundai-mobis-ev-battery-cooling-technology
[3] https://newsroom.aaa.com/2025/02/aaa-fear-in-self-driving-vehicles-persists/#:~:text=For%20drivers%2C%20enhancing%20vehicle%20safety,automotive%20engineering%20director%20at%20AAA.
[4] https://evmagazine.com/technology/idtechex-ev-power-electronics-is-driving-future-efficiency

- **Other Product Updates:** Vehicle configurations, restyles and trim levels are expanding. Increased range is a perpetual goal, as is minimizing weight.

Fully Electric vs Hybrid

The technology of fully electric vehicles (EVs) has evolved rapidly over the past decade, outpacing the development of hybrid vehicles in many ways. While both types of vehicles aim to reduce fuel consumption and lower emissions, fully electric vehicles are undergoing rapid technological advancements that make them increasingly competitive and sustainable compared to hybrid vehicles.

Overcoming Range Anxiety Issue

Electric vehicles (EVs) have made significant strides in overcoming the range anxiety issue, which refers to the fear of running out of battery power before reaching a charging station. Several key factors and advancements are contributing to alleviating this concern:

- **Expanded Charging Networks**: The growing availability of public charging stations across cities, highways, and rural areas is crucial to reducing range anxiety. Networks like Tesla Superchargers, Electrify America, and ChargePoint offer thousands of fast-charging stations that make it easier for EV owners to find a charging point when needed. The ability to charge at various locations, including shopping centers, restaurants, and hotels, further eases concerns.
- **Faster Charging Stations**: The rise of fast chargers, which can charge an EV battery up to 80% in as little as 30 minutes, makes it easier to 'top off' the battery quickly during longer trips[5]. Fast chargers are becoming increasingly common along major highways, particularly along 'EV corridors' that link key cities.
- **In-Vehicle Navigation Systems**: Many modern EVs come with advanced navigation systems that can help drivers plan routes, considering battery range and charging station locations. Some vehicles even provide real-time information about nearby charging stations and the status of chargers, letting drivers know which stations are available or in use.[6]
- **Convenience of Charging at Home**: The ability to charge an EV overnight at home reduces range anxiety significantly. Most EV owners can start each day with a fully charged battery, and for many daily driving needs (commuting, errands), the range of

[5] https://www.electrifyamerica.com/
[6] https://www.nber.org/papers/w33342

even the most basic EV is more than sufficient. This reduces the need to frequently rely on public chargers for short trips.

- **Home Charging Stations**: With easy installation of Level 2 home chargers, EV owners can take advantage of faster charging overnight, ensuring they have a full charge each morning without needing to worry about running low on battery during the day.
- **Government Support and Incentives**: Governments are investing in EV infrastructure, with many offering tax incentives or grants to encourage the installation of home chargers or the building of more public charging stations. These initiatives, while they last, may help create a more supportive environment for EV owners, making it easier to travel confidently.
- **Solar Charging**: Integrating solar panels into the roofs of vehicles, or utilizing solar-powered charging stations, is another emerging solution that could help reduce range anxiety by supplementing EV's power supply with renewable energy during the day.
- **Vehicle Range**: This is improving over time in concert with evolving battery technologies and vehicle design refinements.
- **Financial Uncertainty:** The technology is being impacted by manufacturer bankruptcies and market retrenchment by a number of vehicle manufacturers (e.g. Volkswagen)[7] . Note that other manufacturers are scaling back EV production and refocusing on ICEs and hybrids at this time.[8]

[7] https://www.ccn.com/news/technology/volkswagen-layoffs-plant-closures-volvo-scrapped-electric-vehicle-target/
[8] https://www.instituteforenergyresearch.org/regulation/proposed-ev-manufacturing-facilities-are-being-cancelled/

Automobiles

Manufacturers

As of 2025, most passenger vehicle manufacturers offer at least one electric vehicle in the US market. Some manufacturers had planned to transition to all-electric product lines; however, such plans have been delayed or postponed given market conditions and continued demand for ICEs. Mercedes-Benz and Volvo are among those, as well as Ford and General Motors.[9] Meanwhile, there have been a few bankruptcies of firms manufacturing EV products; in the US, the most recent examples are Canoo and Fisker. Further, there are makes of EVs (principally owned by Chinese firms) that are not sold in the US at this time. See various trade publications including Car and Driver, Consumer Reports, and Cox Automotive for an updated list of EV offerings.

Vehicle Characteristics

Acceleration, Handling and Braking

The automobile industry touts EV acceleration and handling capabilities. Weight, and weight distribution within the vehicle, seem to be both positive and negative depending upon the vehicle and its center of gravity – and most EV battery packs are placed low in the vehicle but do add to curb weight and braking demand. Most, if not all EVs feature regenerative braking, which allows the vehicle to feed electricity into its battery pack, a plus especially where EVs operate in urban environments with frequent braking. Recent vehicle testing has shown that some EV models' brake lights do not illuminate when using this feature, which if braking is set to be aggressive, can elevate the risk of crashes. Several manufacturers have subsequently addressed this issue.[10]

Range

Vehicle ranges vary widely depending upon the manufacturers' data, tests done by car enthusiast magazines and advocates for the US market. As of 2024, at the lower end are Nissan's Leaf and the Fiat 500e. On the higher end, there are premium models offered by Tesla, Lucid and Rivian, though the Chevrolet Silverado reportedly can deliver up to 400 miles per charge.

[9] https://carbuzz.com/all-the-automakers-that-have-pushed-back-ev-production/
[10] https://www.consumerreports.org/cars/car-safety/brake-lights-can-fail-to-provide-fair-warning-on-some-evs-a9533519285/

Reliability

Reliability is impacted by computer hardware/software issues in certain models while others have proven to be more reliable. EV manufacturers have issued multiple recalls and other fixes through their dealer networks to address reliability problems.[11]

Utility (model styles, on/off road capability, all-wheel drive) mirrors the industry trends toward SUVs and crossovers, many of which feature greater ground clearances and cargo carrying strengths.

Crash Safety

Recent tests by the University of Nebraska[12] and the Texas Transportation Institute[13] indicate potential problems with EV crashes involving barriers and guardrails. WestCOG recommends that CTDOT should evaluate testing being conducted and the safety performance of its own roadway infrastructure.

Cost

As of August 2024, the average price of a new EV was greater than $56,000, according to Kelley Blue Book - about $10,000 more than the average gas-powered passenger vehicle. Figure 1 and Source: Cox Automotive, Kelley Blue Book

Figure 2 show nationwide EV sales and price statistics for January and March 2025, which indicate that prices of new EVs had declined slightly but rose again.

[11] https://insideevs.com/news/category/recalls/
[12] https://news.unl.edu/article/nebraska-tests-suggest-us-highways-are-not-ready-for-widespread-ev-use
[13] https://tti.tamu.edu/news/tti-advances-research-on-ev-safety-and-roadway-infrastructure/

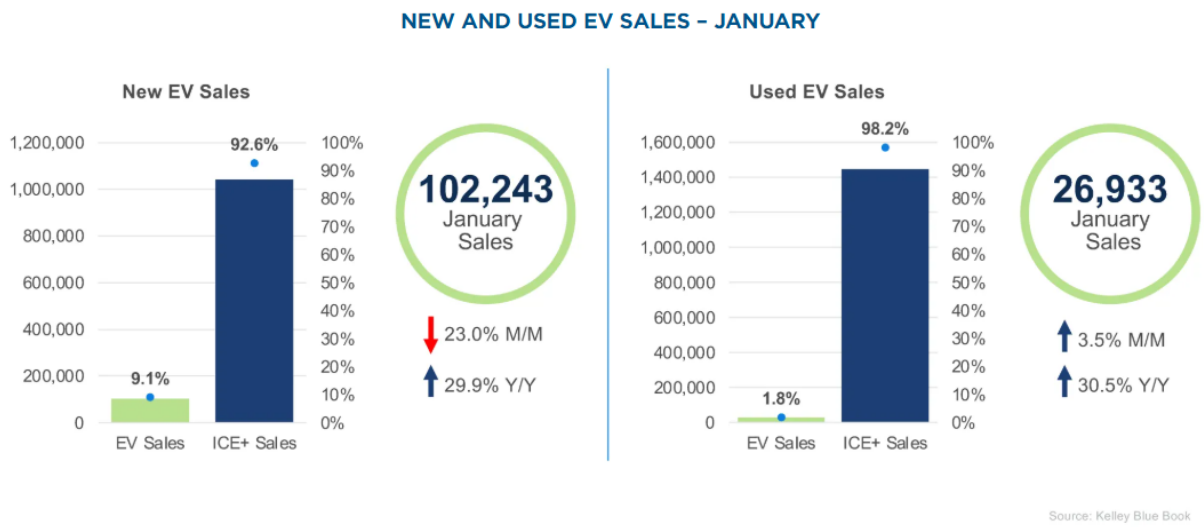
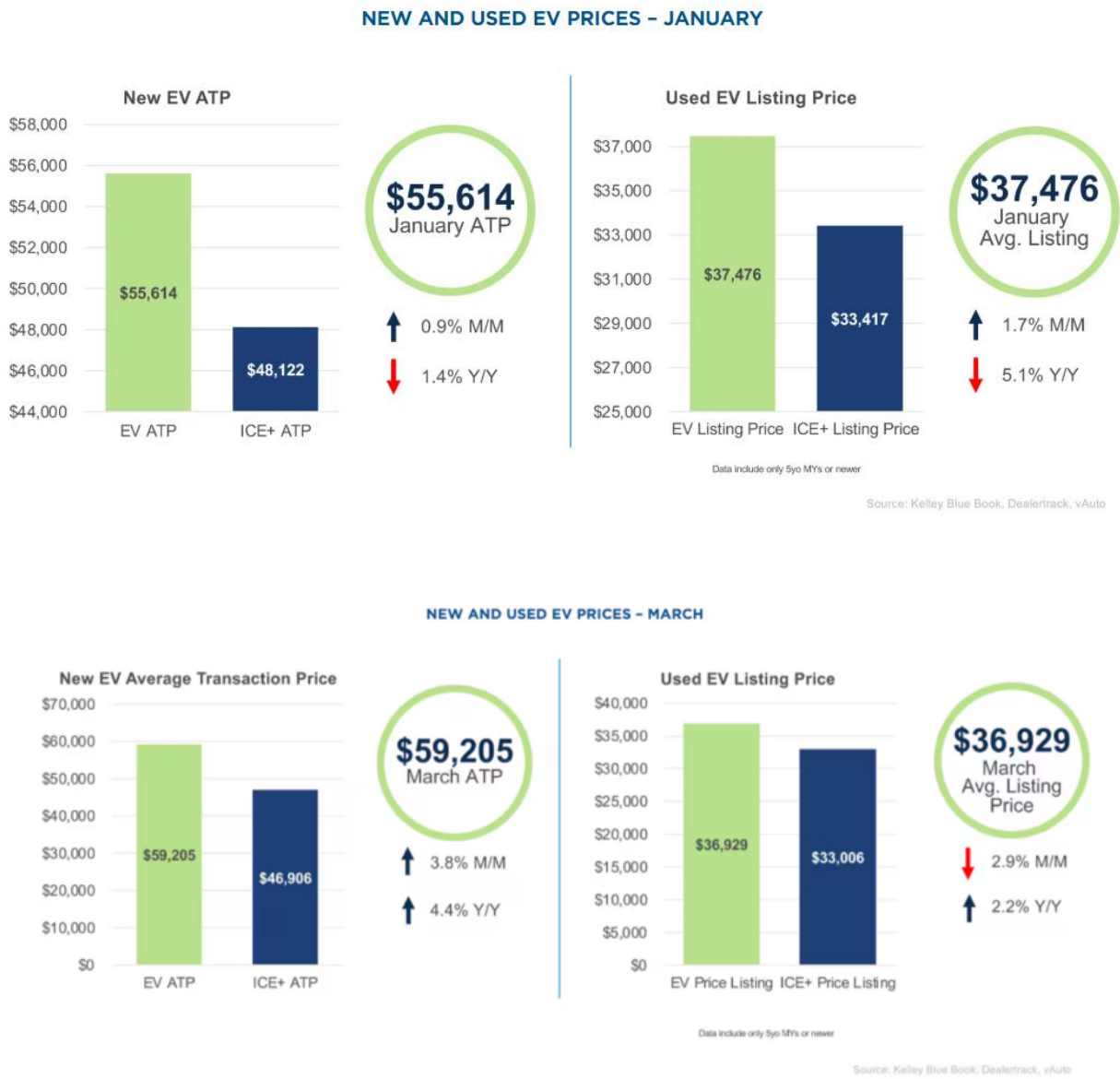


Figure 1. New and Used EV Sales - January



Source: Cox Automotive, Kelley Blue Book

Figure 2. New and Used EV Prices

Insurance

Reduced maintenance costs are associated with a significant reduction in the number of mechanical systems, with EVs generally eliminating a transmission, alternator, or emissions

control equipment. However, the increased complexity of the electronic systems in EVs has been associated with software defects and recalls.

Despite the promise of lower maintenance costs, the repairability of EVs has proven to be more costly than other vehicle types. One reason for this is that (depending on the model) the battery pack is designed as a structural component of the vehicle. Another reason is that the fabrication of individual body parts (depending upon the model) may not facilitate repair and instead require replacement or scrappage depending on the severity of the damage. From an insurance perspective, this can lead to the 'totaling' of an EV after only a few years of use. Another challenge has been that EV parts are available only from the original equipment manufacturers (OEMs) rather than third-party suppliers.

Accordingly, EVs to date have been associated with higher automobile insurance costs than for ICE vehicles. EV passenger cars can cost approximately $44 more per month, in comparison to other vehicles[14]. Some factors related to insurance can include the lack of repair shops and EV mechanics; the high cost of repairs and battery replacement; the risk of fire; pedestrian safety being at risk due to low EV sound; and cybersecurity threats. Battery replacement is a large factor that impacts insurance costs for EVs because the parts are found to be rarer and, as a result, more expensive. The repairs are also risky and can amount to almost half of an EV's price, with the average insurance being up to 20% higher than other vehicles.[15] However, as EVs become more common on the road, the market for their parts and number of repair shops may increase while insurance rates may decline. Note that in recent years as EV values have decreased, their total loss frequency has increased. In the U.S., EVs were written off as a total loss 9.93% of the time in Q1 2024 (up 8% from Q4 2023 and 30% from Q3 2023). As for repairable vehicles, in Q1 2024 the average severity was $6,066 for all EVs compared with $4,703 for ICE vehicles in the US, a difference of $1,363 or 29%.[16]

Charging Costs

The cost of EV charging is variable, based on the type of utility, location, time of day, and location of the chargers, whether they are home chargers or public stations. For example, some public charging stations charge different rates by the minute, leading to inconsistent pricing.[17] Meanwhile, other stations are subscription-based, and the price can vary depending on the time. Additionally, the type of charger impacts the speed of the charging as well as the cost.

[14] https://content.naic.org/insurance-topics/electric-vehicle-insurance-rates
[15] https://www.cnbc.com/select/electric-car-insurance-what-you-need-to-know/
[16] https://www.mitchell.com/insights/auto-physical-damage/article/plugged-in-ev-collision-insights-q1-2024
[17] https://witricity.com/media/blog/ev-vs-ice-surprising-differences

Electricity rates in Connecticut are higher than the national average, with residential rates increasing since June 2024.[18] The state's Energy Choice program is an opportunity for residents to select their electricity supplier within a deregulated market. Understanding charging costs is important to consider, as of February 2025, the average cost to charge an electric vehicle (EV) at public charging stations in Connecticut is approximately $0.377 per kilowatt-hour (kWh).[19] It should also be noted that there would be a buffer of 10% battery left to charge.[20] Most public charging stations have fees and varying prices. According to Kreft et al, it is discouraged to rest your EV at public charging station for longer than needed to make space for other vehicles waiting to charge. [21] To maintain immediate plug-out, these charging stations have idle fees – an incentive that is not included in residential charging – where overnight charging is frequent.

Battery electric vehicles such as the Tesla Model 3, are cheaper to drive per mile. To put it into perspective, a Model 3 costs $0.033 per mile with a $10.40 charge for a 310-mile range. Whereas, a 2020 BMW 3 Series would take 30 miles per gallon and cost $0.11 per mile of gasoline – with the assumption of a $3.19 per gallon of premium gas. This indicates that there are various saving advantages of driving an EV in comparison to an internal combustion vehicle.

Overall, charging an electric vehicle (EV) overnight at home is typically the most cost-effective option. While gas prices fluctuate and electricity rates vary by region, charging an EV usually costs less per month than filling up a traditional vehicle.[22] Though free charging stations exist, most public charging stations charge fees, which are generally higher than home charging rates. Electricity rates can change depending on where you live, the time of year, and peak charge periods. Fortunately, rates are generally lowest late at night, which is ideal for anyone thinking about switching to an EV.

There are different levels of electric power chargers that can be understood.

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[18] https://electricityrates.com/connecticut/#:~:text=Connecticut's%20Electricity%20Landscape,national%20average%20of%2016.34%2FkWh.

[19] https://gasprices.aaa.com/ev-charging-prices/

[20] https://evclubct.com/ufaqs/how-much-does-it-cost-to-charge-my-ev-at-home/

[21] https://www.sciencedirect.com/science/article/pii/S0306261924009279

[22] https://www.kbb.com/car-advice/how-much-does-it-cost-to-charge-an-ev/

AC Level 1 Charging

Level 1 charging uses a standard 120V outlet and is the slowest option, with 5 miles of range per hour. [23] It is most ideal for home charging and not as common in public stations.

AC Level 2 Charging

Level 2 charging is faster, typically found at public stations and workplaces. It uses a dedicated 240V circuit and can charge an EV much quicker than Level 1. Around 80% of public chargers are Level 2, offering more power for faster charging.

DC Fast Charging

Direct Current Fast Charging (DCFC) is the fastest option which can provide up to 200 miles of range within 30 minutes of charging. They can be found most likely alongside highways and may be expected to grow as more electric vehicles are on the road.

The electric grid is the most common power source for charging stations as it is reliable and provides a more consistent flow of electricity for charging EVs. [24] This is a more convenient system as it does not require special materials or permits to pull power from existing infrastructure.

The next common source is on-site solar panels that generate renewable energy from sunlight and maintain it for charging use. Although a sustainable option, they can be expensive to install and cannot provide appropriate power during low-sunlight periods. However, while they may have a higher cost, they are more eco-friendly since they do not rely on the grid. [25] See recommendations on Solar Carports below.

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[23] https://afdc.energy.gov/fuels/electricity-stations#:~:text=Approximately%2025%20miles%20of%20range%20per&text=Level%202%20equipment%20is%20also,delivering%207.2%20kW%20of%20power.

[24] https://macelectricco.com/where-do-ev-charging-stations-get-their-electricity-from/

[25] https://1charging.com/how-do-ev-charging-stations-get-their-power/

Consumer Interest and Customer Satisfaction

Consumer interest in EVs is mainly attributed to the promise of lower maintenance costs as well as the perception of EV environmental benefits. A 2021 study identifies government incentives for EVs in developed countries as including tax incentives, free parking benefits, exemption from tolls, and purchase subsidies. The environmental impact of operating an EVs is generally constructive – since they use batteries instead of internal combustion engines (ICE), they do not produce CO_2 and air pollutants such as particulate matter, SO_2 and NO_X, eliminating tailpipe emissions of greenhouse gases and reducing local air pollution. However, it is still important to note that EV use does not eliminate global emissions. The production of EVs and the electricity they use results in the release of air and other types of pollution, although the level and location of this pollution depends on where EVs and their components are produced, and where and how electricity is generated. That being said, EVs are generally believed to have a smaller environmental footprint when considered from a lifecycle perspective.[26]

In terms of operational efficiency, EVs can be more energy-efficient than gasoline or diesel-powered vehicles. Gasoline vehicles have 11-27% wheel-well efficiency, whereas EVs powered by renewable energy can have up to a 70% efficiency rate.

In extremes of cold or hot weather, EVs must utilize battery power for heating and cooling. With respect to heating, passenger EVs use a minimal amount of power to operate the heater which is generally more efficient than the typical ICE vehicles. This also attests to the longevity of electric vehicles and how they can keep the cars warm for longer periods without resulting in significant battery drainage.

Owners' opinions vary, with industry advocates reporting positive experiences and others reporting the opposite. Other sources, like J.D. Power, reported in a 2023 survey that EVs scored less well than their ICE counterparts, largely due to recall issues. Consumer Reports has also given EVs lower scores on certain aspects of EVs, such as assembly quality. It is perhaps more important to consider the opinions of those parties who do not have a direct stake in the outcome. For example, according to the American Automobile Association (AAA), EVs are the reason customer satisfaction scores are declining among American drivers. More recalls, and poor knowledge in the service department, have resulted in the first decline in CSI scores in 28 years, according to J.D. Power.[27] In addition, consumer interest in purchasing EVs has declined from last year, according to the latest AAA annual consumer survey on EVs. Only 18% of U.S. adults reported they would be "very likely" or "likely" to buy a new or used EV, down from 23% last year. Perhaps more compelling, 63% said they were "unlikely or very unlikely" to

[26] https://www.cnbc.com/2021/07/26/lifetime-emissions-of-evs-are-lower-than-gasoline-cars-experts-say.html
[27] https://www.greencars.com/news/service-satisfaction-is-down-and-evs-are-to-blame

select an EV for their next car purchase.[28] Whether such trends are likely to endure remains to be seen.

Sector Uptake

Distribution of EVs by State

JD Power, a US-based consumer information company, projects that EV retail sales for calendar year 2025 will remain at or about 9.1% of all retail vehicles sold. Factors influencing this percentage include potential changes in federal EV incentives, possible tariffs on both EV and gasoline-powered vehicles and ongoing public charging network development challenges. J.D. Power also projects that a change will occur in the marketplace; in past years premium segment EVs predominated; going forward, more 'mass market' EVs will sell. In the U.S., New York, Florida, and Colorado will see EV sales growth. To date, California has been the leading EV adoption location. Among the states with the fastest-growing EV adoption rates were New York (23,000); Florida (22,400), Colorado (14,600), Michigan (10,700) and Texas (8,400). [29]

Distribution of EVs in Connecticut

According to CT Insider, "About half of Connecticut's 169 towns have an EV ownership rate of less than 2%. Waterbury in New Haven County, New Britain in Hartford County and Bridgeport in Fairfield County have some of the lowest ownership rates in the state. The concentration of EVs in Fairfield County overall, and the scarcity of EVs in most of the rest of the state, (could have motivated) state legislators to cancel plans in March to phase out the sale of new, gas-powered cars by 2035." [30]

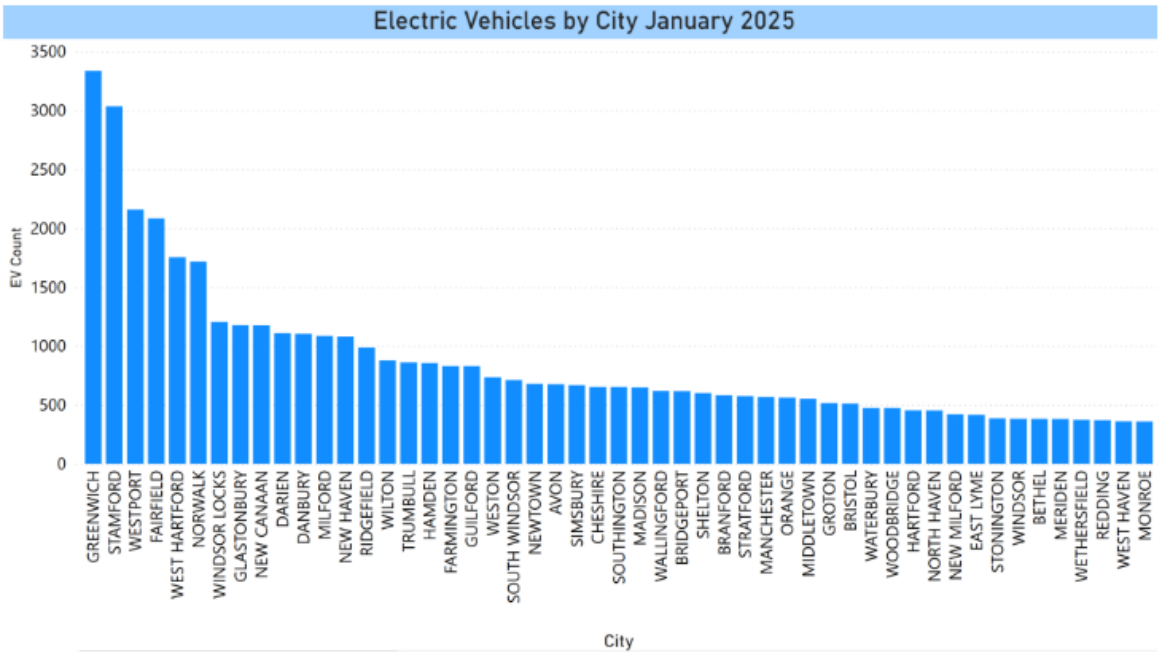
The EV Club of CT reported in January 2025 that the total number of EVs registered in Connecticut was 60,489 as of January 1, 2025. Westport (10.4%) and Weston (10.1%) were followed by New Canaan (8.1%) and Greenwich and Woodbridge (7.5%). The overall statewide rate was 2.7%. Further, Source: EV Club of CT

Figure 3 shows a count of EVs by City in Connecticut (source: EV Club of CT).

[28] https://ev.aaa.com/articles/consumer-interest-in-evs-is-declining-surveys-show/
[29] https://www.jdpower.com/business/resources/e-vision-intelligence-report-january-2025
[30] https://www.ctinsider.com/connecticut/article/ev-ct-charging-stations-19788894.php

Count of Registered EVs by City

In terms of raw EV counts, Greenwich remains at the top with 3335 registered EVs, followed by Stamford (3035), Westport (2158), Fairfield (2083), and West Hartford (1753). The charts below are for the 2025 numbers and trended numbers going back to 2018.



Source: EV Club of CT

Figure 3. Count of Registered EVs by City

Several other WestCOG communities also make this list, namely Darien, New Canaan, Danbury, Ridgefield, Wilton, Weston, Newtown, New Milford, and Redding.[31]

Policy Effectiveness

One challenge for policymakers is determining the effectiveness of consumer EV purchase/lease incentive programs vs. investing in charging infrastructure. WestCOG has not found any information showing that such an analysis has been done. The Connecticut Department of Energy and Environmental Protection (CTDEEP) represents that its Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) Program, which subsidizes EV leases or purchases, has been successful. It is also making funds available for charging infrastructure (see https://portal.ct.gov/pura/electric/office-of-technical-and-regulatory-analysis/clean-energy-programs/electric-vehicle-charging-program.)

[31] https://evclubct.com/where-the-evs-are-january-2025/

The effectiveness of state and federal rebates is also a consideration. WestCOG reviewed the State of Connecticut's CHEAPR Program. While CTDEEP reports that the Program has been effective, it remains to be determined whether the subsidies provided are optimal from a public policy standpoint.[32]

The Institute for Energy Research (IER) notes that the potential rollback of federal EV subsidies could generate approximately $300 billion in savings over ten years. Also, IER notes that while electric vehicles may fulfill a role in the US transportation industry, consumers – not government – should "be at the center of decision-making." [33]

Consumption

Should an electric vehicle be classified as a durable good, or does it fall under a different category? Research conducted in 2024 suggests that consumption of EVs is akin to mobile devices – and, that perception has had an impact upon EV resale value. In line with the work of economist Peter Drucker on planned obsolescence in the automobile industry, this depreciation is a form of subsidy to the second or third owner borne by the first owner. Given the expense of purchasing a new EV, this subsidy is significant. It also has an impact on the initial buyer, as the values of used EVs have impacted that buyer's ability to trade the vehicle. What is interesting about this trend now is that automobile obsolescence was based largely on styling changes in the past; today, it is the result of technological changes.

Fleet Vehicles

Public Vehicles

Some of WestCOG's municipalities have leased or purchased EVs. For example, the Town of Westport has three Tesla's which they use as police vehicles and acquired two Chevrolet Bolts in 2021 that are used for municipal inspections by the Public Works Engineering Division and the Assessor's Office.[34] As of 2024, the Town also acquired an electric motorcycle and an all-terrain utility vehicle. The City of Norwalk reports that as of 2024 it had seven electric vehicles.

Rental Cars

In the US market, major car rental companies such as Avis, Enterprise, Hertz, National, Thrifty have offered EVs for rent – and some, for sale. Of these companies, a widely publicized acquisition plan in 2021 by the Hertz Corporation garnered significant attention. It developed an ambitious plan, with the goal of ordering 100,000 Tesla vehicles, and the establishment of

[32] https://yankeeinstitute.org/2023/07/18/taxpayers-taken-for-a-ride-with-expansion-of-electric-vehicle-welfare-program/
[33] https://www.instituteforenergyresearch.org/regulation/ev-sales-fell-5-percent-in-april/
[34] https://www.efleets.com/en/proof-and-insights/news/town-hall-debuts-new-electric-town-cars.html

an extensive charging network to support this fleet. Hertz ultimately acquired about 60,000 EVs, a mixture of Tesla, GM and Polestar products. However, Hertz's experience with strong customer resistance, coupled with maintenance and accident issues, and steep depreciation led to a decision in January 2024 to liquidate a third of its EV fleet, or about 20,000 vehicles.[35] The company subsequently continued to liquidate additional EV's; its goal was to sell 30,000 EVs by the end of 2024.[36] Instead, Hertz is continuing to offer ICE vehicles, which are proving to be more popular with customers – as well as more reliable and profitable.

Public Service (i.e. taxis)

As taxis, EVs can operate well in a densely developed urban environment provided that there is adequate charging infrastructure. However, they need to be charged more frequently than private EVs – and the time required to charge them is a cost to the driver, who depends upon having a vehicle with minimal down time. The higher purchase cost is also a disincentive.[37]

Fire Suppression - General

A bill (HB06627) was recently introduced in the 2025 session of the Connecticut legislature that, if signed into law, would require all EV manufacturers to furnish a guide for handling EV battery fires, particularly to limit thermal runaway and re-ignition, and how to store EVs that have damaged lithium-ion batteries, written specifically for each vehicle.

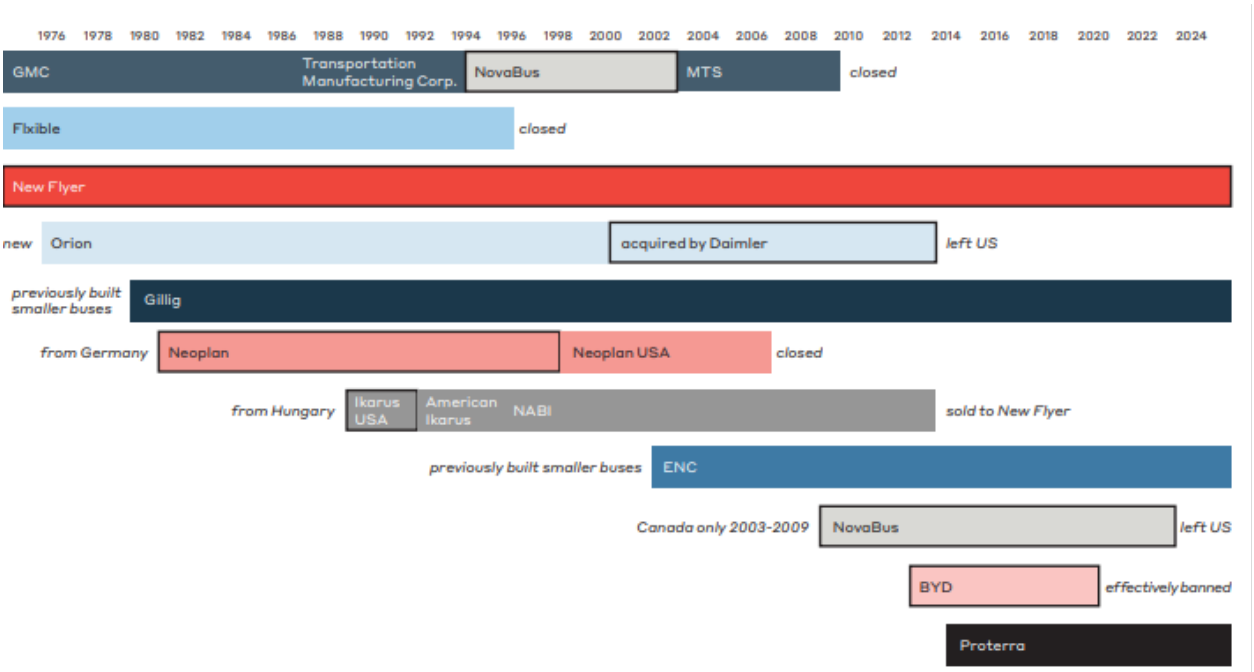
[35] https://www.cnn.com/2024/03/18/business/hertz-ceo-departure-ev/index.html
[36] https://www.teslarati.com/hertz-continues-to-get-thrashed-by-evs-updates-plans-for-massive-fire-sale/#google_vignette
[37] https://www.ampcontrol.io/post/electric-taxi-cabs-benefits-drawbacks-and-fleet-management

Transit vehicles

Manufacturers

As of 2023, the United States electric bus (transit and school/intercity/other) market consisted of several manufacturers, including Blue Bird Corporation, Gillig LLC, GreenPower Motor Company Inc., MCI, Motiv Power Systems Inc., New Flyer of America Inc. (NFI Group Inc), Proterra Inc., REV Group Inc., The Lion Electric Co. USA, Thomas Built Buses Inc. (Mercedes-Benz Group AG), and Volvo Group North America LLC (AB Volvo). The impact of the August 2023 bankruptcy of Proterra was significant. Proterra's operations were subsequently split into three companies: Phoenix EV (transit buses, school buses); Volvo Group (batteries) and Camber (charging systems). As of the writing of this Study, school bus maker Lion Electric Company in both Canada and the USA filed for bankruptcy; their future is uncertain.

Error! Reference source not found. and **Error! Reference source not found.** show information for various manufacturers through 2023.



Source: X (2023)

Figure 4. 40 Foot Transit Bus Manufacturers, USA

Manufacturers – Continued

Length	Type	Manufacturer(s)	Average Base Price (USD)*	Advertised Range (miles)	Weight (kg)	Passenger Capacity (sitting)
60'	BEB	BYD*, New Flyer	1.4 M – 1.6 M	152 – 276	17,237 –22,680	120 standing
	FCEB	New Flyer	1.8 M	370		
45' (Coach)	BEB	BYD*, MCI	1.2 M – 1.6 M	196 – 250		
40'	BEB	BYD**, ENC, Gillig, New Flyer, Proterra***	800,000 – 1.2 M	178 – 374	15,000	30
	FCEB	ENC, New Flyer	1.2 M – 1.5 M	300 – 430		
35'	BEB	BYD**, ENC, Gillig, New Flyer, Proterra***	800,000 – 1.1 M	182 – 295		
30'	BEB	BYD**, ENC, GreenPower	800,000	158 – 191		
24' (Cutaway)	BEB	GreenPower, ARBOC, Endera	220,000	153	6,350 –11,793	20

**Reflects average price from Washington, and Virginia state contracts.*
***Vehicles are not currently eligible for purchase with federal funds.*
**** Proterra filed for Chapter 11 Bankruptcy Protection, which might impact future vehicle availability.*
Source: WSP (2023)

Source: The State of the U.S. Transit Bus Zero Emission Transition
Figure 5. Available Zero Emission Bus Specifications

According to Metro Magazine (an industry newsletter) the manufacturer New Flyer reported having experienced financial issues in early to mid-2023, which forced it to restructure its finances. More recently, Nova Bus exited the US transit bus market and became a solely Canadian bus supplier, repeating a similar decision which the company had made fifteen years before.[38]

Finally, ENC and their parent REV Group decided to shut down their bus assembly operations citing COVID supply chain effects and the difficulty of sourcing and financing electric bus components; however, they were sold to Rivaz and are expected to continue under that brand. Meanwhile BYD rebranded its transit division as RIDE.

The result of these dynamics is that, as of 2024, there are just a few North American manufacturers in the heavy-duty transit bus market including: GILLIG, New Flyer, Ride

[38] https://www.metro-magazine.com/10220991/north-american-transit-bus-deliveries-up-7-in-2023

Mobility, and Phoenix Motorcars.[39] BYD, which is a Chinese company, does have a facility in Lancaster, CA and claims to meet FTA's Buy America requirements (more than 70% domestic content and final assembly in US); some US transit systems have purchased their vehicles but it is unclear to WestCOG that these purchases met Buy America requirements. Solaris, a Spanish company with manufacturing facilities in Poland, entered the US market in December 2024 and their first US sale to a transit agency was recently publicized.[40]

APTA Bus Manufacturing Task Force (2024)

To address the dynamics of the bus manufacturing industry as it relates to transit, the American Public Transportation Authority (APTA) convened a Bus Manufacturing Task Force in late 2023 and released a report in early 2024. APTA advised that there are international bus manufacturers, but most are not able to sell to the US market. One major challenge is complying with the domestic content requirements of the Buy America Act when bus purchases involve USDOT or other federal funds. No consensus was reached among Task Force members on approaches to encourage more companies to build buses in America. Some members encouraged APTA to engage with FTA to explore ways to do so, including approval of a "bridge" to Buy America compliance through limited phase-in of Buy America requirements. Other members cautioned that this could put existing manufacturers, who comply with Buy America, at a financial and competitive disadvantage.[41] As of February 2025, implementation of Buy America respective to transit vehicles (both road and rail) is being reviewed by federal agencies and by the US Congress. Going forward, WestCOG does not anticipate that Buy America will be modified to allow federal funds to be used to acquire transit vehicles that do not meet its requirements.

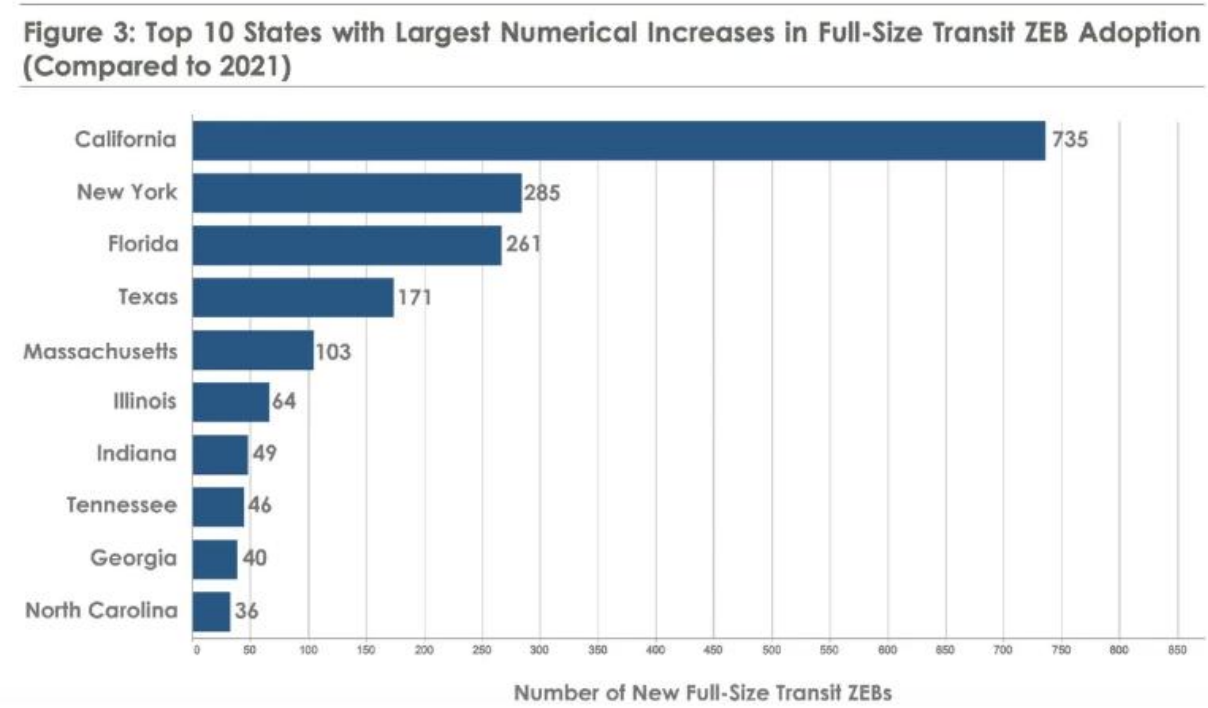
Vehicle Characteristics

Insurance

Insurance costs for transit vehicles will be influenced by the cost of the vehicles themselves, which are higher than for ICE vehicles. Maintenance and storage facilities, to the extent that they must be built or upgraded, will also carry increased insurance costs. WestCOG reached out to an insurance firm specializing in transit industry insurance and was unable to obtain more specific information.

[39] https://www.fastcompany.com/91070580/electric-buses-public-transit
[40] https://www.solarisbus.com/en/press/solaris-signs-first-contract-for-electric-bus-deliveries-to-the-united-states-of-america-2263
[41] https://www.apta.com/wp-content/uploads/APTA-Bus-Manufacturing-Task-Force-Recommendations.pdf

Sector Uptake



Source: Calstart

Figure 6. Top 10 States with Largest Numerical increases in Full-Size Transit ZEB Adoption (Compared to 2021)

Figure 6 shows that California has the largest numerical increase in full-size transit ZEB adoption since 2021. FTA reported that in 2022 there were 1,873 active electric buses on the roads, up from 1,548 in 2021. The active all-electric buses made up approximately three percent of the 60,995 public transit commuter, municipal, and trolley buses in the nation. In 2022, electric buses were used by agencies in 43 states, up from 37 states in 2021.[42]

Although there are many active orders from transit operators for zero-emission vehicles, traditional propulsion technologies constitute most manufacturer deliveries. Transit bus deliveries by propulsion type were recently as follows:

- Diesel was still the predominant propulsion technology in 2023 with 1,973 units delivered, representing a decline of 231 units, or -10%, from 2,204 units in 2022.
- Hybrid propulsion proved itself in 2023 with a major increase to 916 units from 521 units in 2022, or a 395 unit and 75% increase year-over-year.
- Natural gas, or NGV propulsion, increased slightly from 780 units in 2022 to 850 units in 2023. This 70-unit increase resulted in an approximate 9% year-over-year bump for NGV.

[42] https://www.govtech.com/biz/data/how-many-electric-buses-does-your-city-have-2023-edition

- Electric buses were 579 units in 2023 vs 504 units in 2022, representing a 75 unit increase or 15%.
- Fuel-cell buses were with 31 units in 2023 vs 42 units in 2022, representing an 11-unit decrease, or -26%.

For the remainder of 2024, Metro magazine forecasted a continued decrease in diesel propulsion technology orders in favor of primarily electric buses. They also predicted that bus builders would make progress in working through their backlog, and that CNG and hybrid deliveries were forecasted to remain reasonably favorable in the overall market mix.[43]

Battery-Electric Bus (BEB) Deployments in and around the WestCOG region

As bus technology has evolved, let's look first at the hybrid ICE/electric buses. These made their debut in the WestCOG region about fifteen years ago.[44]

CT*transit* has operated hybrid diesel-electric buses since 2011.[45] These hybrid buses are powered by a combination of an ICE paired with a generator, electric storage system and an electric motor. Lithium-ion batteries provide an extended range for the bus.[46] It is WestCOG's understanding that their performance to date has been positive overall; a total of 18 such buses were assigned to Stamford Garage.

At present, the WestCOG region's transit operators are moving ahead with plans for fleet acquisitions and/or facility construction. As of November 2024:

- CT*transit* Stamford Garage: constructing vehicle charging/storage space and operating BEBs
- HARTransit: has taken delivery of two Ford electric sedans for administrative use
- Norwalk Transit District: constructing vehicle charging/storage space

[43] https://www.metro-magazine.com/10220991/north-american-transit-bus-deliveries-up-7-in-2023
[44] https://cptdb.ca/wiki/index.php/Connecticut_Transit#Stamford_Division
[45] https://busride.com/cttransit-debuts-articulated-hybrid-electric-buses/
[46] https://www.metro-magazine.com/10024332/cttransit-unveils-nova-artics-new-flyer-hybrids

CT*transit* Stamford Division

Table 1 shows that the Stamford Division had BEBs on the property as early as 2022.[47]

Table 1: CT*transit* Battery Electric Bus Deployments, 2022						
Vehicle Numbers	Date of Manufacture	Brand	Model	Propulsion (Drivetrain)	CT*transit* Garage Assignment	Status
2101-2112	2021	New Flyer	XE40 Xcelsior CHARGE	Siemens Electric Permanent Electromagnet Motor 1DB2022-1NA06	2101-2110: New Haven 2111-2112: Stamford	For New Haven and Stamford garages. 2101-09 in service as of 4/2022. 2111 on property as of 4/2022. All units pulled from service as a safety precaution in July 2022 after 2102 caught fire.[7] They subsequently returned to service in July 2023.[8]

Table 1. Stamford Division Battery Electric Buses

The Stamford CT*transit* garage is the smallest of the three CT*transit* garages but is projected to be the first one to have an all-electric revenue vehicle operation. Highlights include:

• **Buses**: CT*trans*it moved in four BEBs assigned to its New Haven Garage to conduct a pilot test in late 2023; this pilot test ended in 2024 and the vehicles were returned to the New Haven Garage. CT*transit* subsequently took delivery of thirteen BEBs which were assigned to Stamford Garage; as of December 2024 these vehicles are being cycled on routes throughout most of the service area. In addition, the next round of twenty BEBs are scheduled for delivery in CY 2027, at which point Stamford Garage's fleet will be 70% BEB.[48]

• **Facilities**: A pilot upgrade in 2023 included the installation of five 150KW plug-in chargers in the existing bus storage building, as well as a fire pump with back-up generator, and fire suppression upgrades. In addition, a transformer and line feed were sized to support 21 150KW chargers. Concurrent with the electrification of the existing bus storage building, CTDOT is designing a free-standing 11-BEB building on-site for additional indoor storage and charging

[47] https://cptdb.ca/wiki/index.php/Connecticut_Transit#Stamford_Division
[48] Source: CTtransit

capacity. The addition of this building will allow 100% of the fleet to be stored and charged indoors. Design was scheduled to be completed by the end of 2024, with construction to be completed at the end of 2026. The facility will be equipped with all necessary fire suppression upgrades, as well as eleven (11) pantograph dispensers.

As of 2025 CT*transit* is the sole operator of BEBs and hybrid buses with operations based in the WestCOG region from the Stamford garage.

Other operators

Adjacent to the WestCOG region, Greater Bridgeport Transit (GBT) has put electric buses into service.[49] Beginning in 2020, GBT tested the state's first two Proterra Catalyst electric buses. In 2021, these buses operated on regular routes. An additional three electric (Proterra ZX5) buses were added in 2022. GBT has posted that it plans to add additional electric buses, with expectations to bring the fleet to 20% zero-emission buses by the end of 2024. GBT does operate the Coastal Connector route into the WestCOG region, connecting to the Norwalk Transit District (NTD) system at its hub facility, but WestCOG is unaware of whether BEBs are deployed on this route.

In addition, the HVMPO and SWRMPO TIPs include funding for BEB charging infrastructure and buses. The specific amounts attributable to each transit property are being programmed in the CTDOT STIP at present and are not finalized.

Through a competitive bid process, the Original Equipment Manufacturer (OEM) New Flyer was awarded a BEB contract by CTDOT in September 2020. CT*transit* is currently in possession of eleven (11) BEBs - seven (7) of which are operating out of the CT*transit* New Haven Division and four (4) are housed and operating out of the CT*transit* Stamford division. New Flyer has since built 50 additional BEBs for CTDOT. These buses are anticipated to be put into revenue service at each of the CT*transit* properties as well as several other transit districts across the state by the fourth quarter of 2024. Additionally, CTDOT has entered into an electric bus contract that would allow the purchase of up to 142 more BEBs through another competitive procurement. [50]

Non-Revenue Vehicles

Deployment in the region is at present limited. HARTransit purchased two Ford Mach-E's for their administrative/operational staff's use in 2024.

WestCOG believes that future electric bus deployments by HARTransit and Norwalk Transit District will depend upon state procurements and allocations to individual transit agencies.

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[49] https://www.govtech.com/education/k-12/breakdowns-recalls-fuel-skepticism-of-electric-school-buses

[50] https://portal.ct.gov/dot/publictrans/bureau-of-public-transportation/battery-electric-bus-projects-and-partners?language=en_US

Manufacturer abilities to meet market demand, plus funding and construction necessary for facility renovations, will also be issues.

Outlook

Several transit properties have sidelined some or all their BEBs as a result of warranty issues, parts/service problems, and lower-than-planned durability. Examples include:

Austin, TX: Capital Metro had been operating 23 BEBs in a fleet of 402 buses, not including commuter buses or shuttle buses. As of Fall 2024, it put 46 new Proterra BEBs in storage, as Proterra's bankruptcy caused the associated charging equipment to be unavailable. It has also procured New Flyer BEBs. In total, its BEB fleet = 104 buses. Despite initial plans to completely electrify its fleet, Capital Metro's policy states that a reliable transit service, even with diesel buses, is better for the city and the environment than less reliable public transit with an all-electric fleet.

Asheville, NC: it was reported in February 2024 that three of the five BEBs the city purchased in 2018 were sitting idle due to a combination of software issues, mechanical problems and an inability to obtain replacement parts.

Des Moines, IA: the Des Moines Area Regional Transit Authority (DART) acquired seven electric buses from Proterra with $1.45 million in assistance from FTA in September 2017. These buses were put into service in January 2021. As of April 2025, DART has moved forward with disposing of the buses, as FTA granted a full waiver of the federal interest in the buses. This decision is the result of the buses being taken out of service after 22 months, due to expiring warranties, major mechanical failures, safety concerns and driver complaints. The buses were on the road about 60% of the time, compared with an average 90% for non-electric buses.[51]

Denver, CO: the Denver Gazette reported two of the four e-buses Colorado Springs' Mountain Metropolitan Transit acquired in 2021 were not running as of January 2024.

Edmonton, Alberta: the City sued Proterra for $82 million in damages over BEB structural and component defects, plus poor range performance. The commitment to purchase these BEBs was made in 2016 and sixty BEBs were purchased, an order which constituted 6% of the city's fleet of 1,000 buses. It was reported that up to 75% of those buses were inoperable as of late November 2023 [52]

[51] https://www.businessrecord.com/dart-scraps-electric-bus-program/
[52] https://edmontonjournal.com/news/local-news/high-risk-city-pays-for-2016-gamble-on-hobbled-electric-bus-fleet

Los Angeles, CA: "Foothill Transit, based in West Covina and serving the San Gabriel Valley, parts of Los Angeles and Pomona Valley, had idled thirteen of its thirty-two battery-electric buses as of August 2021. At one point, the agency reported that up to 67% of its electric buses were not operating during 2019 and 2020[53] and it was difficult to get parts to repair them. One bus was a total loss in January 2020 when it caught on fire while recharging".[54] Foothill Transit pursued an FTA bus buyback to retire these buses early.

Philadelphia, PA: SEPTA sidelined its $24 million fleet of 25 BEBs in 2019-2020 due to structural cracks and other defects, one fire, and overall lower actual ranges than projected and has procured ten New Flyer hydrogen fuel cell buses to try out alongside its current diesel hybrid buses. SEPTA reported that it still expects to have BEBs in its fleet.

Some, including Asheville and Colorado Springs, have paused purchasing more all-electric transit vehicles for now, and are instead opting for adding hybrid models (or diesel, CNG or hydrogen) to their fleets until EV technology improves.[55]

Transit

BEBs began entering service at various transit agencies across the US over a decade ago. In New England, the Worcester Regional Transit Authority (WRTA) in Massachusetts acquired six Proterra Catalyst BEBs in 2013 under an FTA grant to test their performance. Early results showed some promise; WRTA's general experience was that these buses were best suited to short, level routes and the number of BEB vehicle or charging equipment outages required traditional ICE buses to maintain schedules on the shorter routes and to provide service on the longer routes. As of 2024, WRTA still has its Proterra Catalyst BEBs (it is unknown whether they are in service) and advises that it is ordering additional BEBs to work towards electrification of its fleet.

Other Examples

AC Transit reported that their Zero Emission Bus (ZEB) program generated over five million miles and eliminated more than 15,025 metric tons of CO_2. Their ZEB fleet consists of 58 ZEBs: 30 Hydrogen Fuel Cell Electric and 28 Battery Electric Buses. AC Transit's website reports that they have logged 6.5 million zero-emission miles to date and have invested $294 million in their ZEB program.[56]

CTA (Chicago, IL): CTA's website advises that it currently has 25 BEBs in its fleet and three of its seven existing bus garages are now equipped with charging facilities for electric buses, with

[53] https://www.foxbusiness.com/politics/electric-buses-sitting-unused-cities-across-the-us
[54] https://www.dailynews.com/2021/07/28/government-shouldnt-pick-winners-and-losers/
[55] https://www.foxbusiness.com/politics/electric-buses-sitting-unused-cities-across-the-us
[56] https://www.actransit.org/zeb

plans to purchase additional vehicles and expand to additional routes and garages in the coming years. Its plans are to go fully electric by 2040. CTA officially reports that "Proterra electric buses are tested to perform year-round in Chicago. The transit property advised that the electric buses performed well in winter weather, and there had not been any fleet challenges related to cold weather."[57]

TriMet (Portland, OR) has the 11th largest bus fleet in the US.[58] It has operated BEBs since 2019 and in 2024 added 24 new BEBs. TriMet is also preparing plans to acquire fourteen hydrogen fuel cell buses in the next few years.[59] A study of their BEB operations indicated that the BEBs have performed best on short routes and their range was most impacted by the number of ramp deployments. Regenerative braking helped recharge the batteries.[60]

It appears that BEBs have performed best in areas with temperate climates, level of terrain and roadways that are in good repair. There have been technological improvements that have reportedly benefited the performance of electric transit buses since they were first manufactured. However, there are implementation challenges, many of which are similar to electric vehicles generally:

Operation in extreme heat or cold is a challenge. Some transit properties (including CT*transit*) have had to equip BEBs with ICEs to run HVAC systems – particularly for heat, as minimum bus interior temperatures must be maintained to carry passengers. This measure can conserve battery charge which would otherwise be consumed. As a US Department of Energy information bulletin stated, "The energy used by electric school buses (ESBs) electric cabin heaters is second only to the energy used to propel the vehicle...."61 This energy requirement increases as temperatures drop. One BEB study showed that range decreased by 33% when air temperature was 25°F, a 30-degree decrease from the ideal conditions of 55°F–60°F."62 An AFDC study noted that transit agencies in colder climates have reported that HVAC takes as much as 50% of the total power to heat their BEB interiors.[63]

- Range and terrain limitations. These factors have been observed by many transit agencies, including WRTA in Worcester (MA), and Duluth Transit Authority (MN).[64]

[57] https://wirepoints.org/huge-problems-with-proterra-electric-transit-buses-in-many-cities-though-cta-and-pace-say-no-concerns-wirepoints/
[58] https://news.trimet.org/wordpress/wp-content/uploads/2018/09/TriMet-Non-Diesel-Bus-Plan-September-2018.pdf
[59] https://news.trimet.org/2024/08/welcome-aboard-trimet-introduces-new-generation-of-battery-electric-buses/
[60] https://tram.mcgill.ca/Research/Publications/Ebus_run.pdf
[61] https://afdc.energy.gov/files/u/publication/cold_weather_impacts_on_electric_school_buses.pdf?c8f5f786c9
[62] https://www.michigancapitolconfidential.com/news/electric-school-buses-lose-one-third-of-range-in-cold-weather
[63] https://afdc.energy.gov/vehicles/electric-school-buses-p3-m2
[64] https://www.duluthmonitor.com/2020/09/19/electric-bus-pilot-project-reveals-problems/

- Equipment failures and maintenance needs. Out-of-service time has been notably long, and some transit agencies have had to sideline some BEBs[65], or send them back to the manufacturer for repairs. in New York state, the Association for Pupil Transportation advised that out of a sample fleet of 100 electric school buses, they have experienced a 20% failure rate on any given day – compared to the 1-2% out of service rate for traditional buses.[66] In the past, warranty coverages have covered some issues – but the retreat of some of the manufacturers has exacerbated the problem.
- Useful Life: it remains to be determined whether BEBs will meet FTA's minimum Useful Life Benchmarks (ULBs) of twelve or fourteen years. Foothill Transit (CA) was compelled to negotiate a buy-back effort with FTA when its fleet of EV buses proved able to withstand only about seven years of service.
- Need for additional vehicles to cover routes. This need arises from lower range capabilities, general battery depletion, requirements for recharging times, and equipment outages.
- Fires. While not frequent, these have occurred at different transit agencies. Close to home, a CT*transit* bus burned in 2022, prompting concerns and a federal investigation.

Other Issues

Constricted parts supply: For example, Proterra's early presence in the marketplace (and its August 2023 bankruptcy) has had an impact, as Proterra supplied vehicles to many different US transit systems (including WRTA). For Proterra-made buses, parts have been unavailable, and reports indicate that many vehicles have been stored due to lack of parts, or the cost of repairs being infeasible.

Purchase cost: A new electric 40' transit bus typically costs around 100% more than a comparable ICE or ICE hybrid bus. The latest information available suggests that a diesel bus is about $480,000 while an electric bus is $888,000 or more. WestCOG's research has indicated that some transit properties' BEB acquisitions exceeded $1 million per bus. To an electric bus, add also the cost of charging infrastructure, fire suppression and storage facility requirements.

Insurance: Data for transit vehicle coverage is unavailable to WestCOG; however as is the case with EVs generally, insurance costs would be expected to be higher based upon the higher cost of the vehicle to begin with.

[65] https://www.koaa.com/news/news5-investigates/after-destroying-diesel-buses-mmts-switch-to-electric-lacks-power#google_vignette
[66] https://www.govtech.com/education/k-12/breakdowns-recalls-fuel-skepticism-of-electric-school-buses

Electric Vehicle Environmental Considerations

Much has been written about the environmental benefits of electric vehicles. As would be expected, advocates and automobile industry representatives are focused on the lack of tailpipe emissions and the associated Greenhouse Gas (GHG) reductions as the chief benefit, followed by claims of overall benefit to the environment over the life of the vehicle. There is also a benefit of reduced operational noise. Below are topics for debate over these benefits as EVs are being manufactured and consumed, which we examine here.

Disposable Goods: Like mobile devices and other electronics, both manufacturers and consumers' attitudes toward the purchase and use of EVs is reportedly trending toward initial purchase/use and disposal. The value of a used EV (and the technology which powers it) faces rapid depreciation and obsolescence[67]. Accordingly, the usability and longevity of an EV is projected to be less than for a traditional ICE vehicle. This may have an impact on the environment.

Energy: EVs are energy intensive to produce, and in most locations, the power required to fuel them over the course of their use is generated by traditional fossil fuel plants. The electrical infrastructure projects that will be required to supply energy to these vehicles also will have environmental consequences. However, with respect to energy efficiency (operational), EPA cites information from the US Department of Energy stating that "EVs use approximately 87%–91% of the energy from the battery and regenerative braking to propel the vehicle. Gasoline vehicles only convert about 16–25% of the energy from gasoline into movement (averaging highway and city driving)".[68] Another consideration is energy inputs needed for vehicle and battery recycling.

Fires: These are sometimes referred to as 'thermal events' when the fire involves the reaction generated by the battery pack. While all vehicles have a potential fire risk, EV fires are particularly challenging to deal with and the origin of EV fires (chiefly battery packs) is a consideration. Considerable amounts of water are required to quell an EV fire, and the prospect of reignition means that there are longer-term risks.

Raw Materials: EV production requires certain raw materials which must be mined. Most of these materials are being mined in operations that have significant environmental impacts.[69]

Recycling: while there are some recoverable materials in the vehicles themselves, i.e. aluminum, etc., there is not yet a widespread recycling industry set up to process spent EV batteries. In addition, there is a stream of batteries from electronic devices which also largely

[67] https://eepower.com/tech-insights/is-planned-obsolescence-a-concern-for-electric-vehicles/#
[68] https://www.epa.gov/greenvehicles/electric-vehicle-myths, from https://www.fueleconomy.gov/feg/atv-ev.shtml
[69] https://earth.org/environmental-impact-of-battery-production/

go unrecycled. Disposal is not a sustainable option, and the number and number of elements used in a battery should be reclaimed. Note that at present, approximately 5% of the world's total batteries are recycled.[70] Widespread battery recycling would help keep hazardous materials from entering the waste stream, both at the end of a battery's useful life and during its production. USDOE is hopeful that as the industry matures, material recovery from recycling would also reintroduce critical materials back into the supply chain and would increase the domestic sources for such materials. Work is now underway to develop battery-recycling processes that minimize the life cycle impacts of using lithium-ion and other kinds of batteries in vehicles. Below are three recycling processes:

Smelting: Smelting processes recover basic elements or salts. These processes are operational now on a large scale and can accept multiple kinds of batteries, including lithium-ion and nickel-metal hydride. Smelting takes place at high temperatures where organic materials, including the electrolyte and carbon anodes, are burned as fuel or reductant. The valuable metals are recovered and sent to refining so that the product is suitable for any use. The other materials, including lithium, are contained in the slag, which is now used as an additive in concrete.

Direct Recovery: some recycling processes directly recover battery-grade materials. Components are separated by a variety of physical and chemical processes, and all active materials and metals can be recovered. Direct recovery is a low-temperature process with minimal energy requirement.

Intermediate Processes: The third type of process lies between smelting and direct recovery. Such processes may accept multiple kinds of batteries, unlike direct recovery, but recover materials further along the production chain than smelting does.

Separating the different kinds of battery materials used is a challenge. USDOE suggests that battery designs that facilitate disassembly and recycling are important if the goal is for EVs to succeed from a sustainability standpoint. Standardizing batteries, materials, and cell design would also make recycling easier and more cost-effective.[71]

Scrap: as the widespread use of EVs is recent, it remains to be determined what the long-term durability will be in the field. However, it is documented that some EVs are being prematurely scrapped (totaled) by insurers because of costly repairs, either from accident damage or technology failures. Exposure to salt (and salt water) has impacted additional vehicles. The decision to/not to 'total' a vehicle is influenced by perception of risk, especially where the batteries may have been compromised as well as the current steep depreciation of EVs.

[70] https://earth.org/environmental-impact-of-battery-production/
[71] https://afdc.energy.gov/vehicles/electric-batteries#recyclability

Summary: while there are some positive environmental benefits touted by advocates, widespread adoption will present significant economic and environmental challenges. The impacts of electricity generation and supply, manufacturing requirements and excavation and disposal of battery components must be addressed.[72]

[72] https://www.mackinac.org/blog/2023/electric-vehicles-scar-the-environment

Freight vehicles

In the U.S., around 49 million tons of goods are shipped daily, totaling $52 million worth of products, from groceries to electronics. However, freight transportation, largely powered by internal combustion engine (ICE) trucks, has a significant environmental impact, similar to personal vehicles. The industry heavily relies on two key resources:

- **Fuel:** In 2019, fleet trucks consumed nearly 180 billion gallons of fuel, including diesel, contributing to tailpipe emissions and environmental harm from fuel extraction.
- **Energy:** The fleet transport sector consumed 5,490 trillion BTUs of energy in 2019, more than any other freight sector, further straining environmental resources.

Significant amounts of freight are transported toward the WestCOG region by rail and sea as well. Both modes rely entirely on ICEs. A smaller amount of freight moves through the WestCOG region by rail.

Manufacturers

As of 2025, over thirty companies are actively developing and/or producing electric heavy-duty trucks, including Volvo (VNR Electric), Nikola Motor (using fuel cell technology), BYD, Peterbilt, Daimler, and Tesla. According to data publicized by the Environmental Defense Fund in June 2024, as of January 2024 of a U.S. fleet of 12.2 million trucks, 13,000 or 1.06% were electric. [73] WestCOG's literature review indicates that articles reporting on such vehicles peaked in 2022-2023 and tailed off in 2024. As in other vehicle sectors, some manufacturers have entered bankruptcy protection, most recently Nikola.

Vehicle Characteristics

The current per-charge range of a heavy-duty electric vehicle (EV) truck depends on the model but can range from 150 to 500 miles. Examples:

- **Tesla Semi:** has a range of 500 miles[74]
- **Volvo VNR Electric:** has a range of 275 miles[75]
- **Freightliner eCascadia:** has a range of 155 or 230 miles[76], and
- **Peterbilt 579EV:** has a range of 150 miles. [77]

Performance information for freight EVs specific to the WestCOG region is not available.

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[73] https://truckparkingclub.com/news/how-heavy-electric-trucks-are-gaining-a-foothold-in-the-us/

[74] https://www.tesla.com/semi#:~:text=With%20less%20than%202%20kWh,miles%20on%20a%20single%20charge.

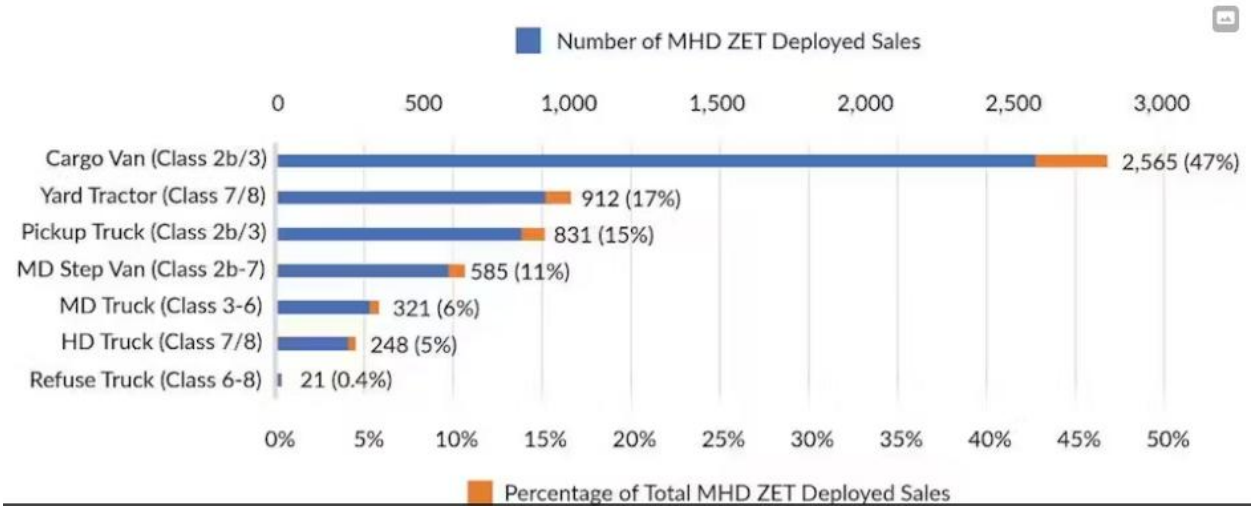
[75] https://www.volvotrucks.us/trucks/vnr-electric/

[76] https://www.freightliner.com/blog-and-newsletters/electric-truck-faqs/#:~:text=For%20the%20Class%208%20eCascadia,typical%20range%20to%20230%20miles.

[77] https://www.peterbilt.com/trucks/electric/579EV

Sector Uptake

According to CALSTART data, the total number of medium- and heavy-duty zero-emission truck deployments in 2022 constituted 0.3% of the total 1,186,966 Classes 2b-8 deployed sales. The 3,510 ZET units sold did constitute a 78% increase over the previous five years, but that's simply not good enough to build confidence.



Source: Hitch, J (2024)

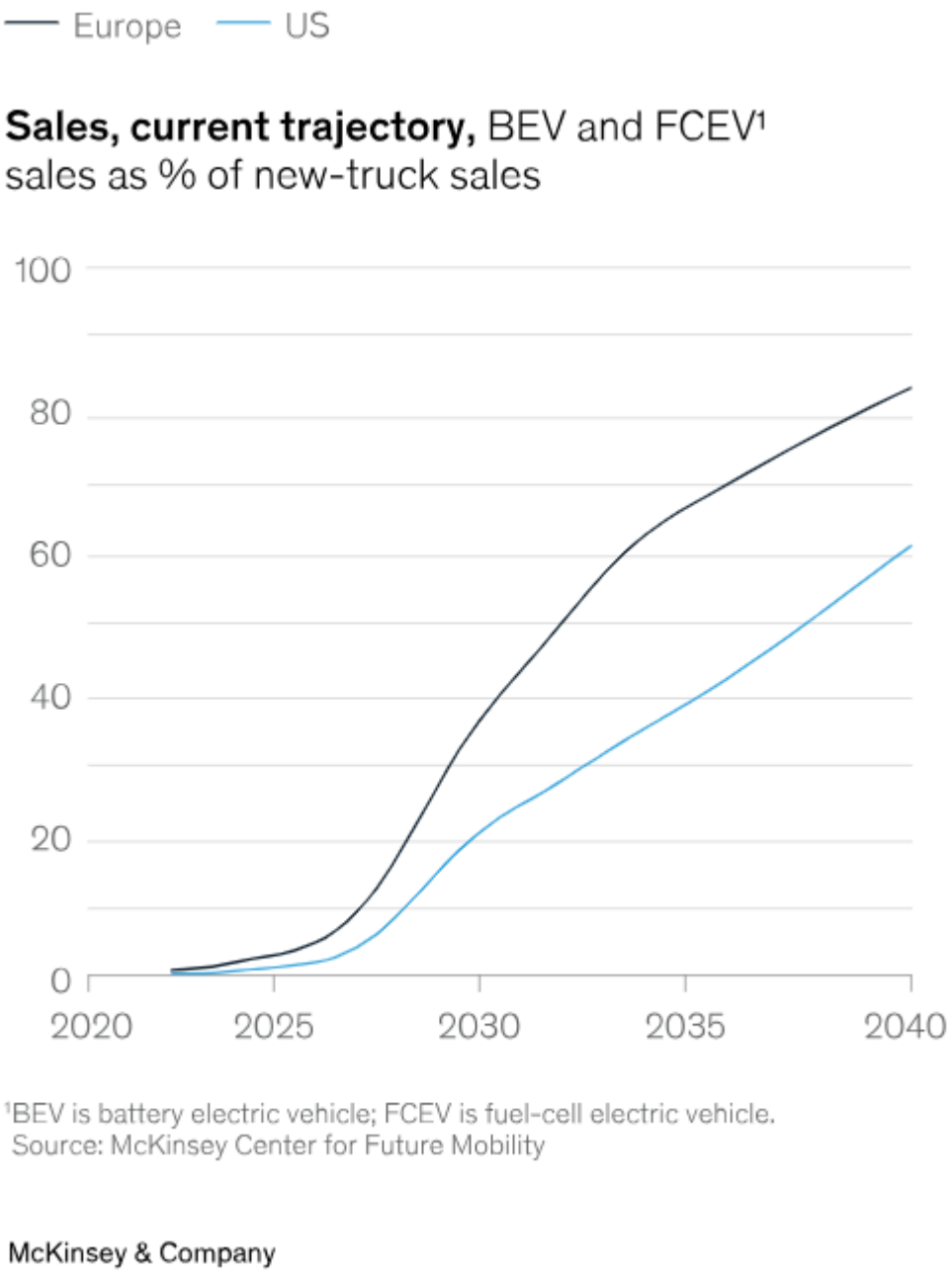
Figure 7. Total Number of Medium and Heavy-Duty Zero Emission Truck Deployments in 2022

As of 2023, "electric truck sales shares remained low across most major markets. With the exception of China, cumulative electric medium- and heavy-duty truck ("truck") sales to date number in the hundreds in most countries (just under 2,000 electric trucks were sold across the entire European Union in 2022), as shown in Figure 7. Sales shares generally remain well under 1% in medium- and heavy-duty segments, with major shipping logistics companies running demonstrations of electric trucks in regional and long-haul electric operations."[78]

McKinsey & Company is one of the industry analysts which predict greater adoption, as shown in Source: McKinsey & Company

Figure 8. [79]

[78] https://www.iea.org/reports/global-ev-outlook-2023/trends-in-electric-heavy-duty-vehicles
[79] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-bumpy-road-to-zero-emission-trucks



Source: McKinsey & Company

Figure 8. Current Trajectory of BEV and FCEV Sales

Firms in the business as of the close of 2024 include: Workhorse, Volvo Group, Tesla, Nikola, Mercedes-Benz, International, Ford, BYD and others. A literature review suggests that there was much speculation about the potential growth of these products in 2022-2023; however, updated information and industry rollout publications appeared less visible in 2024 and early 2025.

Electric Freight Truck Implementation

Examples:

- **Amazon:** In 2019 Amazon announced plans to put more than 100,000 Rivian electric delivery vans into service by 2040. As of 2024, 15,000 Rivian EV trucks have been put into service.[80] Reportedly, Rivian will also be making the delivery vans available to other customers. Also in 2024, Amazon announced that it had placed a number of fully electric Volvo semi trucks into ocean freight service in California. Those trucks are hauling heavy cargo containers and customer package loads in Amazon's first- and middle-mile operations.[81] Close to the WestCOG region, Amazon is preparing to construct a new facility on the Waterbury/Naugatuck area[82]; it is expected that this facility will serve as a platform for some electric vehicle usage.
- Schneider, a freight trucking company with over 10,000 tractors, purchased fifty Freightliner eCascadias through California's Joint Electric Truck Scaling Initiative. It then added forty-two more in a separate order. USEPA funds and state vouchers, in addition to the Volkswagen Environmental Trust, funded a portion of most, if not all, of these vehicles.[83]

For 2025, recent market research indicates that market interest in all heavy duty trucks (including electric trucks) will be modest at best in North America, though stronger in other countries.[84] Market shortages and EV firm financial instability, coupled with public policy and regulations, will prove to be part of this dynamic.[85] Particular to electric trucks, industry sources suggest that market growth will require:

- **Battery Technology Improvements:** Current charging times for heavy-duty trucks can exceed an hour even with high-powered chargers, which is far from reaching the same timeline as a diesel fill-up;
- **Increased Range;**
- **Infrastructure Deployment:** The Megawatt Charging System (MCS) being developed allows for up to 3.75 MW of power, but widespread deployment remains years away, and

[80] https://electrek.co/2024/07/30/amazon-ev-milestone-15000-electric-delivery-vans-in-service-100000-by-2030/
[81] https://electrek.co/2023/11/07/rivian-ends-amazon-exclusivity-seeks-new-suitors-for-commercial-vans/
[82] https://www.supplychain247.com/article/amazon-warehouse-waterbury-naugatuck-connecticut
[83] https://www.freightwaves.com/news/electric-trucks-should-shake-off-setbacks-in-2024
[84] https://www.spglobal.com/ratings/en/research/articles/241211-2025-global-outlook-for-heavy-duty-trucks-isn-t-rosy-13354457
[85] https://www.reuters.com/business/ups-fedex-transition-electric-vans-slowed-by-battery-shortages-low-supply-2024-04-25/

- **Cost Parity:** Manufacturing economies of scale and technological improvements will be needed to reduce the significant price premium over diesel trucks.[86]
- **Port Facilities:** As the WestCOG region is proximate to the Port of New Haven, and the Ports of New York and New Jersey, or PANYNJ (and functionally impacted by freight movements which originate or are destined to PANYNJ, electrification of port activities (particularly transportation) are of interest.

In October 2024, the USEPA announced that PANYNJ was selected to receive up to $344,138,135 to work in tandem with five partners to implement Catalyzing Change: Zero-Emissions NY-NJ Port Projects for a Greener Future. The proposed project includes the deployment of electric cargo handling equipment and drayage trucks with supporting charging infrastructure. In exchange for this, PANYNJ committed to scrapping a portion of the existing fleet. The project includes the installation of vessel shore power infrastructure.[87]

Port equipment such as cranes, gantries, and conveyor belts have a high propensity to be electrified, and many, if not most, already are. Electrification can convey several benefits but also involves several drawbacks. The most notable expected benefit is an improvement in the energy and environmental performance of ports. Electrification is expected to lead to lower operating costs if electricity costs are low compared to other sources. It is also expected that electrification increases port resilience, particularly if the port is able to generate a share of its electricity and is able to function outside the local power grid. Still, these expected benefits have not yet been realized. [88]

[86] https://www.transflo.com/blog/the-uncertain-future-of-electric-class-8-trucks/

[87] https://www.epa.gov/newsreleases/epa-announces-historic-400m-clean-ports-investment-new-jersey

[88] https://porteconomicsmanagement.org/pemp/contents/part3/ports-energy-transition/

Outlook

As of 2024, the near-term prospects for electric truck adoption in the long-haul freight industry are projected to be modest, due to various factors:

- **Vehicle Weight:** The battery packs that are necessary to power a semi-trailer are considerably heavy. Weight factors are significant. Battery-electric trucks, which run on two approx. 8,000-lb. lithium-ion batteries, are far heavier than their clean-diesel equivalents.
- **Reduced Payload = More Truckloads, More Vehicle Miles:** Since trucks are subject to strict federal weight limits, mandating battery-electric heavy trucks will decrease the payload of each truck, putting more trucks on the road and increasing both traffic congestion and tailpipe emissions.
- **Wear/tear on public road and bridge infrastructure:** Federal and state transportation officials (and Departments of Transportation) need to quantify the impact of the additional weight these vehicles have.
- **Lack of charging facilities:** Various industry publications cite this issue.
- **Charging time and impact upon driver productivity:** Include additional stops for charging. Presently, a clean diesel truck can spend 15 minutes fueling anywhere in the country and then travel about 1,200 miles before fueling again. In contrast, today's long-haul battery electric trucks have a range of about 150-330 miles and can take up to ten hours to charge.[89]
- **Vehicle cost and impact upon long-term ownership costs**: As of 2024, a new, clean-diesel long-haul tractor typically costs in the range of $180,000 to $200,000. A comparable battery-electric tractor costs upwards of $480,000. That $300,000 upcharge is cost-prohibitive for many motor carriers. More than 95% of trucking companies are small businesses operating ten trucks or less. Complying with these mandates will push many carriers out of business and tighten capacity nationwide, causing severe price inflation for all goods.
- **Environmental Issues:** Sourcing rare minerals needed to produce lithium-ion batteries is another major hurdle. Tens of millions of tons of cobalt, graphite, lithium and nickel will be needed, which could take as long as 35 years to acquire given current levels of global production. Expanding that capacity carries a giant environmental footprint.
- **Labor Violations:** rely heavily on foreign child labor from nations like the Democratic Republic of Congo unless the U.S. is willing to permit more domestic mining operations.

[89] https://www.trucking.org/news-insights/heavy-dose-reality-electric-truck-mandates

- **Benefits of other technologies:** Today's clean diesel trucks produce 99% lower emissions than those from the 1980s. Sixty trucks today emit what just a single truck emitted in 1988. However, a century-old 12% federal excise tax on heavy-duty vehicles disincentivizes fleets from updating their equipment with today's cleaner diesel tractors.

Fleet industry representatives have weighed in on the near-term prospects for truck electrification. For example, the American Trucking Association recently testified to Congress that "if the product, charging infrastructure, and power is not available to comply with unrealistic implementation timelines, then regulators are setting trucking—and the American consumer—up for failure." [90]

Revenue replacement for loss of fuel tax revenue. A Vehicle Miles Traveled (VMT) option might be considered; however, policymakers foresee that a weight-mile tax could have issues also, including tax evasion and the cost of collecting the taxes. There is concern that collection costs will be significantly higher than the current fuel taxes, and those costs will divert the revenues needed from upkeep of the roads. [91]

[90] https://www.trucking.org/news-insights/heavy-dose-reality-electric-truck-mandates
[91] https://www.fleetowner.com/emissions-efficiency/article/21280008/truckings-electrification-problem

Infrastructure

Power Generation

Transmission and Distribution

This section is focused upon the electrical grid infrastructure needed to provide for all these vehicles.

Eversource, Connecticut's main energy company, provides an interactive hosting capacity map that lays out available capacity information for residential and commercial customers to integrate energy resources such as electric vehicle infrastructure[92]. The map allows users to identify the grid's ability to support EV storage and its key features can help them understand if their current location supports renewable energy infrastructure. It includes the following key features:

- Grid capacity accommodation for extra power sources
- Solar energy potential for installation
- Real time data on grid capacity
- Geographical insights

Some EV models use vehicle-to-grid (V2G) technology to enable them to send power back to the grid. Unused energy stored when the car is in park can be sent back into the grid during peak hours, typically during the afternoon when there is more need.[93] This results in the stabilization of voltage and frequency, which can lead to a decrease in the need for more power plants to control the demand. It is unclear whether this functionality has any long-term impact upon the EV itself, i.e. battery pack performance.

Charging Stations

Passenger Vehicles

Charging stations and resources for municipalities to enable EV use in their communities include:

[92] https://www.eversource.com/content/residential/about/doing-business-with-us/interconnections/connecticut/connecticut-hosting-capacity-map
[93] https://witricity.com/media/blog/ev-vs-ice-surprising-differences

- **City of Norwalk:** As of 2024, the City had twenty electric vehicle chargers in key locations, including twelve chargers at City Hall; two chargers at the Norwalk Police Department, and six chargers at the Public Works facility on Smith Street.[94]
- **City of Stamford:** There are three 40-amp fast charge parking spaces in the Bell Street, Summer Street, and Bedford Street Garages. Additionally, there are two 30-amp charging spaces in the Bedford Annex Parking Lot. The Transportation, Traffic & Parking Department is adding a fourth charging space in each of its Downtown Parking Garages.[95]
- **Town of Newtown:** The first municipal EV charging station in Newtown was installed at the Municipal Center in 2017. Chevrolet Bolt, the first EV purchased by the town in 2018. In 2024, two new dual-headed charging stations were installed at Edmond Town Hall.[96]
- **Town of Ridgefield:** $50,917, was made available from the state's settlement of a lawsuit with Volkswagen in 2018. The grant will be used to install six dual chargers for electric vehicles: three at the Venus Municipal Building, two on Governor Street, and one at the Parks & Recreation Center. The chargers will not be free of charge to motorists, who will pay a fee for their use. Revenues will be used to offset maintenance and operational costs for the hardware.97
- **Town of Westport:** Charging policies were adopted in 2024. Fees are now being charged.[98]

Charging Station Locations

There are several platforms for charging station locators that help electric vehicle users find charging stations in specific locations across the U.S. The notable platforms that have been used most frequently in the electric vehicle market are: ChargeHub, ChargePoint, and the U.S. Department of Energy Alternative Fueling Station Locator. Each platform offers a detailed overview of electric vehicle charging stations throughout the country, allowing users to plan their routes based on available stations.

ChargeHub is an app and platform curated for EV owners to assist them in finding, managing, and tracking EV charging stations across North America[99]. It helps users in real time by

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[94] https://www.facebook.com/CityofNorwalk/photos/here-is-another-milestone-the-city-of-norwalk-reached-in-2024-to-help-make-norwa/1028350829336112/?_rdr

[95] https://www.stamfordct.gov/government/operations/transportation-traffic-parking/parking/electric-vehicle-parking

[96] https://gogreennewtown.com/progress

[97] https://patch.com/connecticut/ridgefield/ridgefield-approves-funding-ev-chargers-new-sidewalks-more

[98] https://www.ctinsider.com/westport/article/westport-electric-vehicle-charging-fee-18693607.php

[99] (n.d). *ChargeHub*. https://chargehub.com/en/about-chargehub.html?_gl=1*142qz5s*_up*MQ..*_ga*MTcwMzg0NTA4OC4xNzM0NDQ4OTUz*_ga_NSMWTMS73N*MTczNDQ0ODk1Mi4xLjAuMTczNDQ0ODk1Mi42MC4wLjEzOTIyNDkzMzE.

managing their needs through trip planning and locating charging stations. Its key features include a charging station locator, real-time availability, trip planning, user reviews, and ratings, as well as a membership pass.

The charging station locator for ChargeHub involves an interactive map that allows users to filter based on the type of charger needed (e.g. level 1, level 2, or Direct Current Fast Chargers). The map also provides filters for connector types, station status, and charging costs. In addition, users can also plan long-distance trips through the app by seeing which stations may be available along their route, overall aiming to combat driver anxiety. Moreover, ChargeHub provides a payment system that creates access to various charging networks in certain regions, from a single account. Overall, ChargeHub's platform offers convenience for EV users through its interactive map with trip planning, real-time availability, and a payment system.

In comparison, ChargePoint is a separate charging station network that is more widely known and operates on a global scale. It provides a variety of services for drivers and businesses through its app, subscription options, home charging, and business integration[100]. The charging network is available across North America and Europe, offering level 2 and DCFCs for faster charging. Its business model relies on offering solutions for business by installing EV chargers in offices, hotels, shopping centers, and more. To summarize. ChargePoint globally leads the EV charging network through its flexibility in payment options as well as its services for home charging and comprehensive EV solutions.

The USDOE Alternative Fueling Station Locator is an online tool that aids users in finding various types of fueling stations across the U.S. Apart from EV charging stations, it offers information for alternative fuels such as propane, hydrogen, compressed natural gas, and more[101]. The USDOE Alternative Fueling Station Locator has several key features including various filters through its interactive map, station details, and overall comprehensiveness. The interactive map allows one to search and filter through different EV charges, locations across the county, accessibility based on public and private stations, as well as the accepted payment methods of the stations. In conclusion, the purpose of this database supports the adoption of alternative fuel vehicles and focuses on reducing range anxiety by helping to promote the usage of clean cars and decreasing fossil fuel dependency.

Available Features	**ChargeHub**	**ChargePoint**	**U.S. DOE Alternative Fueling Station Locator**
Charger Type	Level 1, Level 2, DCFC	Level 2, DCFC	Level 1, Level 2, DCFC

[100] (n.d). *ChargePoint*. https://www.chargepoint.com/?utm_source=google&utm_medium=cpc&utm_campaign=IV-Search-Brand-US&_bt=575989657841&_bk=chargepoint&_bm=e&_bn=g&gad_source=1&gclid=EAIaIQobChMIkoS88I2vigMVozHUAR2gUiCUEAAYASAAEgJAcvD_BwE

[101] (n.d). *Alternative Fueling Station Locator*. https://afdc.energy.gov/stations#/find/nearest

Trip Planning	Yes (Stations Along Route)	Yes (Stations & Real-Time Availability)	No
Real-Time Availability	Yes	Yes	No
User Reviews	Yes	Yes	No
Payment System	ChargeHub Pass	Pay-as-you-go or Subscription Model	Payment Method Filtering
Accessibility Filters	Yes (Connector Type)	Yes (Connector Type)	Yes (Public/Private)

Table 2. Comparison Chart of Charging Station Locators

Methodology/Parameters for Placing EV Charging Stations

Charging stations are convenient for EV users, especially locally, however, it is important to understand the process behind the parameters of their placement. Local public policies can play a role in determining this deployment, by supporting effective and accessible EV charging infrastructure. According to the Electrification Coalition, local governments must examine their current policies that impact EV infrastructure which can include zoning regulations, permits, parking, and building codes[102]. The purpose is to identify the barriers and the opportunities for the growth of EV infrastructure – which will form the basis of policy creation. Shaping public policy for EV deployment involves creating an agenda of actions, for example, this may include:

- Building public momentum
- Fleet electrification
- Evaluating parking
- Decreasing delays by expediting permit processes

The Electrification Coalition local government playbook suggests that policy adoption occurs over the next six months that engage with community stakeholders which will ensure long-term success. For state and regional planning, specific to EV infrastructure, it is recommended that there be an EV charging roadmap developed, to track goals, targets, and timelines by ensuring effective allocation of resources and considering the broader priorities for regional areas. The U.S. Department of Energy suggests that the focus be prioritized on marginalized communities most exposed to environmental hazards, also considering the factors of rural and urban settings related to equitable access[103]. Additionally, it mentions cost considerations related to managing equipment, operating, installation, and maintenance costs. Also accounting for the following factors:

- Compliance with equipment standards
- Ownership models and site-host responsibility
- Signage and markings for ADA compliance

[102] https://electrificationcoalition.org/wp-content/uploads/2023/01/Local-Government-Playbook_Reader-file.pdf
[103] https://afdc.energy.gov/fuels/electricity-infrastructure-development

- Utility roles to manage grid capacity

Overall, for efficient site planning for EV charging stations, the goal should be to identify government-owned properties and encourage the deployment of sites by facilitating community involvement and stakeholder engagement through offering incentives.

CASE STUDY – Seattle

Seattle is a great example of a city with a strong focus on environmental sustainability, prioritizing transportation by adopting clean mobility opportunities – particularly in electrification. There have been several established clean mobility initiatives and programs over the years which has led to the city having its own comprehensive electric vehicle strategy plan. This strategy has been set to align with their goals which have been outlined in the city's Climate Action Plans which are focused on expanding ride-share programs and public charging infrastructure[104]. In addition, the Seattle Clean Drive Initiative of 2016 emphasized the need to increase EV ownership to 30% by 2030, which would also involve speeding the electrification process by facilitating private and public partnerships.

The city also passed an ordinance in 2019, which would require all new buildings to have the correct foundation of infrastructure to support EV charging stations – this included multi-family and single-family housing. It is important to note that Seattle's ordinance was formulated to address the challenges underrepresented communities face with a lack of access to charging stations, namely in low-income neighborhoods. The ambitious goals of the city have been further outlined in its 2030 electrification plan which includes the goal to produce zero-emission mobility and 100% shared mobility by 2030. These strategies have put Seattle on the pedestal for shaping its electrification fleet and continue to do so.

Freight Vehicles

In 2024, USEPA awarded $249 million to a coalition of states including Connecticut to install EV chargers for medium- and heavy-duty trucks. In CT, these chargers are proposed to be installed along I-95.[105] Clearly, similar charging facilities may be needed along I-84, I-91 and I-395 in CT as well, if electric trucks become popular.

[104] https://afdc.energy.gov/case/3101
[105] https://ctmirror.org/2024/08/01/ct-air-pollution-ev-truck-chargers/

Policies and Incentives

WestCOG conducted a review of federal and state EV policies. General laws and policies on electric vehicles in CT are compiled at https://afdc.energy.gov/fuels/laws/ELEC?state=CT. These can be reviewed by CT agencies, coordinated through CTDOT and the Office of Policy and Management, to ensure that CT's policies are up-to-date and do not work at cross-purposes. WestCOG expects that federal EV policies will change somewhat in 2025-2026, particularly on mandates for EV adoption as well as tax treatment.

Federal

It appears that the chief federal level EV policy of concern presently is the new federal emissions mandates under the EPA's Greenhouse Gas Phase 3 for the 2027 model year. As part of these rules, the goal is to electrify 25% of new long-haul trucks by 2032, as well as upwards of 40% of new short-haul daycabs.[106] This will likely be challenged.

Also subject to review is a federal law which allows vehicles powered primarily by electric batteries to exceed the weight limit on the power unit by up to 2,000 pounds, up to a maximum gross vehicle weight of 82,000 pounds (23 U.S.C. § 127(s)).

State

Highway weight limit for trucks: there is a bill proposing increased weight limits for trucks carrying recyclables https://www.cga.ct.gov/2025/TOB/S/PDF/2025SB-00297-R00-SB.PDF and there was a bill in 2024 proposing increased weight limits for electric commercial vehicles https://www.cga.ct.gov/2024/ba/pdf/2024SB-00186-R000245-BA.pdf

Taxation Policy

Federal

According to the American Trucking Association, "the trucking industry is the leading payer into the Highway Trust Fund (HTF), contributing almost half of all (HTF) revenues while representing just 4% of road users. Heavy-duty electric trucks also contribute to the HTF through the Heavy Vehicle Use Tax, the tire tax, and the federal excise tax. The American Trucking Associations has long advocated for a long-term, stable revenue source for the HTF that is paid for equitably by all road users. The Fair SHARE Act (introduced in Congress on 2/12/25 would require EVs to contribute to the HTF through a two-tier fee structure similar to and modeled after the current federal gas tax and the heavy vehicle use tax. The bill would: 1) Impose a one-time fee of $1,000 on all-electric vehicles at the manufacturer level and 2)

[106] https://www.ccjdigital.com/regulations/emissions/article/15739586/future-of-zeroemission-trucking-in-the-united-states

Impose a one-time fee of $550 on each battery module with a weight greater than 1,000 pounds at the manufacturer level."[107]

Connecticut

One consideration is the need to establish parity in tax treatment of EVs with all other vehicles to ensure that there is adequate federal/state revenue for roadway maintenance. Connecticut, and other states, are seeking ways to protect state budgets from revenue erosion caused by reduced gas tax income. With the increased use of electric vehicles (which avoid the gas tax) and general improvements to vehicle fuel efficiencies, the gas tax's ability to be an effective user fee for road use is steadily diminishing. Additionally, many states do not index their rates to inflation, so the real value of revenues is eroding over time.[108] Some states have considered replacing their gas taxes with vehicle miles traveled (VMT) taxes instead, using actual miles driven as the metric for the user fee instead of gas consumed. Connecticut currently implements a VMT tax on large trucks: as of 2023, all vehicles weighing more than 26,000 pounds are required to pay. The fee ranges from 2.5 cents per mile for trucks weighing 26,000-28,000 pounds to 17.5 cents per mile for vehicles weighing more than 80,000 lbs.[109] Reportedly, in the 2025 session, the legislature may consider proposals to address the disparity between revenue and cost growth to ensure the health of the Statewide Transportation Fund and the state's continued investment in transportation.[110]

EV/EV Equipment Purchase/Lease Financial Incentives

Federal Policies

The US Department of Energy's Alternative Fuels Data Center (AFDC) provides information on the current and past versions of the federal tax credit program. Various program changes have been made since its 2008 inception; the Program sets limits on eligible vehicle types, household incomes, and origins/dates of manufacture.[111] As of 2025, the federal government is reviewing continuation (or not) of some or all provisions of the Program.

The Inflation Reduction Act of 2022 amended IRC § 30D for new EVs and added IRC § 25E for previously owned EVs to strengthen the financial incentives for taxpayers considering an EV purchase. The IRS recently published new procedural rules in the Treasury Regulations that

[107] https://www.trucking.org/news-insights/no-more-free-rides-evs-must-pay-their-fair-share-highway-trust-fund

[108] https://taxfoundation.org/data/all/state/state-gas-tax-rates-2024/

[109] https://www.overdriveonline.com/business/article/15066287/connecticut-truck-vehicle-miles-traveled-tax-signed-into-law

[110] https://www.cga.ct.gov/2025/rpt/pdf/2025-R-0007.pdf

[111] https://afdc.energy.gov/laws/409.

went into effect July 5, 2024, with revised credits that can save taxpayers up to $7,500 on certain new EVs and up to $4,000 on certain previously owned EVs. Still, the rules surrounding these credits can be confusing for both experienced tax professionals and average taxpayers.[112]

New Electric Vehicles

Buyers may be able to get a federal tax credit of up to $7,500. If the EV is a van, SUV, or pickup truck, the MSRP must be $80,000 or less. For all other new EVs, the MSRP cap is $55,000. The taxpayer's Modified Adjusted Gross Income (MAGI) thresholds for new vehicles are $300,000 for joint returns, $225,000 for heads of household, and $150,000 for everyone else. Taxpayers can only claim the new EV credit once per vehicle, based on the vehicle identification number (VIN).[113]

Previously Owned Electric Vehicles

For buyers of a previously owned EV that costs $25,000 or less, the federal tax code allows for a credit of either $4,000 or 30 percent of the sale price, whichever is less. No credit is available for previously owned vehicles whose sale price exceeds $25,000. As with the new vehicle credit, the buyer's MAGI must not be above a certain amount, which is $150,000 if the buyer files a joint return, $112,500 for a head of household, and $75,000 for all others.[114]

Charging Stations

Federal EV Charger Tax Credit: for installations of home EV chargers, the federal credit is generally 30% of the charger's cost or $1,000, whichever is smaller. Consumers wanting to install an EV charger at a business or investment property can take advantage of a credit that is generally 30% of the charger's cost or $30,000, whichever is smaller. Buyers can claim the EV charger tax credit the following year on their income taxes using IRS Form 8911. A scan of available information indicates that Connecticut does not offer a tax credit for installation of privately owned charging stations.[115] Eversource does offer equipment rebates for Connecticut customers who purchase and install 'managed charging' equipment at home, however.[116]

State Policies

https://portal.ct.gov/deep/air/mobile-sources/cheapr/cheapr---home

The Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) offers incentives to Connecticut residents who purchase or lease an eligible new or used battery

[112] https://www.taxpayeradvocate.irs.gov/news/nta-blog/electric-vehicle-tax-credits-issues-and-pitfalls/2024/06/
[113] https://www.taxpayeradvocate.irs.gov/news/nta-blog/electric-vehicle-tax-credits-issues-and-pitfalls/2024/06/
[114] https://www.taxpayeradvocate.irs.gov/news/nta-blog/electric-vehicle-tax-credits-issues-and-pitfalls/2024/06/
[115] https://afdc.energy.gov/laws/13032
[116] https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/electric-vehicles/charging-stations/ct

electric (BEV) or, plug-in hybrid electric (PHEV) vehicle from a licensed Connecticut automobile dealership or original equipment manufacturer who is voluntary participating in the program (see Source: CTDEEP

Figure 9).

Funding of CHEAPR: the CHEAPR incentive program, as set forth in section 22a-202 of the Connecticut General Statutes, is funded through the "Clean Air Act" fee on new motor vehicle sales and motor vehicle registration renewals. As of July 1, 2022, 100% of the fees collected are directed to funding the program. Until 2019, the CHEAPR pilot program was made possible through funding commitments by American Electric Power Service Corporation, Eversource Energy and Avangrid.

Administration of CHEAPR: the program is implemented by the CT Department of Energy and Environmental Protection (CTDEEP) with the assistance of a program vendor and the input of a seventeen (17) member advisory board. CHEAPR is administered statewide by the Center for Sustainable Energy® (CSE) in San Diego, CA.

Program statistics are available at https://portal.ct.gov/deep/air/mobile-sources/cheapr/cheapr---program-statistics

CHEAPR Rebate+ Program: this Program offers additional incentives to certain income qualified Connecticut residents who purchase or lease an eligible new or used battery electric (BEV) or, plug-in hybrid electric (PHEV) vehicle from a licensed Connecticut automobile dealership or original equipment manufacturer. Rebate+ incentive levels were increased on 1/1/25, as shown in Source: CTDEEP

Figure 10.

Plug-In Hybrid Electric Vehicles (PHEVs)

A PHEV is a vehicle that can be driven solely on electricity, powered by its internal rechargeable battery but also includes an internal combustion engine or electric generator powered by gasoline to extend the range of the vehicle.

MSRP Cap[1]: **$50,000**

Standard Rebate: **$750**

Rebate+ New Incentive (Standard + Rebate+): **$2,250**

Rebate+ Used Incentive: **$3,000**

What are the CHEAPR incentive amounts?

Battery Electric Vehicles (BEVs)

A BEV is a vehicle that obtains all its power from energy stored in rechargeable battery packs. BEVs use electric motors and do not use an internal combustion engine therefore burning no gasoline.

MSRP Cap[1]: **$50,000**

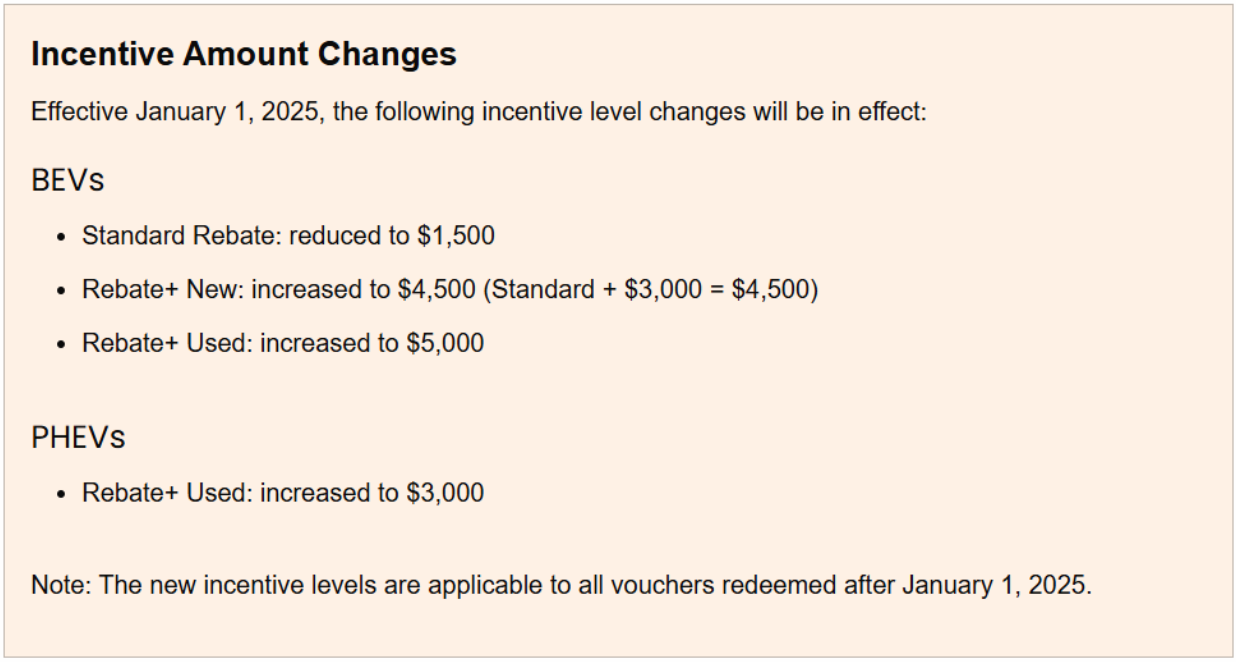
Standard Rebate: **$1,500**

Rebate+ New Incentive (Standard + Rebate+): **$4,500**

Rebate+ Used Incentive: **$5,000**

Source: CTDEEP

Figure 9. CHEAPR Incentive Amounts



Source: CTDEEP
Figure 10. CHEAPR Incentive Amount Changes

Rebate+ Used is available to Rebate+ qualifying individuals who purchase or lease a used eligible vehicle from a Connecticut franchised used automobile dealer or original equipment manufacturer (i.e. Tesla) (see Source: CTDEEP

Figure 11 and Source: CTDEEP

Figure 12). Rebate+ qualifying individuals must meet one of the following criteria:

- Reside in an Environmental Justice (EJ) Community or Distressed Municipality, or
- Participate in a qualifying state or federal income qualifying program, or
- Have income less than 300% of the Federal Poverty Level (FPL).

https://portal.ct.gov/-/media/deep/air/mobile/cheapr/cheapr-used-eligible-vehicle-list.pdf

Note that the CHEAPR incentive program is a Connecticut state program and is independent of the federal electric vehicle tax credit. Participation in other incentive programs does not disqualify an applicant from participation in CHEAPR.

Program Summary

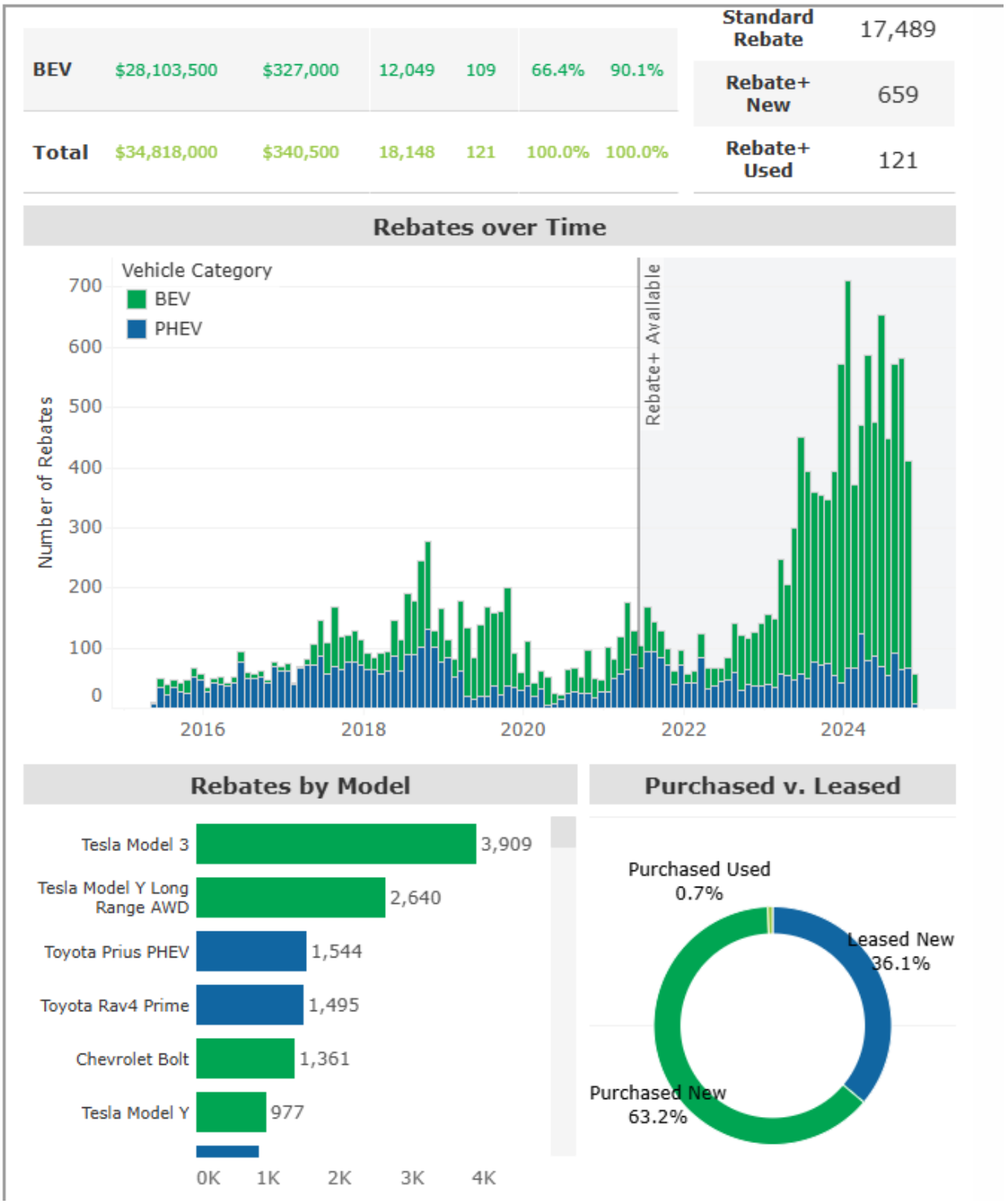
Select a vehicle category to filter visuals	Total Amount		Rebates		Percent	
	New	Used	New	Used	New	Used
PHEV	$6,813,500	$14,625	6,219	13	32.1%	9.6%
BEV	$30,780,250	$369,000	13,137	123	67.9%	90.4%
Total	$37,593,750	$383,625	19,356	136	100.0%	100.0%

New EVs	19,356
Used EVs	136
Standard Rebate	18,576
Rebate+ New	780
Rebate+ Used	136

Source: CTDEEP

Figure 11. CHEAPR Program Summary

As of February 10, 2025



Source: CTDEEP

Figure 12. CHEAPR Program Summary

~~Above~~ Statistics as of the end of the 2024 calendar year.

For more information on EV financial incentives, visit https://portal.ct.gov/deep/air/mobile-sources/cheapr/cheapr---faq or for federal information, visit https://fueleconomy.gov/feg/taxcenter.shtml or https://fueleconomy.gov/feg/taxfaqs.shtml

Analysis

There do not appear to be any restrictions on a consumer's combined eligibility for federal and state EV and charging equipment incentives.

Connecticut Policy - The Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) Program

This program offers incentives to Connecticut residents who purchase or lease an eligible new or used battery electric (BEV) or, plug-in hybrid electric (PHEV) vehicle from a licensed Connecticut automobile dealership or original equipment manufacturer. CHEAPR was established in 2015.

"In 2019, Governor Lamont signed a bill giving CHEAPR the first $3 million collected from state drivers paying the Greenhouse Gas Reduction Fee (GHG) added to vehicle registration costs, the remainder going to the General Fund. Since 2020, CHEAPR has been managed by a 12-member board that sets the amount and eligibility rules. The program originally offered rebates up to $3,000 toward buying or leasing a new electric vehicle. The rebates have since been increased to up to $9,500, depending on the vehicle type, for new or used vehicles.

In 2022, Governor Lamont signed the Connecticut Clean Air Act which changed the funding structure and allocated 100 percent of the GHG to the rebate program. Beginning in Fiscal Year 2024, every dollar over $5.2 million collected from the Regional Greenhouse Gas Initiative (RGGI) is diverted to the CHEAPR account. It also expanded the rebate program to include eBikes.

This Act also eliminated the December 2025 sunset date and increased the MSRP maximum for vehicle eligibility from $42,000 to $50,000. It also gave administration power to the Department of Energy and Environmental Protection (CTDEEP) commissioner to allocate, distribute and use CHEAPR funds. The commissioner is required to prioritize granting rebates for $50,000 cars to residents of Environmental Justice communities and those having household incomes at or below 300 percent of the federal poverty level and who participate in certain welfare programs.

Surveys conducted in 2021 and 2022 by CTDEEP show that more than half of respondents would have purchased the vehicle even without a rebate. Given that, it has been questioned

why legislation eliminating the program's five-year sunset clause was signed and funding for the program was increased.[117]

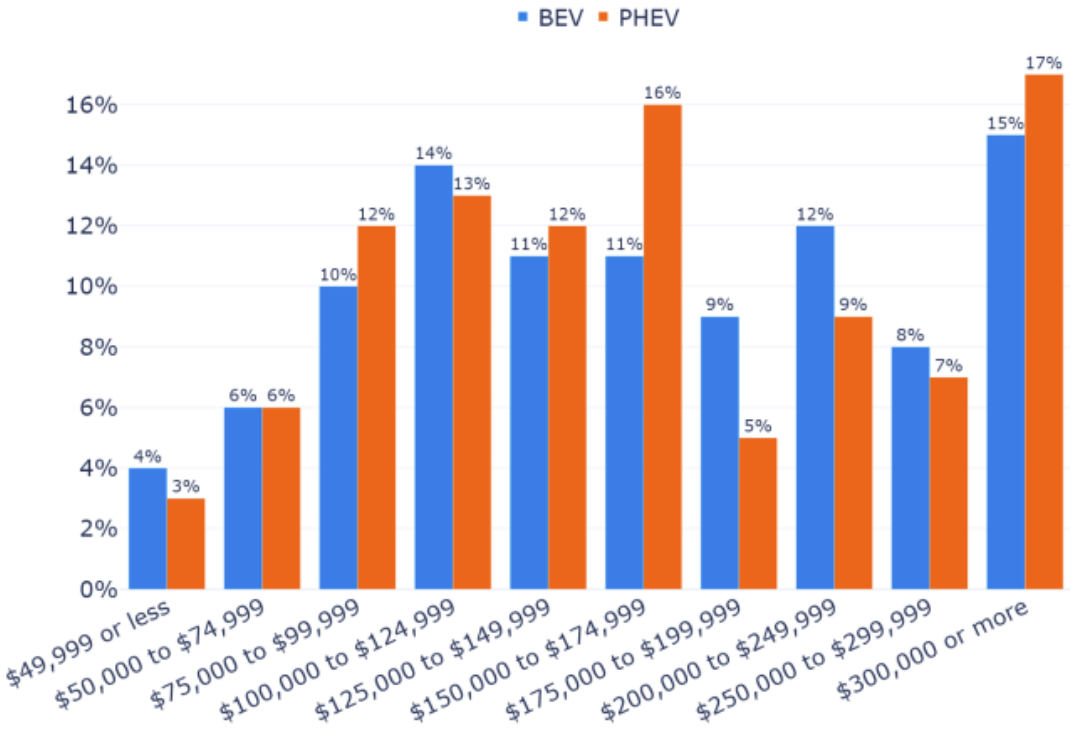
According to the 2024 CHEAPR and CT eBike Incentive Program Annual Report, which analyzed the program's performance from July 2022 to June 2023, EV application volumes doubled compared to the previous year. The increased participation was mostly attributed to a program change that raised the manufacturer's suggested retail price (MSRP) cap from $42,500 to $50,000, making residents able to afford a $50,000 car now eligible.

The report includes a survey of individuals who participated in both the eBike and EV rebate programs, examining demographics, motivations, and rebates' significance. Out of the 2,316 rebated vehicles purchased or leased during the July 2022-June 2023 reporting period, 958 applicants (or 42%) completed the survey.

For rebates on battery electric vehicles (BEV), 80% of survey participants reported household incomes of $100,000 or more. Similarly, 79% of those who redeemed rebates for plug-in hybrid electric vehicles (PHEV) had household incomes exceeding $100,000 (see Source: Yankee Institute

Figure 13). The report also highlights a notable rise in participation from households with incomes greater than $300,000, compared to the previous reporting period where only 9% earned above that threshold.

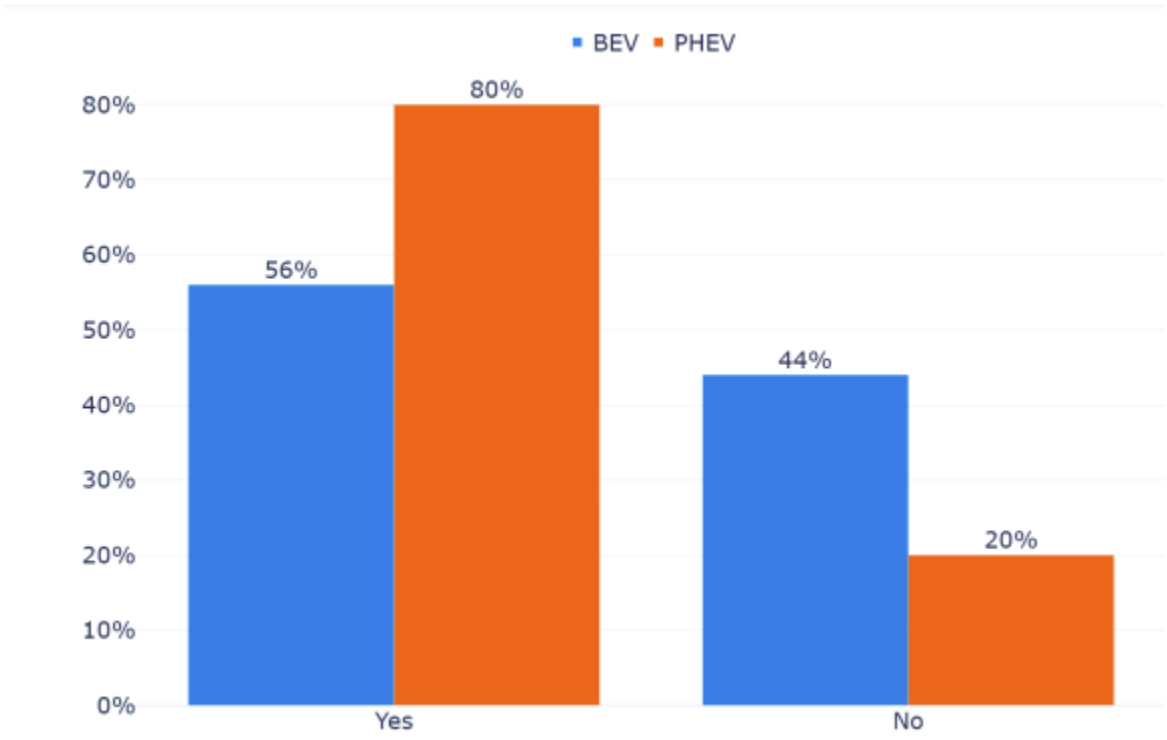
[117] https://yankeeinstitute.org/2023/07/18/taxpayers-taken-for-a-ride-with-expansion-of-electric-vehicle-welfare-program/



Source: Yankee Institute

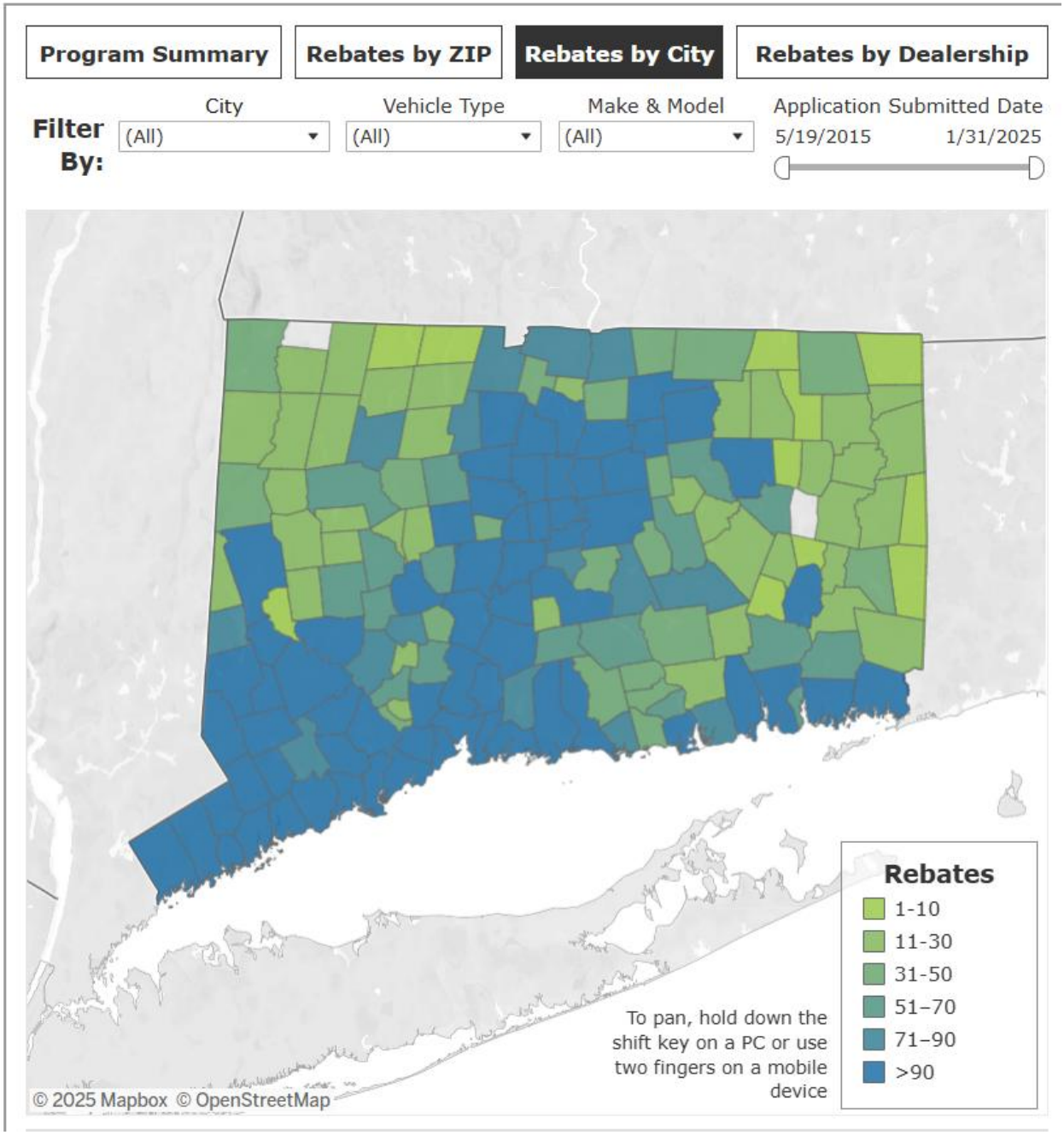
Figure 13. Annual Household Incomes of CHEAPR Survey Respondents

Of note from this survey is that 56% of BEV respondents stated they would have purchased the vehicle without a rebate, and 80% of PHEV buyers replied similarly, as shown in Figure 14.



Source: Yankee Institute

Figure 14. Respondents Indicating if They Would Have Required a BEV or PHEV Without the Rebate



Source: CTDEEP

Figure 15. Rebate Statistics by City

Center for Sustainable Energy (2025). Connecticut Department of Energy and Environmental Protection Connecticut Hydrogen and Electric Automobile Purchase Rebate, Rebate Statistics. Data last updated 2/4/2025. Retrieved [insert date retrieved] from: http://ct.gov/deep/cwp/view.asp?a=2684&q=565018

WestCOG's review of CHEAPR data available from CTDEEP indicates that as of February 2025 4,888 individual CHEAPR rebates were applied for totaling $9,827,625 in the zip codes covering the WestCOG municipalities (see Source: CTDEEP

Figure 15 and Table 3). This number might be slightly higher than the actual number of rebates granted, as zip code 06752 covers both Bridgewater (inside the WestCOG region) and part of the Town of Roxbury, outside the WestCOG region but this is a reasonable approximation as the number of rebates in the Town of Roxbury are not likely to significantly change these estimates. At present, CHEAPR rebates in the WestCOG region account for 27% of all CHEAPR rebates statewide (by zip code), as shown in Table 4.

Planning Region	Sum of Rebate Amount	Percentage of CT Total	Number of Rebates awarded
CRCOG	$9,135,750	25%	4,897
MetroCOG	$2,912,500	8%	1,443
NECOG	$446,500	1%	220
NHCOG	$956,000	3%	544
NVCOG	$3,034,250	8%	1,504
RiverCOG	$1,963,750	5%	1,096
SCCOG	$5,934,625	16%	3,146
SECOG	$2,160,500	6%	1,060
WestCOG	$9,827,625	27%	4,888
Grand Total	**$36,371,500**		18,798

Table 3. CHEAPR Rebates by Planning Region

Planning Region	Sum of Rebates	Percent of Total CT Rebate Amount	Rebates Filed	Average Rebate per Customer	2023 Population*	Percent of Total Population Who Applied for a Rebate
CRCOG	$ 9,135,750.00	25%	4,897	$ 1,865.58	969,029	0.51%
MetroCOG	$ 2,912,500.00	8%	1,443	$ 2,018.36	326,296	0.44%
NECOG	$ 446,500.00	1%	220	$ 2,029.55	95,829	0.23%
NHCOG	$ 956,000.00	3%	544	$ 1,757.35	112,848	0.48%
NVCOG	$ 3,034,250.00	8%	1,504	$ 2,017.45	452,303	0.33%
RiverCOG	$ 1,963,750.00	5%	1,096	$ 1,791.74	174,983	0.63%
SCCOG	$ 5,934,625.00	16%	3,146	$ 1,886.40	566,803	0.56%
SECOG	$ 2,160,500.00	6%	1,060	$ 2,038.21	279,025	0.38%
WestCOG	$ 9,827,625.00	27%	4,888	$ 2,010.56	621,232	0.79%
Grand Total	$ 36,371,500.00		18,798	$ 1,934.86	3,598,348	0.52%
					* ACS 2023 5 year estimates	

Table 4. Percentage of Total Population Who Applied for a Rebate

Another measure of interest is rebate program per capita. Notably, the WestCOG region shows the highest update of rebates among all regions per capita. The WestCOG region also leads on the basis of rebate amounts as well. Notably, the average median income of the WestCOG region is the highest. It can be inferred from the data that higher income individuals are more willing and able to purchase EVs; further, their ability to purchase more expensive EVs also could be a contributing factor to higher rebate amounts.

According to the EV Club of Connecticut, CTDEEP "has budgeted $9.2 million annually for incentive payments: 87% of these incentives were for the Battery Electric Vehicle (BEV) standard incentive, followed by the Plug-In Hybrid Electric Vehicle (PHEV) rebates, and supplemental rebates and used EV rebates for income limited individuals." The EV Club further reported that the standard rebate for BEVs would be reduced. Indeed, it was: as of January 1, 2025 the $2,250 standard BEV rebate was reduced to $1,500. An additional reduction to $1,000 by July 2025 was also projected.

Planning

Regardless of the uses to which a vehicle may be designed for, the prospective owner/operator can assess:

- Acquisition and maintenance costs
- Benefit to the environment based upon projected GHG emissions reduction (can include power generation GHG emissions to net the benefits out)
- Life-cycle environmental considerations – from manufacturing to decommissioning.
- Are the trips mission critical (emergency vehicles) which place a priority on service dependability during outages, or would they be used for discretionary trips?

Passenger Vehicles

See Clean Transportation Coalition of Western Connecticut. EV Zoning Regulations Pilot - Fairfield County. Updated 2024. https://evzoningregs.com/ev-zoning-regs-pilot-1/f/ev-zoning-regulations---fairfield-county-connecticut-pilot

Transit

There are several layers of policies relevant to transit electrification. At the federal level, the Federal Transit Administration (FTA) has pursued a policy of directing its recipients (i.e. transit agencies) to plan for and implement the use of electric vehicles in revenue and non-revenue operations. A large part of that implementation includes retrofitted or new storage and charging facilities, which at many properties include new building and lot construction. Also, at the state level Connecticut's bus electrification policies can be derived from the CTDOT

Transit Climate Action Plan (2023)[118] in which policymakers banned the procurement of diesel transit buses by public transit agencies in CT, effective January 1, 2024. In addition, at least 30% of transit buses purchased or leased by the state must be zero-emission by January 1, 2030. The CTDOT statewide Battery Electric Bus (BEB) initiative implements carbon reduction measures to meet State legislative mandates and executive orders and supports the State's goal for transitioning all buses in Connecticut to 100% BEB by 2035.[119] Also, CTDEEP has adopted recommendations for transit electrification in its Priority Climate Action Plan (2024).[120] Finally, transit agencies have adopted their own electrification goals as part of their operational planning efforts.

Going forward, policymakers will have to revisit policies and laws already enacted while working with the transit industry to address the following issues:

- Agreement on achieving requirements, goals and targets;
- Realism with respect to implementation schedules;
- Reliability issues with electric bus technology, and
- Availability of other technologies.

Freight

From the CTDOT Statewide Freight Plan Update (2022): According to IHS Markit research, about 80 percent of heavy- and medium-duty trucks in the United States are powered by diesel fuel. The size of the diesel-powered trucking market, the lack of large-scale charging infrastructure, and improvements in diesel engine emissions and fuel economy suggest that diesel will remain the dominant truck power source at least through 2040, according to the firm. However, the firm predicts that electric truck sales will grow by 15 percent annually over the next few decades, growing to 34 percent of the market by 2040. Electric and hybrid truck market adoption will be driven by ownership costs and fitness for use in key applications.

Diesel trucks continue to enjoy advantages for long-haul trucking, notably longer range between fueling. Hybrid and electric trucks will likely achieve the greatest penetration in the medium duty market, particularly urban trucking firms making short deliveries, many of which are driven by e-commerce sales. These use cases are better suited to electrification since range is less important in such operations. However, uncertain variables like the cost of diesel fuel and the regulatory environment may change this outlook. It is also possible that fully electric trucks could become preferred over hybrids given the simplicity of fully electric powertrains and ongoing improvements in battery technology. Some manufacturers and fleets

[118] https://www.transit.dot.gov/sites/fta.dot.gov/files/2023-10/CTDOT-Climate-Action-Plan-July-2023.pdf
[119] https://portal.ct.gov/dot/publictrans/bureau-of-public-transportation/battery-electric-bus-projects-and-partners?language=en_US

dhave been rethinking hybrid technology due to high capital and maintenance costs. In any event, there are use cases in Connecticut where electric or hybrid trucks may make sense. For example, Tilcon (a construction material supplier) uses some hybrid trucks. Connecticut port terminals could also convert their on-site vehicle fleets (e.g., yard hostlers) to electric power. As battery and hybrid technology continues to improve, more fleets will likely adopt these technologies. CTDOT and/or its partner agencies can also consider grant programs aimed at replacing diesel trucks with electric and hybrid trucks.[121]

The Plan recommended for Medium and Heavy-Duty EV Charging Infrastructure that CTDOT continue to participate in the Multi-State Zero Emission Vehicle (ZEV) Task Force and develop a multi-state action plan to identify barriers and propose solutions to support widespread electrification of medium- and heavy-duty vehicles.

Barriers to this widespread electrification may include:

- Inadequate power grid to support increased EV charging;
- Lack of charging locations and staging for charging vehicles;
- Lack of standard and clearly defined charging rates, and
- Variations in charging adapters and plugs.

Regional Studies

In 2023 NYMTC completed a Clean Freight Corridors Planning Study to advance high-efficiency, low-emission alternative transportation technologies in the region's freight fleet.

The NYMTC Study:

- Inventoried existing alternative fuel infrastructure in the region;
- Reviewed current and emerging alternative fuel technologies;
- Identified gaps between existing and future alternative fuel infrastructure capacities;
- Analyzed goods movement trends and forecasts;
- Identified and defined optimal corridors for recommended designations as clean freight corridors, and
- Identified needs for the development of additional clean freight infrastructure in each corridor.

"The vast majority of freight moving in the MAP Forum region (88% of freight tons) is carried by trucks." [122]According to the Transearch forecast embedded in the Study, the volume of

[121] https://portal.ct.gov/dot/-/media/dot/freight/2022-2026-connecticut-statewide-freight-plan.pdf?rev=f2261c61f8c8481383b8d2b1c38c9ab9&hash=D93579E65381C6A41F42DAC616D1C766

[122] https://www.nymtc.org/Portals/0/Pdf/Freight/Clean%20Freight%20Corridors%20Planning%20Study/Task%204%20Tech%20Memo.pdf?ver=4r_Mox3pS6b-QssCBqWtZg%3d%3d, p. 5.

freight moved in the MAP Forum region, when measured by tonnage, is expected to increase by approximately 37 percent between 2018 and 2045, from 655 million tons to 900 million tons. The region has a larger truck mode share than the nation due to several factors, including the large consumer market served by last-mile truck deliveries, intraregional interplant and distribution moves, and the under-developed freight rail network east of the Hudson. For these reasons, trucks and the roads where trucks travel, are crucial elements of the region's freight system. Alternative fuels are therefore an important means of reducing emissions and associated effects attributable to freight transportation. Highway corridor segments carrying the greatest volume of commodity truck flows include:

- I-95 in Union County, NJ (7 million truck units in 2018);
- I-95 at George Washington Bridge, NY/NJ (6.8 million truck units in 2018);
- I-495 east of I-295 in Queens, NY (5.4 million truck units in 2018);
- I-84 in New Haven County, CT (4.4 million truck units in 2018); and
- I-78 in Lehigh County, PA (4.3 million truck units in 2018)."[123]

The Study predicted that the transition to electric vehicles for freight would be strong, if not swift. Part of what supporters had hoped for was the nationwide adoption of California standards on commercial vehicles. In December 2021, New Jersey and New York State adopted California's Advanced Clean Trucks (ACT) rule, which was predicted to accelerate the adoption of electric trucks in these states by requiring manufacturers to participate in a credit/deficit program to increase the percentage of electric truck sales beginning in model year 2025. The consultant team felt that adoption of ACT in these states would increase the demand for zero-emission charging and fueling infrastructure not only in New York and New Jersey, but in neighboring states along key regional corridors. In Fall 2023, at the direction of the General Assembly, Connecticut proposed adoption of updated emissions standards for light-duty passenger vehicles (cars), and new emissions standards for medium and heavy-duty vehicles (trucks). Those proposed standards were not adopted.[124]

Risks and Challenges

There are some EV implementation risks and challenges which consumers need to consider:

- **Adequate Supply of Service Outlets and Technicians:** Those dealerships intending to sell and service EVs have had to invest heavily in both equipment and personnel training. Faced with this potential commitment, some US dealerships (i.e. Buick, Cadillac) have elected to close or to discontinue selling a particular make. In Buick's

[123] https://www.nymtc.org/en-us/Regional-Planning-Activities/Freight-Planning/Clean-Freight-Corridors-Study

[124] https://portal.ct.gov/deep/air/mobile-sources/ct-proposed-emissions-standards-for-cars-and-trucks

case, over 2,000 franchises have closed in recent years for this reason. The Ford Motor Company is ending a controversial electric vehicle dealership program that initially asked store owners to invest up to $1 million to sell EVs.

- **Battery Pack Integrity:** An accident can compromise the pack's integrity and require replacement. This significantly increases the cost of EV accident repair and in some cases can cause the vehicle to be totaled by the insurance company covering the vehicle. EVs constitute only a fraction of vehicles on the road, making industry-wide data hard to come by, but the trend of low-mileage zero-emission cars being written off with minor damage is growing. While some automakers like Ford Motor Company and General Motors Corporation have said that they have made battery packs easier to repair, Tesla's Model Y has a structural battery pack that is said to have "zero repairability."[125] In addition, EV batteries can weigh a significant amount, which also takes up a large amount of space in the vehicle. On average, the battery pack may weigh about 1,000 lbs., which can vary based on capacity.[126]
- **Charging Facility Availability:** While CTDOT has an approved National Electric Vehicle Infrastructure (NEVI) Plan with funding attached that covers highway corridors, it is a plan and its implementation will take time. Further, its geographic reach is limited. If EVs are to proliferate there is a need for readily available, serviceable charging equipment. This need increases for EV owners whose trips require multiple charging stops. One challenge EV owners encounter is that charging equipment location information (apps) do not always indicate whether that equipment is in use by another vehicle or is out of order.
- **Cybersecurity Concerns:** "Modern EV chargers are equipped with communication processors that connect to smartphone apps, allowing users to monitor and manage charging remotely. This opens a pathway for cyberthreats; hackers can exploit vulnerabilities in these systems to access user data, disrupt charging processes, or even manipulate the power grid. An April 2024 USDOE release highlighted the potential for infiltration of EV charging systems, unwanted access to sensitive data and the potential for causing widespread disruptions, including potential blackouts. The USDOE's Office of Cybersecurity, Energy Security, and Emergency Response (CESER) is at the forefront of this effort. CESER is investing in new cybersecurity research, development and demonstration projects to bolster the security of EV charging infrastructure. In 2023, CESER allocated $5 million to projects across USDOE's national laboratories aimed at addressing identified risks in the EV and cybersecurity sectors."

[125] https://www.reuters.com/business/autos-transportation/scratched-ev-battery-your-insurer-may-have-junk-whole-car-2023-03-20/

[126] https://evbox.com/en/complete-ev-battery-guide#:~:text=On%20average%2C%20EV%20batteries%20weigh,900%20kg%20(2%2C000%20pounds).

- **Electric Shock:** This does not appear to be a chief concern for the motorist but is a concern for the technician repairing the vehicle – particularly if there is damage to the vehicle. Note that according to the National Renewable Energy Laboratory (NREL), EVs' battery packs are designed to disconnect in the event of a crash.
- **Electric Costs in CT:** Various sources state that Connecticut's consumer electricity rates are among the highest in the US. Of course, these costs can be offset where EV owners can take advantage of renewables (i.e. solar), and off-peak charging. The greatest variability is at a charging station, at which rates can vary widely.
- **Federal Grants – Buy America:** There are restrictions upon the sale of EVs which do not meet US requirements for domestic parts content or manufacturing. Some manufacturers have attempted to navigate this obstacle by building plants in other countries not subject to US tariffs. BYD, for example, is blocked from selling its transit vehicles in the US when FTA funding is involved. However, BYD claims that its buses meet US requirements for 70% US content. Transit authorities have sidestepped the Buy America requirement in some cases by using non-federal funds to purchase vehicles; in addition, FTA has issued waivers for procurements of certain transit vehicles (vans and minibuses). Note that BYD vehicles are in operation on Martha's Vineyard and Cape Cod.
- **Greenwashing:** Some companies use EVs as a marketing tool to appear environmentally friendly while continuing unsustainable practices. Greenwashing, or the deceptive practice of promoting environmentally friendly products or initiatives to deflect attention from harmful activities, is a common concern in the automotive industry. Some automakers may highlight their EV offerings as a way to enhance their corporate image and appeal to environmentally conscious consumers, while neglecting to address broader sustainability issues such as supply chain transparency, resource extraction, and emissions reduction targets (and human rights abuses)[127]
- **Grid Capacity Constraints:** The prospect of rolling blackouts is a relatively new occurrence in the US and was most recently publicized in California and Texas. The possibility of it continuing to occur in the US generally depends upon EV demand, AI expansion and grid capabilities. In New England, ISO New England operates the power grid. It is expected that the spread of EV usage may strain grid capacity, some estimating that by 2050 there will be a 38% increase in electricity demand from such use; however, this may also vary by state.
- **Interactions with Roadway Safety Equipment:** Recent EV crash tests with guardrails and highway barriers conducted by the University of Nebraska-Lincoln have shown

[127] https://bowseat.org/news/the-complex-truth-about-electric-vehicles-are-they-truly-eco-friendly-and-guilt-free/#:~:text=Greenwashing%20and%20Ethical%20Concerns,labour%20practices%2C%20including%20child%20labour.

that guardrails and other impact attenuating devices designed for vehicles in general do not perform well when struck by EVs. This is believed to be due to the increased weight of an EV.

- **Limited Range:** It depends upon the vehicle; some advances have been made. One model sold in the US (the Lucid Air), has been rated at 410 miles; at the other end of the spectrum there are EVs with lower ranges, like the Volkswagen ID Buzz (about 230 miles) or the Fiat 500e, which has a range of 84 miles. Note that range estimates vary according to the weather, i.e. extreme heat or cold. In terms of extended travel, EVs may need to be recharged every 3-4 hours and Level 2 charging stations typically take up to 4-6 hours for charging. Almost 80% of public chargers are Level 2, which may contribute to extended wait times when recharging while on the road.
- **Ownership Costs:** At this time, most EVs cost more than their ICE counterparts. While some EV savings can be realized as there are fewer mechanical systems and moving parts, other EVs can generate operating costs that are equal to or higher than their ICE equivalents. There are a limited number of electric vehicles that cost under $30,000, without tax credits. The cost barrier can also increase with models used, as they most often have a reduced battery range. When EV vehicles require new parts, those parts are available only from the manufacturers, and not from third-party suppliers – which increases cost. Add to this the cost of home charging infrastructure; increased insurance costs, and the scale can tip backward. Much depends upon the characteristics of the vehicle itself, and how the vehicle is used. EV operating costs compare well when the vehicles are well suited to shorter trips with multiple stops, but their economy value declines with longer-distance driving.
- **Resale Value:** Recent reports indicate that EV values decline at a faster rate than ICE vehicles. Part of this dynamic is that EVs are much like consumer electronics, albeit that they are mobility devices with complicated electronics. EV technology is evolving rapidly as well, which hastens depreciation and obsolescence.
- **Transit Fleet/Facility Costs:** The transit agencies implementing BEBs are having to plan for: 1) calculating the equivalent number of buses they must procure in order to maintain service on routes and meet schedules. In many cases, it is necessary to procure two or more buses for every one ICE bus that would not be operated on a given route. 2) BEBs must be stored in a facility that meets requirements for fire safety, so as not to risk fire spreading to other vehicles in the event of a charging malfunction or thermal incident with the battery pack. 3) Charging infrastructure must also be procured, installed and energy consumption monitored.
- **Wear/Tear (Vehicle Weight):** The cumulative impact of EVs on pavements, roadways and bridges is yet to be measured but it is correct that EVs weigh more than their ICE equivalents. Tire life is reportedly less than ICEs as a result. BEBs and heavy-duty EVs

(trucks) will exact even greater wear and tear on roadway infrastructure. However, with fewer components, EVs can typically face fewer issues and are not subject to the general wear and tear of ICE vehicles.

Findings & Considerations

Technology

1. **Need for battery reclamation and recycling**.

   Groups such as the Union of Concerned Scientists recommend adoption of policies around the reuse and recycling of EV batteries that reduce demands for material demand and mining in the future. The industry may consider implementation of an "Extended Producer Responsibility" (EPR) approach to help address this issue. An EPR program assigns the recycling responsibility to the manufacturers who design and produce these batteries, and mitigates the burden on individual owners, small businesses, and disassemblers and facilitating a centralized and more sustainable recycling process.[128] Note however, that such a policy could increase the cost of an EV to the initial consumer.

Manufacturers

1. **Monitor and evaluate recall and repair histories for certain makes of EVs that may be under consideration for lease or purchase. When available, consumers can also consider purchasing extended warranties.**

   Transit agencies must consistently monitor updates from vehicle manufacturers, including any relevant recalls and technical information to make well-informed decisions when procuring fleet vehicles. The nature of the transit equipment manufacturing market, with fluctuating availability, technological advancements, and shifting industry standards, requires transit agencies to stay proactive. Given the complexities, agencies such as CTDOT must collaborate, to ensure that their procurement processes are aligned with the specific needs and service requirements of the communities they serve.

   This can help make the procurement process more efficient, share valuable insights into the performance and reliability of various manufacturers, and ensure that the purchased vehicles meet safety, environmental, and operational standards. This can allow agencies to leverage collective purchasing power, reducing costs while ensuring high-quality, reliable vehicles are integrated into their fleets. Furthermore, staying informed about product recalls and manufacturer updates is essential for maintaining fleet safety, reducing

[128] https://www.ucsusa.org/resources/all-about-ev-battery-recycling

operational downtime, and preventing unnecessary repair costs. Continuous monitoring and collaboration with key stakeholders will ensure that transit agencies can provide dependable and efficient services to the public.

2. **Standardize transit vehicle components to accelerate the manufacturing process to improve delivery schedules while generating adequate spare part inventories and increase economies of scale, thus lowering costs.**
   This was an American Public Transportation Association (APTA) recommendation from its 2024 Bus Manufacturing Task Force report which found potential benefit in the development of a limited set of options and floor plans for some major bus systems. This might include floor and seating layouts, axles and drivetrains, the operator's space/components, door and window systems, and HVAC systems.[129] Other organizations such as the Eno Foundation extended this line of thinking to transit infrastructure generally - which included stations, platforms and other supportive facilities and equipment.[130]

Consumers

1. **Electricity and other operational costs.** Municipalities can promote EV cost calculator tools that can help consumers estimate the total cost of EV ownership compared to ICE vehicles. It can take into consideration the following factors:
   - Fuel cost comparison
     - Electricity rates
     - Average gas prices
   - Maintenance costs
     - Oil changes
     - Tire rotation
     - Brake repair
     - Battery maintenance
   - Available discounts
   - Resale value (and depreciation)
   - Tax incentives and rebates
     - Federal tax credits
     - Rebates specific to states (e.g. CHEAPR)
   - Charging and infrastructure costs
   - Initial price

[129] https://www.apta.com/wp-content/uploads/APTA-Bus-Manufacturing-Task-Force-Recommendations.pdf
[130] https://projectdelivery.enotrans.org/wp-content/uploads/2021/07/Saving-Time-and-Making-Cents-A-Blueprint-for-Building-Transit-Better.pdf

- Insurance

In addition, they can provide detailed reports on the lifetime costs associated with owning both types of vehicles. By doing so, municipalities can partner with CTDOT or third-party organizations to public reports which compare the cost of EV and ICE vehicles. It can also consider depreciation rates and repair costs. In 2023, the Environmental Defense Fund released a total cost of ownership (TCO) analysis, which compared the lifetime costs over 10 years of owning and operating EV vs ICE vehicles.[131] It covered factors such as home charging setups, annual registration, insurance and an overall multifaceted review of ownership costs. The key takeaway of this study summarizes that over 10 years, all the EVs studied are estimated to be the same or less expensive to own or operate, in comparison to ICE vehicles. The study equates the lifetime savings of owning and operating an EV to over $18,000. It explains that although the insurance and face value costs are high, it saves you more in the long run. Taking into account the costs associated with fuel and maintenance of an ICE vehicle, this study concluded that EVs are more cost-effective over their life span.

By conducting studies as such and providing effective tools like the cost calculator – municipalities would share valuable insight into the financial aspect of transitioning to EVs.

2. **Prioritizing the Deployment of Home Charging.** Municipalities can consider promoting home charging over public charging for EV owners. Through public awareness and education, municipalities can address this consideration by emphasizing the benefits of home charging for EV owners. It is important to note that the infrastructure costs associated with installing home chargers is less expensive than maintaining and installing public chargers. [132] In addition, the long-term savings with home charging do not require municipal investment of energy monitoring or constant upgrades. Municipalities can also stress that home charging is more convenient for residents as they would not need to rely on finding available charging stations nearby. Moreover, the environmental benefits of home charging include reduced congestion and emissions, and as a result carbon footprint associated with public charging. Incentivizing home charging installation could also be an option and has been done in cities such as San Francisco – which has a few different rebate programs. The San Francisco PG&E program provides $700 rebates to eligible residents for home charging

[131] https://www.edf.org/sites/default/files/2023-07/WSP%20Total%20Cost%20of%20Ownership%20Analysis%20July%202023.pdf
[132] https://qmerit.com/blog/comparing-long-term-cost-analysis-of-ev-home-charging-vs-public-charging/

equipment.[133] Furthermore, public education is important for residents to learn about the ease and benefits of home charging – this includes information sessions or partnerships with manufacturers to offer installation solutions for residents. Providing clear and concise information on home charging can help to encourage the public to rely on home charging rather than public chargers. In Portland, Oregon this has been implemented, as the city has worked on educating its residents on its Smart Charging Program through various means.[134] This includes online resources such as a dedicated webpage and online webinars to provide information on incentives and the installation process. In summary, initiatives like these can help streamline the process of encouraging municipalities to motivate the public to invest in home charging systems instead of relying on public chargers.

Infrastructure

1. **Promote the Permitting of Solar Carports.** Solar carports are canopies that capture solar energy over parking spaces which convert unused spaces into renewable energy sources.[135] In Massachusetts, they are incentivized overground mounts and have fewer constraints. Solar carports are found more in the commercial sector, installed by businesses in parking lots. They can range from large to small installations in parking lots. Though residential ones are possible, commercial vehicles require steel foundations which add to the costs – but are suitable options for those homeowners whose roofs are not ideal for solar panels. It is also important to note that EV batteries are weather-sensitive and may be damaged in colder conditions.

   About electric vehicle (EV) charging, solar carports are an excellent solution for home charging, offering numerous advantages over public charging stations. Homeowners with solar carports can charge their electric vehicles with power generated directly from the sun, providing them with an independent, renewable energy source. This is especially valuable in the context of rising electricity prices, as solar carports allow homeowners to generate their energy and reduce their reliance on the grid. Unlike public charging stations, which often involve fees for charging and are subject to availability, a solar carport at home offers the convenience of always having a charger available, 24/7. This means EV owners can charge their vehicles overnight or during the day without having to wait in line at a public station or worry about running out of charge while on the road. Additionally,

[133] https://www.pge.com/en/clean-energy/electric-vehicles/getting-started-with-electric-vehicles/residential-charging-solutions-rebate.html
[134] https://portlandgeneral.com/energy-choices/electric-vehicles-charging/charging-your-ev/charging-your-ev-at-home
[135] https://www.energysage.com/solar/alternatives-to-rooftop-solar/what-is-a-solar-panel-carport/

charging at home with solar energy is far more cost-effective in the long run compared to public charging, which can be more expensive, especially for fast charging.[136] With a solar carport, homeowners can reduce their utility bills and avoid additional charging fees while ensuring that their EV is always powered by clean, renewable energy. This can be especially beneficial in areas with high electricity costs, where public charging may become expensive over time.

Moreover, solar carports offer the added benefit of protecting vehicles from the elements while charging. In colder climates, where EV batteries are particularly sensitive to extreme temperatures, a solar carport can shield vehicles from snow, ice, and freezing temperatures, potentially prolonging the lifespan of both the vehicle and its battery.[137] This is a major advantage over public charging stations, which often offer little or no protection from weather conditions.

In comparison, public charging stations—while necessary for long-distance travel or for those without home charging options—are often limited in number, location, and charging speed. As electric vehicle adoption grows, finding an available and convenient public charging station can become a challenge, especially in densely populated urban areas or rural regions with sparse infrastructure. Solar carports, however, provide a reliable, local solution to home charging needs and are not constrained by the location and availability issues common with public charging infrastructure.

Furthermore, solar carports contribute to the long-term sustainability of EV charging infrastructure. They not only supply power for electric vehicles but can also serve as energy storage or power backup for nearby buildings. This means that solar carports can be integrated with energy storage solutions to store excess energy during the day, which can then be used to power homes or businesses at night or during power outages. This helps to offset peak energy demand, ultimately saving money and increasing grid reliability. As more businesses and homeowners adopt electric vehicles, solar carports provide an ideal way to seamlessly integrate clean energy generation with EV charging needs, promoting both sustainability and resilience.

Pros of solar carports:

- Protect vehicles from the sun and elements while generating power

[136] https://enphase.com/blog/ev-chargers/charging-your-ev-solar-panels-just-makes-sense#:~:text=The%20best%20method%20of%20charging%20your%20EV&text=Solar%20power%2C%20on%20the%20other,cost%20an%20average%20of%20%241%2C058.
[137] https://www.jackery.com/blogs/knowledge/ultimate-guide-to-the-solar-carport#:~:text=The%20potential%20benefits%20of%20solar,day%2Dto%2Dday%20maintenance.

- Cost-effective building
- Reduce utility bills and offer backup power during blackouts
- Can turn an EV into an energy storage source

Cons of solar carports:

- Requires space on your property for construction
- Connecting it to the grid or a home battery can be complicated and costs

One example of solar carports is Gismo Power, which is a portable solar charging station, featuring a class 2 electric vehicle charger.[138] It also generates electricity for nearby buildings and the grid by utilizing unused surface for solar energy. The mobile carport solar system targets small businesses and homes and eases strain on infrastructure by performing best when helping to maximize renewable energy generation. By supporting the development of cleaner energy solutions, Gismo Power represents a forward-thinking approach to sustainable energy generation and EV charging infrastructure.

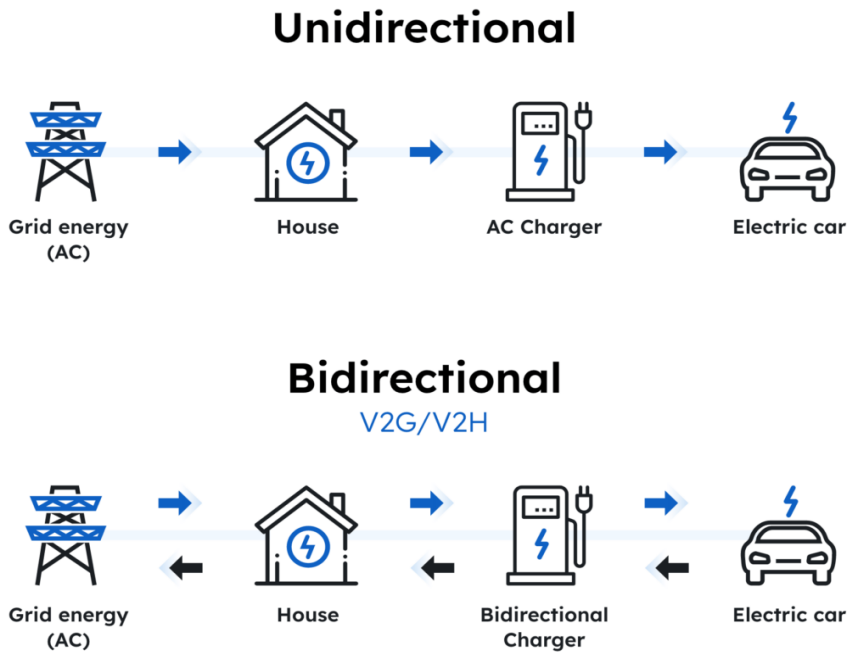
2. **Addressing Grid Capacity Concerns and the Risk of Blackouts.**

As EV adoption continues to grow, municipalities are facing increasing pressure due to the electric grid – which potentially leads to capacity concerns and possible blackouts. To address these concerns, municipalities can take steps to improve infrastructure through smart grid technologies, grid optimization and emergency preparedness.

In doing so, municipalities can support the development of vehicle-to-grid (V2G)technologies – where EVs could feed power back into the grid while absorbing electricity during peak hours (see Source: AMPECO

Figure 16). This would allow for a distributed energy source and would balance the supply and demand of the grid – therefore, reducing capacity concerns. Local grid optimization can also be something that regional utility companies can consider collaborating with municipalities to ensure local grids are optimized to handle EV charging loads by monitoring and maintaining charging patterns to reduce the potential of blackouts or brownouts in high-risk areas.

[138] https://gismopower.com/



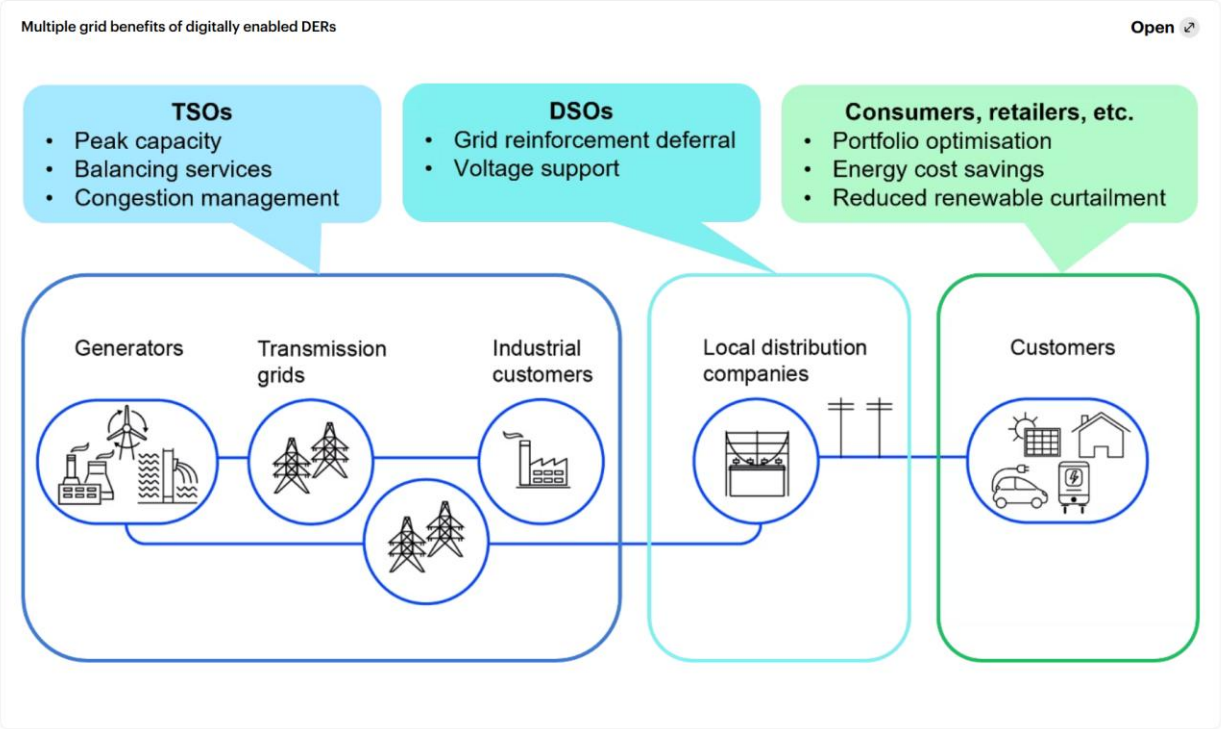
Source: AMPECO

Figure 16. Smart Charging

Furthermore, grid operators can develop backup plans to prepare for extreme events and handle the increased demands during this timing which would place a stress on the existing grid capacity. Microgrids are another option that municipalities can explore the potential of by using distributed energy resources (DER) – which are smaller scale – to improve the resilience of local grids (see Source: IEA

Figure 17).[139] DERs can include solar panels, battery storage, as well as combined heat and power systems can be implemented to supply power during emergencies.

[139] https://www.iea.org/reports/unlocking-the-potential-of-distributed-energy-resources



Source: IEA

Figure 17. Multiple Grid Benefits of DER

As EV adoption increases, municipalities can actively consider the implementation of smart grid technologies, optimization of local grids, and investment in emergency preparedness to improve grid reliability and resilience.

1. **CT National Electric Vehicle Infrastructure (NEVI) Plan Implementation.**

Municipalities and CTDOT could work together to promote the development of charging facilities where stations are prioritized. Note that all NEVI Plans are being reviewed at the federal level and are expected to be revised; a public comment period will apply. Municipalities can ensure that the revised NEVI plan meets their goals.

2. **CTDOT can work with municipalities to assess the effectiveness of current road infrastructure equipment.**

CTDOT could work with municipalities to assess the effectiveness of current road infrastructure for EVs through a collaborative approach which would confirm that both state and local needs are met.

- **Data Collection and Analysis:** CTDOT could work and collaborate with EV charging providers such as ChargePoint, to collect and analyze public charging station usage, which includes peak charging time, duration of charging sessions, and the number of charges per day at each station. This ongoing performance monitoring can keep track of under-utilized and well-used existing stations.
- **Pilot Projects:** CTDOT could monitor traffic flow and charging station accessibility by testing whether the road infrastructure can improve access. This can be done through trialing dedicated lanes or access points which lead to charging stations deployed during peak hours in commuter-heavy urban areas. In turn, the data may be used to track the feasibility of wider implementation. In twenty states as of 2015, alternative fuel vehicles and high occupancy lanes (HOV) have been implemented to improve traffic efficiency.[140] For example, Arizona has allowed Alternative Fuel Vehicles to use HOV lanes, identified via license plate – regardless of the number of passengers in the car.
- **Long-Term Planning:** CTDOT could evaluate the effectiveness of existing crash barriers by analyzing accident data and identifying high-risk areas to see where they may need to be either upgraded or installed. For example, in 2021, the California Department of Transportation (Caltrans), conducted a cost-benefit analysis of concrete barriers and metal guardrails, considering factors such as maintenance and durability.[141] It was found that concrete barriers are more cost-effective in high-volume roadways with higher crash instances due to lower maintenance costs.

Performance

1. **Ensure that public safety personnel have access to manufacturer instructions and adequate equipment/training to respond effectively and safely to EV fires.**

The HB-6627 bill introduced in Connecticut in 2025 is an act that requires EV manufacturers to provide guides for fighting battery fires to fire departments to protect firefighters who are called to fight an EV fire when such vehicle is on the road or in storage.[142] It also focuses on improving the training for first responders to handle the risks associated with EV fires. In doing so, emergency personnel can receive adequate training to understand the risks and specific protocols involved with EV fires. This includes identifying the different types of EV batteries such as lithium-ion and the associated dangers.

[140] https://afdc.energy.gov/laws/HOV
[141] https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/final-report-task-3848-a11y.pdf
[142] https://legiscan.com/CT/text/HB06627/id/3076015

In general, most EV manufacturers provide detailed training to first responders on the specific hazards and systems in their vehicles. For example, Tesla has a first responder guide for each of its models, including the different chargers.[143] It also includes online resources for fire departments to familiarize themselves with important details in case of fires. Firefighters can also work with manufacturers to ensure that emergency medical personnel are trained in the nuances of each vehicle model, such as disabling high-voltage systems or knowing where the battery is located.

The HB-6627 bill also focuses on ensuring that municipalities equip first responders with the proper tools necessary to safely handle EV fires. By adhering to this bill, municipalities can improve public safety personnel training, ensure collaboration with manufacturers, enhance emergency response capabilities, and stay updated on latest technologies with will be an important tool as EV adoption grows.

2. Combating Climate, Weather and Terrain Impacts

In combating the challenges related to climate, weather and terrain impacts on EVs, municipalities can consider working with policymakers and others to adopt a multifaceted approach that incorporates a variety of solutions that are both practical and reliable. Though EV chargers are designed to be weatherproof, the rising impacts of climate change and increased heat raise a cause for concern as charging in warmer temperatures can affect the charging time as well as battery health.[144] Due to this, installing EV charging stations built to withstand extreme heat and maintain operation during extreme weather events are needed.

Furthermore, areas with harsh terrain such as rural regions or mountainous areas often lack charging stations - which increases range anxiety for EV users. It is important for municipalities to consider the optimization of development of reliable and fast charging networks that would decrease the range anxiety in these regions. Another suggestion for terrains is to implement navigation systems for EVs which account for real-time weather and terrain data – which suggest alternate routes to avoid extreme or unsafe weather conditions.

Providing community-based support networks for emergency charging solutions in areas that are highly susceptible to extreme weather events such as hurricanes or blizzards is another option. This can be done through temporary emergency charging stations powered by renewable energy. One notable example of this is in California, which deployed temporary

[143] https://www.tesla.com/firstresponders#vehicles-and-charging
[144] https://www.energystar.gov/products/ask-the-experts/ev-charging-tips-prepare-extreme-weather

emergency EV charging stations along safe routes and evacuation sites during the 2020 California wildfires.[145] This allowed drivers to charge their vehicles and evacuate safely.

To mitigate the impacts of climate, weather and terrain on electric vehicles, a holistic approach is needed. This includes investment in resilient infrastructure to ensure that EVs remain viable and effective.

3. **Transit vehicle Heating, Ventilating and Cooling (HVAC) improvements.**

These are necessary in the long term to avoid the current need for fitting ICE equipment to these vehicles to maintain vehicle interior temperatures. The challenge is to provide and preserve adequate battery capacity, which exacts a toll on vehicle weight, range and cost. One HVAC manufacturer, among others, is working to decrease its equipment's power requirements, while developing more efficient vehicle interior temperature monitoring and other refinements such as reducing the number of parts that require repair.[146]

Policy and Planning

Consider implementation of a revised interconnect agreement that allows small-scale generators (i.e. residences) to generate electricity at a reasonable market price, not a locked-in or wholesale price determined at the inception of the agreement that does not adjust to match market conditions. The interconnect agreement can also not be based upon a customer's electricity usage prior to execution of an interconnect agreement, as overall a customer's usage of electricity is likely to increase. See https://www.solarreviews.com/blog/connecticut-net-metering-replacement-program for additional information.

1. **Prioritizing EVs for certain uses. As WestCOG has written, certain uses (i.e. public safety) require vehicles that function as intended in situations where there are power outages or other events. Also, the nature of the vehicle's intended use (mileage, # and distance of trips) need to be planned for.**

Municipalities, state governments, and businesses can consider prioritizing the adoption of EVs for specific use based on factors such as charging infrastructure needs, trip distances, and the effectiveness of reducing greenhouse gas emissions relative to the nature of the vehicle's use. When deciding which vehicles to electrify, it is important to consider the specific needs of different sectors. For example, short trips that involve frequent stops or urban deliveries are ideal for EVs because they can be charged easily and do not impact efficiency. Also, cities or

[145] https://www.sce.com/sites/default/files/inline-files/Wildfire_PSPSPhase2SCEElectricVehiclePlanAugust2020.pdf
[146] https://www.thermoking.com/na/en/road/bus-and-shuttle/bus-hvac-systems/next-generation-te-series-all-electric-bus-hvac.html

businesses in areas with good charging infrastructure can use EVs for local services like public transport, waste collection, or city fleet operations.

It is also important to consider charging needs as vehicles that travel long distances or need quick refueling may not work well with current EV technology, especially in areas with few charging stations. However, for tasks with set routes and shorter distances, like maintenance, inspections, or local deliveries, EVs can be a highly efficient and more eco-friendly option. By considering how vehicles will be used, cities and businesses can deploy EVs in areas where they will most effectively reduce GHG emissions. This approach helps balance cost, efficiency, and environmental impact, making sustainability efforts more effective. These factors, agencies, and organizations can maximize the effectiveness of EV adoption, ensuring that the transition to electric mobility delivers both operational and environmental benefits in a way that is tailored to their specific needs.

Municipalities/states/businesses can consider prioritizing EVs for certain uses based on charging requirements, trip distances, and the effectiveness of reducing GHGs based on use. Staff research suggests that little public information is available. We do observe that there is a general assumption by policymakers that all vehicles procured will be EVs. We found one plan prepared by the Town of Uxbridge, MA which could serve as a model for other municipalities, as it takes a more balanced approach. Some of WestCOG's municipalities have fleet departments, such as the City of Stamford and the Town of Greenwich.

In smaller communities, this work typically is conducted by Departments of Public Works. We did find that there are many different fleet management services and computer programs on the market, and it is assumed that many of the WestCOG communities are already making use of these tools.

2. **Findings on EV rebate programs.**

It will have to be determined at the federal and state level whether these programs have reached the intended consumers and are cost-effective. Note that an analysis of the federal EV program is underway. As for Connecticut, "During the 2022 legislative session, the Connecticut General Assembly passed Public Act No. 22-25—An Act Concerning The Connecticut Clean Air Act (the "Act")—which, in part, creates a property tax exemption for: i) level two electric vehicle charging stations located on commercial or industrial properties; ii) virtually any electric vehicle charging station located on residential properties; and iii) any refueling equipment for fuel cell electric vehicles.

The Act further mandates that all new state facilities constructed on or after January 1, 2023—in which construction costs exceed $100,000—have level two electric vehicle charging stations installed in at least 25% of the facility's parking spaces. For non-state facilities, the Act requires that any new commercial or multi-family residential buildings constructed on or after

January 1, 2023, with 30 or more parking spaces, install level two or direct current fast-charging stations for electric vehicles in at least 10% of its parking spaces—with a municipal option to increase the threshold above 10%. The Act was signed by Governor Lamont and became effective on October 1, 2022, and will exempt from property taxation electric charging stations commencing on and after the October 1, 2022 grand lists. This legislation appears to be aimed at incentivizing (or in certain circumstances requiring) commercial and industrial property owners to add high-speed electric vehicle charging stations to their real estate by removing the associated property tax expense of doing so and, thereby, ultimately increasing the supply of, and access to, charging stations throughout the state." [147]

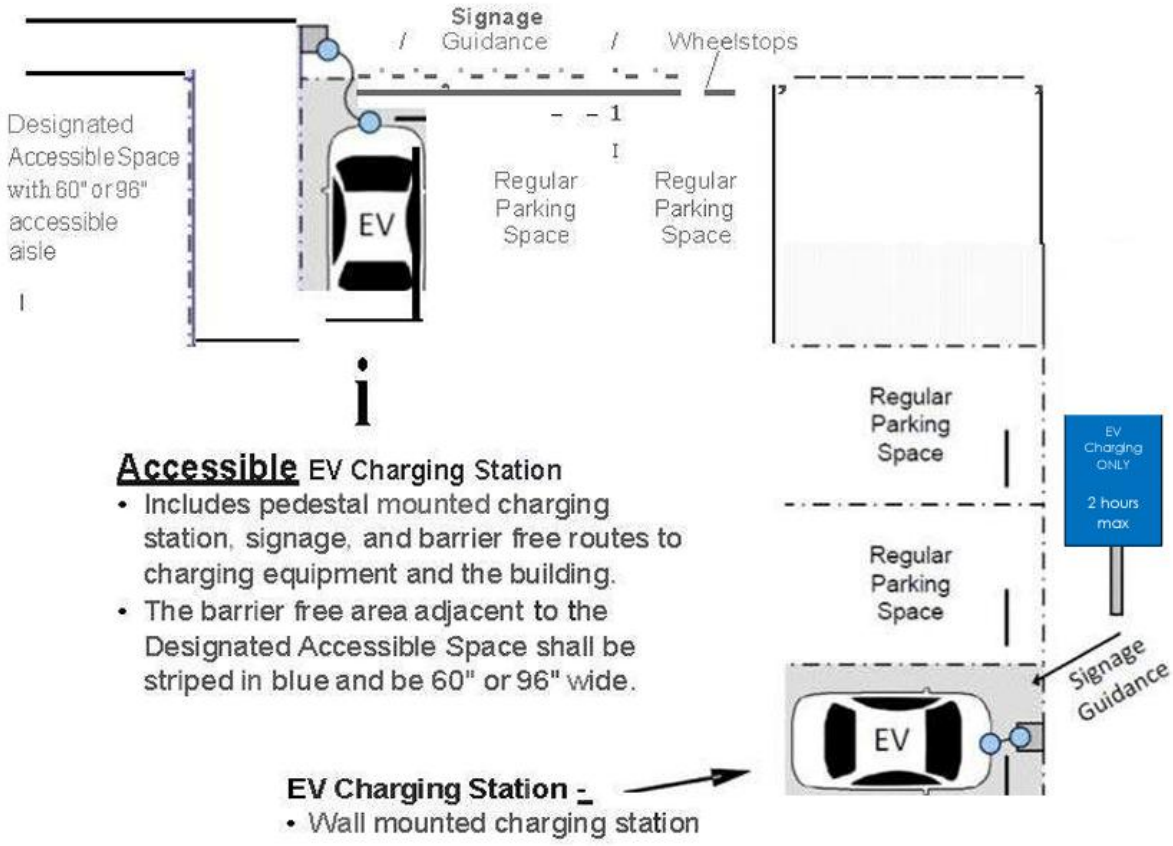
3. **Evaluate effectiveness and practicality of requirements for charging infrastructure in multi-family complexes and on commercial properties.**

Note that Connecticut has a requirement that multi-family properties with 30 or more parking spaces must supply EV charging facilities (Public Act No. 22-25). It would be helpful to know what the number of installations have been since the Act was enacted, and how much they are being used. It would also be helpful to know how many property owners and developers have challenged this requirement.

[147] https://www.pullcom.com/for-what-it-may-be-worth/ct-general-assembly-ev-charging-stations-property-taxes

Appendices

Appendix A: Town of Brookfield Ordinance for Accessible EV Charging Facilities – Diagram



Source: Town of Brookfield, CT

Figure 18. EV Charging Station Design

Appendix B: City of Norwalk - Electric Vehicle Charging Station Requirements

a. Any development with twenty (20) or more parking spaces shall include electric vehicle charging stations, that are at a minimum, Level 2 chargers in at least ten percent (10%) of such parking spaces and EV-Ready in at least ten percent (10%) of such parking spaces. Any multifamily development with less than twenty (20) parking spaces shall be EV-Capable in at least ten percent (10%) of such parking spaces.
b. Any Development within the Flood Hazard Zone Overlay shall not be required to install electric vehicle charging stations within the Base Flood Elevation.
c. Any advertising posted on an EV charger shall not exceed one (1) square foot.

Source: https://www.norwalkct.gov/DocumentCenter/View/34797/Norwalk-Building-Regulations-ART4-Bldg-Lot-Building-Site-Standards---Updated_FINAL-121224

Appendix C: Town of Wilton Electric Vehicle Charging Requirements

PLANNING & ZONING
COMMISSION
Telephone (203) 563-0185
Fax (203) 563-0284

TOWN HALL ANNEX
238 Danbury Road
Wilton, Connecticut 06897

MEMORANDUM December 11, 2023

TO: PLANNING AND ZONING COMMISSION

FROM: Staff, Michael E. Wrinn, Town Planner

RE: Reg # XXX– Planning and Zoning Commission - Electric Vehicle Charging Station regulations in response to Public Act 22-25, The Clean Air Act

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BACKGROUND:

Public Act 22-25 established minimum requirements for the installation of electric vehicle (EC) charging stations when constructing new state facilities, commercial and multi-family buildings or schools.

The Public Act 22-25, The Connecticut Clean Air Act, Section 5.c states the following:

(c) On and after January 1, 2023, a municipality shall require each new construction of a commercial building or multiunit residential building with thirty or more designated parking spaces for cars or light duty trucks to include electric vehicle charging infrastructure that is capable of supporting level two electric vehicle charging stations or direct current fast charging stations in at least ten per cent of such parking spaces. A municipality may, through its legislative body, require any such commercial building or multiunit residential building to include such electric vehicle charging infrastructure in more than ten per cent of such parking spaces.

The Department of Motor Vehicles is required under state law to update its website every 6 months with a new total number of electric vehicles registered in the state. In 2019, a total of 4,120 were registered; in 2022, 11,814 and for the first half of 2023, 7,878 electric vehicles were registered. Demand will be less in the short term but will grow over time.

CURRENT WILTON ZONING REGULATIONS:

The Wilton Zoning Regulations do not currently address or require minimums for EV charging stations. The State Act does allow a municipal option to increase the threshold above the minimum of 10%. The Commission may at its discretion and considering factors such as location, expected demographics, etc., require an additional number of spaces to be equipped, up to a maximum of 20%. The commission could lower the minimum number of spaces required before the 10% comes into play or it could increase the % to a higher number if desired.

NEXT STEPS:

Other recommended options would be to include additional language, such as definitions of EV Charger levels, to ensure that the chargers are at a speed level which provides an adequate charge in a reasonable amount of time Definitions of an Electrical Vehicle, charging stations, etc., would allow clarity. It is also recommended that the location of these units be approved by the Fire Marshals office.

FOLLOWING ARE THE RECOMMENDED CHANGES:

New Definitions to be added:

29-2.B.51.a. Electric Vehicle: A motor vehicle capable of be powered by a battery powered electrical motor.

29-2.B.51.b. Electric Vehicle Charging Station (EVCS) : A parking space served by an electric component assembly or cluster of component assemblies designed specifically to charge batteries within electric vehicles by permitting the transfer of electric energy to a battery or other storage device in an electric vehicle

29-2.B.51.c. Electric Vehicle Direct Current Fast Charging Station: An electric vehicle charging station that utilizes direct current electricity providing forty kilowatts or greater

29-2.B.51.d. Electric Vehicle Level Two Charging Station: An electric vehicle charging station that supplies two hundred eight to two hundred forty volts alternating current

Add New Section 29-8.B.5.g **Electric Vehicle Off-street Parking Requirements**

1. Any new commercial or multifamily residential building development that requires more than thirty (30) or more parking spaces shall include electric vehicle charging stations that are at a minimum, Level two chargers, in at least 10% of such parking spaces. Such chargers will be considered an accessory use.
2. Each EVCS shall receive location approval from the Fire Marshal and the necessary Building Department permits.
3. All EVCS equipment shall be protected by wheel stops, curbs or bollards. If installed adjacent to a sidewalk, the sidewalk width shall not be diminished. Any cords shall be configured so they do not interfere with any pedestrian travel and shall not cross a driveway, sidewalk or passenger loading area.
4. The standard parking dimensions as outlined in Section 29-8.B.11 shall not be reduced by the installation of the EVCS.
5. Signs limiting the EVCS parking space to electric vehicles only shall be required.
6. The EVCS shall be maintained in good operating condition at all times.

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