State of New Hampshire

GENERAL COURT

CONCORD

MEMORANDUM

DATE: **October 31, 2023**

TO: **Honorable Sherman Packard, Speaker of the House**
Honorable Jeb Bradley, President of the Senate
Honorable Paul C. Smith, House Clerk
Honorable Tammy L. Wright, Senate Clerk
Honorable Chris Sununu, Governor
Michael York, State Librarian

FROM: **Representative John Sellers, Chair**

SUBJECT: **Final Report of the Committee to Study Electrical Vehicle Charging for Residential Renters HB 111, Chapter 81:1, Laws of 2023**

Pursuant to HB 111, Chapter 81:1, Laws of 2023 enclosed please find the Final Report of the Committee to Study Electrical Vehicle Charging for Residential Renters.

If you have any questions or comments regarding this report, please do not hesitate to contact me.

I would like to thank those members of the committee who are instrumental in this study. I would also like to acknowledge all those who testified before the committee and assisted the committee in our study.

Enclosures

cc: Members of the Committee

FINAL REPORT

Committee to Study Electrical Vehicle Charging for Residential Renters

HB 111, Chapter 81:1, Laws of 2023

October 31, 2023

Rep. John Sellers	Rep. Greg Hill
Rep. Kristina Schultz	Sen. David Watters

Committee Charge:

The committee shall study accessibility and opportunities to provide electrical vehicle charging for residential renters.

Process and Procedures:

The committee organized on July 18th, 2023, and elected Representative Sellers as Chair. The Chair appointed Representative Kristina Schultz clerk. The committee met three times throughout the study period.

Committee Findings:

The committee received testimony from the following individuals:

Griffin Roberge, NH Department of Energy
Rebecca Ohler and Jessica Wilcox, NH Department of Environmental Services
Cindy Carroll and Kevin Sprague, Unitil
Sean Toomey, NH State Fire Marshal
Natch Greyes, NH Municipal Association
Nick Norman, NH Rental Property Owners Association
Scott Johnston, Chief Electrical Inspector
Michael Jennings, NH Electric Co-op

The committee also solicited testimony from the following:

Eversource
Liberty Utilities
NH Builders Association
ChargePoint

The committee heard testimony that the electric vehicle (EV) charging accessibility for residential renters in NH is near zero percent (0%) and the opportunity for developing this market is near one hundred percent (100%).

The committee heard many reasons why it may be difficult for residential renters who want personal charging capabilities for EVs to find suitable opportunities in the near term. Some of these reasons include;

1. Lack of substantial utility infrastructure at the site to support charging stations which typically are to be called upon primarily during the same few hours of needed electrical increase for home appliances when the vehicle needs charging which could take several hours.
2. Lack of state standardized building codes necessary for new construction "build out" for charging stations such as the codes recently added in Dover and Lebanon NH for new construction.
3. Concerns for a lack of adequate fire protection, equipment, or protocols to protect life and property against high temperature (2,800 degrees) rapid fires.
4. Concerns for a lack of standardized charging ports
5. Business owners less likely to commit to major retrofits given a lack of ownership of EVs.
6. Concerns over expected increases for insurance (property, commercial, accident, environmental) due to risks of fast charging/battery/thermal runaway.
7. Concerns to develop the building/parking garage/electrical infrastructure as well as the additional weight concerns of EV's (in multi-level parking options).
8. Concerns of newer programs designed to deal with the cost of the maintenance and repair and supervision of the charging stations when they are shared among multiple tenants.
9. Business owners who fear increased rents might be necessary to support the substantial infrastructure and whether they will be able to recapture their investment should renters leave and new replacement tenants do not need charging capabilities and are therefore not willing to pay for them.

Many of the listed reasons above need to be solved before landlords would be willing to install EV charging stations. Many unanswered questions remain.

The committee heard that rental properties come in all shapes and sizes. If government were to mandate that all landlords are to provide the opportunity for EV charging stations, government should need to consider each case individually. Landlords could be defined as those who own a single-family home with a room for rent with on-street parking upwards to a large commercial 400-unit residential dwelling with a multi-level parking garage above or below ground. The needs for each are different and the mandates if so desired, should also be different.

The committee heard charging stations can be inexpensive or expensive, ranging from a couple thousand dollars upwards to $100,000, and can be portable or fixed.

While it seems the opportunity to construct many more rental units with charging capabilities in the future is high, it also seems that landlords are not ready to pay-out the cost for installation of these charging stations for one or more of the same reason mentioned above. For some older properties the cost array of retrofitting EV charging stations would depend on the location and current infrastructure in place. It seems clear to the committee the cost for retrofitting an existing property can be much higher than if a new residential rental development was being developed.

The committee heard from the State Fire Marshal that Building and Fire codes will need to be greatly updated because of the heavier weight of the EV over a combustion engine vehicle and concerns that when an EV catches on fire they burn hotter (2,800 degrees Fahrenheit) and longer than a combustion engine fire. The Fire Marshal indicated that many unanswered questions remain with the primary being that no extinguishing protocol exists for fighting even one EV fire yet. He offered additional concerns of the hazardous gases and the protection limitations to the fire equipment of firefighters. He brought up the many thousands of gallons of water needed to fight these fires and the limitations of the smaller communities in terms of manpower and equipment. Finally, he mentioned the potential environmental concerns of the runoff from the firefight with water. Building codes currently do not require the level of fire protection when parking an EV inside an enclosed garage or a garage with multiple levels and multiple vehicles parked one next to another. That remains a concern for the Fire Marshal who said we need additional answers to a great many questions.

Committee Recommendations:

The committee recommends that the concerns above clearly need answers before rapid growth and mandates are discussed. Some concerns will be solved undoubtably, and solutions will evolve and be developed, we feel, by the marketplace.

The committee recommends letting the business market evolve from standardization of chargers, infrastructure, to actual charging station placement like Tesla has done already by adding charging stations where needed most. Development will be fastest in busy municipal areas and along major routes. Development along major routes throughout the state by additional private businesses, government grants and legal settlements (Volkswagen settlement) is currently taking place. Allowing the market to decide the timing is the best use of government’s time and money.

The committee believes mandating landlords to install infrastructure and charging stations would be counterproductive and not recommended. The reason being, it would generally increase rents even if other renters did not own an EV. Grants would help speed development along, but the number of people buying EV’s is not what had been expected and many EV charging stations may go unused for much of the time. Currently an EV cost is higher, and the travel range is half that of a combustion engine vehicle unless one owns a hybrid EV/combustion engine vehicle. Charging times depend on the type of charger but, while most drivers want charging times to be as fast as possible, the manufacturers do not recommend (except in emergencies) the fastest chargers for safety reasons. The faster the EV charges, the higher the cost of the charging station.

The committee knows for the immediate future, residential renters would need to weigh their options to buy an EV with thoughts on where to charge their EV. Some may be able to charge at a business (supermarket, convenient store, shopping mall, etc.) or along a stop where EV charging stations have been added. This action would be similar to those of us who must locate a fuel station (gas and diesel) where we can fill up.

The committe acknowledges that mandates by building codes or any other government mandates, for landlords or home owners to install infrastructure and charging stations will drive the cost of rents and home ownership up and that is the last thing New Hampshire needs today.

Overall, the limited EV charging stations at residential rental properties is only a slight problem, but it is one that will eventually solve itself given time with new technology of engine types and fuel stations becoming the EV charging stations in the future.

Respectfully Submitted,

Representative John Sellers, Chair

Appendix

Memo

July 18, 2023

To: Rep John Sellers
Rep Greg Hill
Sen David Watters
Mr. Bradley Greenland, House Committee Services

Fr: Rep Kris Schultz

Re: Set the overall Agenda for (HB 111) Study of EV for Residential Renters and outline resources

For collaborative planning purposes, here are the questions we may consider answering through this study, as well as the resources (people, organizations, information) we may wish to consult to answer these questions.

Questions:

What do residential landlords & tenants need in order to have electric vehicle charging stations?

What resources are available to landlords & tenants for EV charging station installation?

Is there anything the State of New Hampshire could do to facilitate EV charging station installation for renters & landlords?

Do the answers to these questions lead to any potential legislation?

Potential Resources (people, organizations & information) & Interested Parties:

(in no particular order)

- Rep. David Preece, former Executive Director of the Southern New Hampshire Planning Commission
- NH Dept of Transportation
  - Bill Watson, DOT Administrator, Bureau of Planning & Community Assistance
- NH Dept of Environmental Services
  - Jessica Wilcox, Supervisor of Mobile Sources Section
- landlords & landlord associations
  - Hodges Properties of Concord, my landlord
- tenants & tenants associations
  - Thomas Foil, Tesla owner & residential renter

In response to questions posed by the HB 111 Committee at the September 12th meeting, NHDES contacted the U.S. Department of Energy's Clean Cities Technical Response Team. Below are responses and resources provided pertaining to EV adoption and EV charging for multi-unit dwellings in other states as well as EV safety issues:

EV Charging Infrastructure at MUDs

We recommend referring to the Alternative Fuels Data Center (AFDC) Laws and Incentives database (https://www.afdc.energy.gov/laws/), for laws related to electric vehicle (EV) charging infrastructure at multi-unit dwellings. The Search page (http://www.afdc.energy.gov/laws/search) allows you to identify specific incentives by jurisdiction (e.g., all states), technology/fuel type (e.g., EVs, plug-in hybrid electric vehicles (PHEVs)), regulation type (e.g., building codes) and user type (e.g., multi-unit dwelling). You may view state regulations here: https://afdc.energy.gov/laws/state. Please see below for EV charging station building standards at multi-unit dwellings below. Note that the regulations may discuss mandatory charging station units and/or mandatory EV-capable parking spaces:

Colorado: EV Charging Station Building Standards (https://afdc.energy.gov/laws/13013)
The Colorado Energy Code Board (Board) must develop a model EV-ready building code for counties, municipalities, and state agencies by June 1, 2023. Members of the Board are appointed by the Director of the Colorado Energy Office. The Board must include the following elements in the model building code:

- EV-ready and EV-capable requirements for commercial and residential buildings;
- EV-ready, EV-capable, and EV charging station installation requirements for 20% or more parking spaces at multifamily and commercial buildings;
- Pre-wiring requirements for single-family residential buildings, multifamily, and commercial buildings

Building codes must consider the cost-effectiveness of pre-wiring for EV charging stations. At a minimum, EV-ready parking spaces must have electrical panel capacity, raceway wiring, a receptacle, and a circuit overprotection devise to support an EV charging station with a minimum capacity of 208V.
(Reference House Bill 1362, 2022)

Connecticut: Mandatory EV Charging Station Building Standards
(https://afdc.energy.gov/laws/12955)
Beginning January 1, 2023, new state buildings with project costs greater than $100,000 must install Level 2 EV charging stations at a minimum of 20% of light-duty vehicle (LDV) parking spaces. New commercial or multi-unit dwelling buildings with at least 30 LDV parking spaces must be capable of supporting Level 2 or direct current fast charging (DCFC) stations at 10% of such spaces.

(Reference Connecticut General Statutes 4b-77)

Illinois: EV Charging Station Building Standards for Residential Developments
(https://afdc.energy.gov/laws/13323)
Beginning January 1, 2024, new construction of single-family homes must include a minimum of one EV-capable parking spot. New single-family homes or small multifamily dwellings that qualify as affordable housing must have one EV-capable parking space per dwelling.

(Reference District of Columbia Code 6-1451.03a)

EV Adoption Rates

For United States EV adoption rates, you may refer to the AFDC TransAtlas tool (https://afdc.energy.gov/transatlas/#/) to analyze state-level vehicle counts for all fuel types from 2016 to 2022. Please note the total number of vehicles represents total light-duty vehicle (LDV) registrations as of that year. You may filter by year, technology, and state to view total vehicle counts, market share percentage, or vehicle count in relation to population data. In addition, fuel types are based on vehicle identification numbers (VINs), which do not reflect aftermarket conversions to use different fuels or power sources. A detailed table showing the LDV counts by fuel, per state, is available on the AFDC's Vehicle Registration Counts by State page (https://afdc.energy.gov/vehicle-registration). These vehicle registration counts are derived by the National Renewable Energy Laboratory (NREL) with data from Experian Information Solutions (Experian). Experian (https://www.experian.com/automotive/vehicle-market-statistics) provides vehicle market statistics, including vehicle sales and registrations, down to the zip code level from 2014 to present. NREL purchases data attributes from the light-duty vehicle data (National Vehicle Population Profile) for gross vehicle weight classes 1-3 on an annual basis. NREL conducts further analysis, aggregation, and data review for the data to be more easily understood and interpreted by the public.

At this time, the data included in the AFDC tools is limited to United States and NREL does not provide Canadian vehicle registration data. With that that said, Experian is equipped with information on vehicles in Canada, however this data is private and requires purchase (https://www.experian.com/automotive/vehicle-market-statistics). You may reach out to Experian directly for more information.

It may be worth mentioning that you may request granular United States vehicle registration data through the Clean Cities Toolbox: https://cleancities.energy.gov/toolbox/vehicle-registration-data/. Requests will be processed in the order they are received and may take three weeks to process due to high demand. For more information, see the vehicle registration data FAQ sheet (https://cleancities.energy.gov/toolbox/files/pdfs/vehicle-data-faqs.pdf#).

EV Safety Issues

Overall, while data on EV battery fires is limited, the research indicates that the likelihood of fires in EVs is rare, even compared to internal combustion engines (ICEs). Much of the available research is focused on lithium-ion batteries (LIB).

A National Highway Traffic Safety Administration (NHTSA) report *Lithium-ion Battery Safety Issues for EVs* (https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/12848-lithiumionsafetyhybrids_101217-v3-tag.pdf) determined that under normal conditions, fires or other hazardous events are typically rare:

> *"When the cell and battery are operated within their designated charge and discharge regimes, and remain within appropriate ambient temperature ranges, the risk of cell failure is minimized.*

Further, EV safety guidelines have been developed to ensure proper emergency responses. Many EV companies, such as Tesla, have created emergency response guides for their vehicle models, and have developed emergency disconnects to de-energize the vehicle when extraction is necessary for rescuing passengers (https://www.tesla.com/firstresponders).

Is there any data on rate or number of Level2 / DCFC charging equipment fires?

At this time, we are unaware of any government data citing the number of fires from Level 2 vs Direct Fast charging equipment.

Is there any data regarding EVs catching fire when they are charging vs not charging?

While we are unaware of comprehensive data relating to EV fires during charging as opposed to when they are not charging, NFPA guidance states that most EV fires begin in the battery power system. You may refer to the NFPA 2020 research on *Vehicle Fires* (https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/osvehiclefires.pdf). See below for an excerpt from PDF page 11 of the NFPA report regarding thermal runaway:

> *"Most fire incidents involving battery electric vehicles or plug-in hybrid electric vehicles began in the battery power system. The battery system could, in terms of propulsion, be compared to gasoline capacity in ICE vehicles. EV fire risk increases with more batteries and with batteries containing more energy. In addition to trauma from impact, batteries can be stressed by temperature extremes and fluctuations, heavy rain, overcharging, or charging too quickly. Manufacturing and design issues can also play a role. As manufacturers increase the range of EVs by adding more LIB, the potential heat that could be released in a fire grows.*
>
> ...
>
> *It takes some time for enough energy to accumulate to trigger thermal runaway in a battery. This makes them different from ICE vehicles, which can be quickly ignited by a spark or flame. Fire development in a LIB battery pack might not be obvious in the early stages. The authors recommend fire detection and extinguishing systems to prevent such scenarios. Mechanical and electrical fires, the most common fires in ICE vehicles, become more common as the vehicles age. EVs have not yet reached the ages where these conditions are more commonly seen."*

In addition, per *Vehicle Fires* PDF page 12, EV fires can occur in the following situations:

1. When a vehicle is stationary. Extreme temperatures, high humidity, internal cell failure, and abuse of a LIB at some prior time can all cause such fires.
2. When the EV is charging due to overcharging or problems with the charging stations or cables.
3. After a traffic crash or other abuse does sufficient damage to cause ignition during or immediately after the crash.
4. When a LIB reignites after an initial fire has been handled.
5. Due to external factors, such as arson or other fires (wildland, structure, or other vehicles) nearby.

WORLD RESOURCES INSTITUTE

WORKING PAPER

POLE-MOUNTED ELECTRIC VEHICLE CHARGING: PRELIMINARY GUIDANCE FOR A LOW-COST AND MORE ACCESSIBLE PUBLIC CHARGING SOLUTION FOR U.S. CITIES

EMMETT WERTHMANN AND VISHANT KOTHARI

EXECUTIVE SUMMARY

Highlights

- Public electric vehicle (EV) chargers located at the curbside can help serve drivers without access to a private charger; however, curbside installations often lack the necessary space or are prohibitively expensive. Chargers attached to utility poles and streetlights, or pole-mounted chargers (PMCs), present an emerging alternative to help address these barriers.
- PMCs can save between 55 and 70 percent on installation costs compared to ground-mounted chargers with no additional infrastructure on the curb. However, due to siting and electrical capacity limitations, not all poles can support PMCs.
- U.S. cities are better suited to retrofit utility poles versus streetlight poles due to voltage and capacity constraints of the existing infrastructure. The best type of pole for charging heavily depends on local context. Either way, electric utilities play a critical role in planning and scaling PMC deployments.
- Demand for and awareness of PMCs is growing, but to maximize PMC benefits, equitable access considerations must be built into the planning process while incorporating local community engagement.
- To meet electrification goals, Transportation Network Companies (TNCs), such as Uber and Lyft, need accessible public charging for drivers on their platform. Additionally, TNCs can be a data-sharing and financing partner.

CONTENTS

Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback, and to influence ongoing debate on emerging issues.

Suggested Citation: Werthmann, E., and V. Kothari. 2021 "Pole-Mounted Electric Vehicle Charging: Preliminary Guidance for a Low-Cost and More Accessible Public Charging Solution for U.S. Cities" Working Paper. Washington, DC: World Resources Institute. Available online at doi.org/10.46830/wriwp.21.00023.

Key Findings

Using insights gathered primarily from U.S. cities actively deploying PMC infrastructure, we found:

- PMCs provide an opportunity to install public charging infrastructure in locations previously considered too costly, and infeasible due to lack of curbside space.
- PMCs can help expand public charging networks, especially in residential areas, to support those who do not have access to private charging facilities. PMCs' ability to improve the availability of public charging for all drivers hinges on the degree to which equitable access considerations are prioritized within the site selection process.
- Due to limitations on pole location and electrical capacity, not every pole in a city can support an EV charger. However, utility poles generally have greater electrical capacity than streetlights making them better positioned to support EV charging in more cases. This depends on a city's local context.
- Drivers on TNC platforms present an obvious end user for PMCs. As a result, TNCs present a useful data partner for site selection and may be motivated to finance PMC infrastructure.
- Electric utilities often play a major role in PMC infrastructure ownership, installation, and operation. Utilities are also well-positioned to help finance PMC infrastructure, which presents an attractive business case due to lower installation costs.

Key Recommendations for U.S. Cities and Utilities

Building on the insights and observations gathered across cities with PMC programs, we have developed preliminary guidance for interested U.S. cities and utilities.

Key recommendations include:

- Ensuring technical feasibility of PMC installations can be complex as it uses existing infrastructure. It is recommended to start with a pilot project to establish buy-in and identify any barriers.
- If determined that a PMC project is viable, all relevant stakeholders should be identified and convened. The list of stakeholders can widely vary based on local context.
- These stakeholders will be essential in preparing a suitable plan for PMC deployment, such as generating installation cost estimates, establishing financing and business models, understanding the local permitting process, developing a payment system, and conducting community engagement.
- To help save both time and money, site visits should not be conducted until a short list of poles has been identified through a citywide analysis. This list should include a variety of information, including data related to location, electrical capacity, parking, equitable distribution, local community input, existing chargers, and EV adoption.
- Once chargers have been installed, their performance should be monitored to identify impact on EV adoption and plan for scaled deployment.

1. INTRODUCTION

Transportation electrification is accelerating in the United States. Bolstering this growth, ambitious electric vehicle (EV) adoption targets have been established across the country at the federal, state, and local levels. Most notably, the Biden administration intends for EVs to comprise 50 percent of new vehicle sales by 2030 (Executive Office of the President 2021). While this is a step in the right direction, without an equally ambitious effort to build the charging infrastructure to enable this growth, an insufficient charging network will remain a barrier to achieving these goals. According to the International Council on Clean Transportation, for EVs to comprise just 36 percent of new vehicle sales by 2030, 1.8 million public chargers will need to be deployed—40 times the volume of current U.S. deployments (Bauer et al. 2021; DOE 2021a).

In addition, to truly enable mass EV adoption, public charging access must be equitably distributed to support all drivers. Currently, low-income populations, communities of color, and those living in multiunit dwellings have the least access to charging (Huether 2021; Hsu and Fingerman 2021; Klock-McCook et al. 2021). Similarly, a focus must be placed on providing convenient and reliable public charging to vehicle owners who lack dedicated off-street parking or are unable to charge where they park. Goals for transportation electrification will only be reached if, among other incentives, a concerted effort is made to provide EV charging facilities to those who face the greatest barriers to adoption.

PMCs and other public charging, policymakers and planners should simultaneously prioritize multimodal, shared transportation to reduce private vehicle use, that will accelerate decarbonization and ensure equitable access.

2. METHODOLOGY

This research was informed by a series of qualitative data collection efforts, including a literature review, stakeholder mapping, and interviews. Through the literature review, it was clear a gap exists in evidence-based guidance to deploy PMCs. This process was accompanied by efforts to identify any completed, ongoing, or planned PMC projects in the United States and map the actors most relevant to those initiatives. Building on these efforts, five groups were identified as most relevant to this research:

1. **Have installed:** Cities or utilities that have installed and are operating PMCs; to understand the barriers and enablers encountered during the planning, installation, and operation process and identify lessons learned.
2. **Plan to install:** Cities or utilities currently engaged in the planning process to deploy PMCs; to understand their planning process thus far, plans for installation and operation, and identify barriers encountered or lessons learned.
3. **Exploring viability:** Cities or utilities that have previously explored or are currently exploring the viability of PMCs but have not yet engaged in the planning process; to understand what barriers or enabling factors have already been encountered.
4. **Charging equipment manufacturers:** They manufacture and/or operate PMCs; to understand the opportunity seen in PMCs, document any barriers encountered while implementing this type of infrastructure, and how the manufacturers can support deployment.
5. **Transportation network companies (TNCs):** Several ride-hailing platforms have made electrification commitments dependent on how quickly their drivers can transition to EVs. We spoke with TNCs to understand the opportunity seen in PMCs within their electrification strategy and how they could support deployment.

For each group, an interview questionnaire was designed to provide a standardized framework for discussion. The questionnaires used can be found in Appendix C.

Using this framework and the stakeholder mapping data, interviews were conducted with more than 30 different actors across 13 cities relevant to PMCs. Actors included city governments, electric utilities, charging equipment manufacturers, engineering contractors, TNCs, universities, and nonprofit organizations. A qualitative, rather than quantitative, data collection approach was used for this research as only a handful of U.S. cities have implemented PMC projects. This data collection process was designed to identify learnings most relevant to U.S. cities.

3. OBSERVATIONS FROM CURRENT PMC PROGRAMS

This section details observations made from our research across seven key areas: infrastructure ownership, load management, site selection, physical installation, operation, financing, and community engagement. When necessary, key differences are highlighted between utility poles and streetlights.

3.1 Infrastructure Ownership

3.1.1 Pole ownership

Pole ownership varies by city. In each U.S. city with an ongoing PMC program where we conducted interviews, the owner of utility poles and/or streetlights played an integral role in planning and installation. In the most basic sense, pole owners can approve (or deny) the attachment and interconnection of EV chargers. This section focuses on the ownership of the poles themselves and not of the land poles are installed on because PMCs are most commonly in the public ROW, avoiding the need for legal approval from private landowners.

- **Utility poles:** This infrastructure tends to be owned by electric utilities. In some cases, utility poles are partially or fully owned by telephone and cable service providers who also run wires on this infrastructure. In Melrose, Massachusetts, which launched a utility pole EV charger pilot in April 2021, most utility poles are jointly owned by National Grid (electric utility) and

Table 2 | **Charging Equipment Specifications for Level 1 and Level 2**

CHARGER LEVEL	VOLTAGE (V)	POWER OUTPUT (KW)	AMPERAGE (A)	AVG. VEHICLE CHARGING RATE (MILES/HOUR)
Level 1	120	1.4–1.9	12–16	3.5–6.5
Level 2	208 or 240	3.3–19.2	16–80	14–60

Notes: Level 1 and Level 2 charging are most relevant to PMC installations due to the limited voltage available at poles. DC fast charging is not included in this table as it is beyond the scope of this research. Exact equipment specifications should be collected from the charger manufacturer.

Sources: CALeVIP 2021; DOE 2021b; Plug-in NC 2021.

We found all U.S. PMC programs to be implementing Level 2 rather than Level 1 charging. Level 1 is primarily installed in homes with private parking/garage access where a vehicle can top up on a regular basis. While PMCs are commonly installed in residential areas, they are public charging stations. Within this public setting, the higher power output of Level 2 charging (see Table 2) enables more charging sessions within a given period, improving utilization of the public infrastructure. Similarly, a 2021 study from UC Davis found EV owners who relied on Level 1 residential charging were 52 percent more likely to discontinue EV ownership and switch back to an internal combustion engine (ICE) vehicle, compared to EV owners with Level 2 residential charging (Hardman and Tal 2021).

3.2.2 Pole electrical capacity

Ensuring the reliability of a pole's primary functions (such as a streetlight) is always the first operational priority. If new power demand introduced by an EV charger will inhibit these core functions, upgrades to increase capacity will be needed. If those upgrades are not possible or too costly, PMC installation may not be viable. In the United States, utility poles and streetlights present two different installation settings. Utility poles usually have greater electrical capacity than streetlights often making them a better option for PMCs. However, the best pole for charging is dependent on local context.

Utility pole capacity

Utility poles commonly support several types of wires carrying varying levels of voltage. This set of wires typically includes a secondary distribution wire with a voltage of 208 V or 240 V, making utility poles strong candidates for Level 2 charger installations (see Table 2). Depending on the site-specific context, additional infrastructure, such as a step-down transformer or more fuses, may be required to support an EV charger (Figure 2).

- Portland, Oregon: In a utility pole PMC pilot run by Portland General Electric (PGE), poles with step-down transformers already installed, above or nearby, were prioritized. If PGE's program is scaled further, additional transformers may be needed elsewhere to accommodate chargers on poles lacking an accessible transformer.
- Melrose, Massachusetts: In a few cases, National Grid had to install a larger transformer near the utility pole to accommodate chargers. Even with this additional infrastructure, National Grid estimates PMC installation costs to be between 55 and 70 percent less than ground-mounted chargers. Retrofitting streetlights was also considered, but the additional infrastructure required made it infeasible.

more efficient, last two to five times longer, and can save a city millions of dollars in electricity bills compared to their high-pressure sodium counterparts, reduce electrical load, and make room for new loads, such as a charging station (Gerdes 2013). LED streetlight conversions present an opportunity for PMCs to take advantage of this newly available electrical capacity.

In cases where even with LED fixtures accommodating PMCs is cost prohibitive, a streetlight's preexisting electrical connection could be used to supply electricity to micro-mobility charging docks. This solution has been implemented in Pittsburgh, Pennsylvania, as part of a citywide mobility hubs pilot (Move PGH 2021). Hence, streetlight charging can also support multimodal sustainable transit options. For the hundreds of cities already supporting LED streetlight conversion programs (Northeast Group LLC 2020), this application may be a natural next step to explore.

3.3 Site Selection

A well-designed site identification process for PMCs can save both time and money by efficiently narrowing down the poles best situated for charger installation. The PMC site-selection process provides an opportunity to support a more equitably distributed charging network. Without a deliberate effort to deploy PMCs in areas where drivers face the greatest barriers to adoption, improvements to EV access for all will be limited. We identified several issues encountered by cities installing PMC infrastructure. These considerations are divided into three categories based on geographic scale:

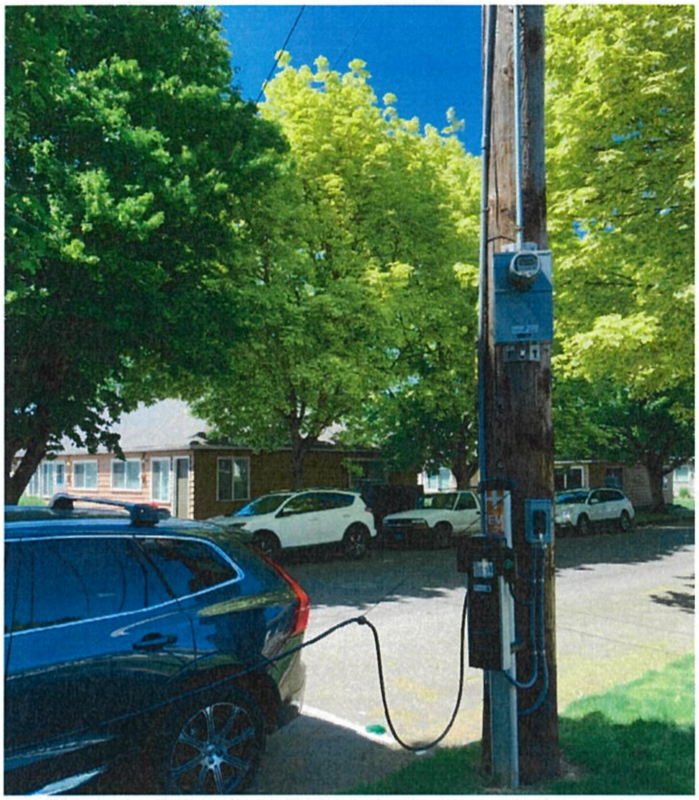
3.3.1 Citywide scale

- **Competition for poles:** Streetlights and utility poles are points of vertical real estate for several applications, most notably 5G sites, surveillance cameras, risers, fire alarm equipment, etc. (Kingson 2021). Due to this growing list of attachments, the available space and, more critically, the available electrical capacity for EV charging at a pole can be limited. In Los Angeles and London, United Kingdom, where 5G deployments are already underway, PMC initiatives have encountered competition with this infrastructure. In London, 5G modules have even been installed on streetlights already housing an EV charger without the operator's knowledge, causing safety concerns. To address this challenge, in Charlotte, custom PMCs are being considered that can integrate other devices potentially in one package.
- **Existing public charging and urban planning strategy:** PMCs are a new tool that can be integrated with a city's existing public EV charging strategy. While PMCs can enable public charging in locations previously deemed infeasible or too costly for installation, areas not suitable for PMCs should also be identified, where alternative approaches can be used to ensure equitable access throughout a city. In addition, PMC deployment can be coordinated with broader sustainable mobility efforts, ones that consider Avoid-Shift-Improve (ASI) framework principles (Bongardt et al. 2019). Compared to a ground-mounted installation, PMCs can be relocated to different locations with relative ease, making them assets adaptable to the changing needs at the curbside, such as the installation of a bike lane.

3.3.2 Neighborhood level

- **Enabling greater access to EV charging:** Greater availability of public charging infrastructure has been shown to increase EV uptake (Hall and Lutsey 2017), a relationship PMCs can help accelerate by improving charging access for residents that lack private charging facilities. In Santa Monica, California, for example, it is estimated that 77 percent of residents live in MUDs (City of Santa Monica 2021). Chargers sited near MUDs or low-income housing can provide go-to charging sites for many potential new EV users living nearby.
  - Some cities, including Los Angeles, are trying a "utilization testing" model, where PMCs are deployed throughout the city in different neighborhoods. Over time, chargers will be added or even relocated to enable greater access throughout the city.
  - Other cities, including Portland, are systematically increasing charger deployments neighborhood by neighborhood while emphasizing equitable access considerations.
- **TNC partnerships:** Collaborating with TNCs to achieve electrification goals can be mutually beneficial. Although platforms like Uber and Lyft have programs to encourage electrification, many drivers are constrained by limited access to charging infrastructure. TNCs can contribute data on charger placement and potentially finance PMCs to ensure the electrification needs of drivers, many of whom reside in MUDs, are met (Rajon Bernard and Hall 2021).

Image 1 | **Eye-Level and Elevated PMC Mounting Configurations**



Notes: (Left) A PMC mounted at eye level in Portland, Oregon. This installation includes an external electrical meter mounted above the charger. (Right) An elevated PMC in Los Angeles, California. Note that this parking space has a parking meter.

Source: Flickr Emmett Werthmann/WRI.

In both these cases, mounting chargers toward the sidewalk can help avoid damage from vehicles, where an elevated charger can also help limit obstruction to pedestrians.

Charging equipment manufacturers offer a range of products; some have equipment designed specifically for pole-mounted applications and others do not. In Los Angeles and Melrose, the equipment manufacturer was a key partner in developing a mounting solution for the city. Other collaborators can include the project's engineering staff. For example, Kansas City used hardware developed by Black & MacDonald, Portland used its in-house PGE engineering team and equipment, and Charlotte developed its equipment at the University of North Carolina at Charlotte — EPIC. As PMCs scale, it is unclear if these custom mounting solutions will continue to be employed beyond the pilot phase.

3.4.4 Metering EV chargers

The kilowatt hours (kWh) distributed by a public EV charger need to be accounted for by a dedicated electrical meter. The meter, whether it is located within a charging station or mounted externally (Image 1), generally needs to be revenue-grade and utility-approved.

PMC installations commonly involve tapping into an existing unmetered electrical service. In several cities we spoke with, the city's streetlights are unmetered, and the utility simply charges a fixed electricity rate based on the type of luminaire installed. Adding PMCs to the lighting circuit complicates this billing process and can require the installation of a dedicated electrical meter to differentiate the power consumed by a PMC from other loads.

cutting or power theft from the lighting circuit. Equipment manufacturers noted maintenance costs were not always incorporated into funding for charger deployments, which becomes an issue for forecasting costs. From our research, solutions to reduce maintenance issues can include using retractable cables to prevent cord cutting and community education about the functionality and usability of the charger to prevent misuse.

3.5.3 End-user costs and payments

End-user costs and payments can directly influence the installation process and charger utilization. Several elements are involved:

Payment for parking: In some cities, multiple departments or agencies have oversight and rules related to curbside parking space, which can make implementation challenging to coordinate. Additional complexity comes from a lack of alignment between the pricing structures for an existing parking zone and the charging station, and their respective fee collection systems (see Image 1). If the two payment systems are kept separate, EV drivers must manage two payments which could deter PMC use. Parking fees are a source of city revenue and free parking for EVs in those spots can reduce that revenue. Some cities have avoided placing chargers in paid parking locations and others have worked with the city's parking department to coordinate. Montreal, Canada, which has deployed several curbside ground-mounted chargers, has developed an API linking charging and parking payments, providing a more seamless user interface.

Pricing structure: For Level 2 charging, the rate at which a vehicle battery receives energy depends on the charger's maximum power output [between 3.3 kilowatts (kW) and 19.2 kW] and the maximum power an EV's onboard inverter can accept. The latter varies from one vehicle to another, with more expensive and powerful EV models often accepting higher Level 2 charger outputs. As a result, charging fees based on charging time rather than a dollar per kWh basis is disadvantageous to some vehicles, making pricing an equity concern.

Payment methods: We observed three payment methods:

- **Credit cards:** While most users may have access to credit cards, having a credit card reader on the charger could be prone to vandalism. Some cities, like New York City, experienced challenges linking data from credit card swipes with the city's accounting department systems.
- **Mobile application payments:** Most low-income individuals do have smartphones, but may not have robust data plans, so it is important to have low cellular data requirements for mobile applications.
- **Radio-frequency identification (RFID) system:** This easy-to-use, contactless payment system is growing in adoption and can be especially useful for vehicle fleets but is also prone to vandalism.

3.6 Financing Charging Infrastructure

Due to lower installation costs, for the same price, more PMCs can be deployed than ground-mounted curbside units. The potentially high demand for PMCs combined with lower up-front costs, presents a high-impact economic case for several funding streams.

3.6.1 Utilities

The average utility stands to create $3 billion to $10 billion of new value from the rise of EVs (Baker et al. 2019). Current PMC deployments in Los Angeles, Portland, and Melrose are funded entirely or in part by the Los Angeles Department of Water and Power, PGE, and National Grid, respectively.

As indicated in Tables 1 and 3, utilities often own and operate streetlights and utility poles. In several cities, the utility also already owns and operates public charging infrastructure. Additionally, utilities have an innate understanding of the existing electrical system, existing capacity suitable for EV charging loads, regulatory barriers, safety considerations, and often have in-house technical expertise regarding charger interconnection. This makes coordination for deployment, program administration, procurement, and infrastructure upgrades, if any, more streamlined and can help reduce program costs and avoid delays. In each city with a PMC program, an electric utility led the initiative or was a key project partner.

PMCs enable greater deployment volumes for the same cost compared to ground-mounted chargers. Electricity demand from charging can lead to increased revenue for the utility, depending on utility tariffs and charger utilization. As with any other form of commercial EV charging infrastructure, utility tariffs should be evaluated progressive and EV-forward cities. Every municipality is home to a unique set of local policies, regulations, and relationships that may not be accounted for in the preliminary guidance below. A pilot project provides the opportunity to uncover any foreseeable barriers, build relationships with relevant stakeholders, and lay the foundation for future expansion. This guidance is broken into four steps:

- **Step 1:** Viability assessment for a PMC program
- **Step 2:** Planning for PMC deployment
- **Step 3:** Siting and installing PMCs
- **Step 4:** Operating a PMC program

4.1 Step 1: Viability Assessment for a PMC Program

Not every city is well-suited to PMC installations. Before proceeding with a pilot, the owners and operators of the poles and charging infrastructure should be identified and consulted to explore all viable options, seek approval, and determine technical feasibility.

Identify pole owners and operators (see Sections 3.1 and 3.5). For both utility poles and streetlight poles, a range of ownership and operation models exist (Table 1 and Table 3). In case of a joint ownership or operation model of pole infrastructure, it is important to involve all parties. In the case of differing ownership between the pole and charger, it is useful to identify the approval process from the pole owner.

Determine the technical feasibility of poles to support EV charging (see Section 3.2). It is recommended to determine to what extent PMCs are technically feasible in the city before proceeding further. The questions in Table 4 are intended to help identify and uncover barriers present within a city's local context that could inhibit PMC feasibility. If streetlights and/or utility poles are identified as possible options, proceed to Step 2. If neither type of infrastructure is identified as a suitable location for EV charging, we would suggest pursuing other charging strategies.

Table 4 | **Identifying Technical and Installation Barriers to PMCs**

UTILITY POLE	STREETLIGHTS
• Do any regulations, policies, or guidelines exist that would prevent objects, such as electrical meters or chargers, from being mounted on poles or certain pole types? • Are existing charger equipment models compatible for attachment to the city's network of pole infrastructure? (Section 3.4) • What types of infrastructure modifications or upgrades are necessary to facilitate Level 1 charging? To facilitate Level 2 charging? (Section 3.2)	
• Do utility poles need to be accessible for maintenance personnel? Could this inhibit charger installation? (Section 3.1)	• Are streetlights wired with a subsurface or overhead connection? If there is a subsurface electrical connection, is the existing electrical conduit large enough to facilitate EV charging? • Are there any structural or aesthetic issues with attaching an EV charger to the pole? • Have any streetlights been converted to LED? (Section 3.2) • Is streetlight power dependent on photocells or timers?

Source: Authors' stakeholder interviews (2021); Puentes 2019.

to proceed with PMC installations. Understanding this can help foresee impacts on charger site selection or other hurdles moving forward.

Establish charging payment scheme. This will largely depend on infrastructure ownership arrangements, utility rates, and the local utility regulatory environment. It is recommended the pricing structure be on a dollar per kWh basis because this approach is most equitable. If chargers will be installed at metered parking locations, coordination with the city's parking payment/enforcement department will be necessary.

Determine project funding source(s). Cities with limited budgets should consider taking advantage of federal and state funding opportunities. A compressive list can be found on Alternative Fuels Data Center's "Federal and State Laws and Incentives" web page (DOE 2021c). Utilities and TNCs can also play an important role in helping to finance PMCs. It is also important to ensure sufficient funding is available for charger maintenance and ongoing operations. As Los Angeles's Bureau of Street Lighting put it, "a broken charger is worse than no charger."

Conduct ongoing, consistent, and broad community engagement. Informing community members about PMC initiatives is a necessary part of the planning process (see Section 3.7). Community groups to engage with can include community boards, faith-based organizations, property management companies, civic/historic preservation organizations that may have issues with chargers in certain designated areas, school boards/staff, recreational and park staff, and others whose property is adjacent to where the equipment will be located. This is a step that should be incorporated throughout the planning and installation process.

4.3 Step 3: Siting and Installing PMCs

After programmatic planning, the following steps are intended to inform PMC siting and installation. This section highlights the importance of incorporating equity data to ensure PMC deployment meets accessibility goals.

Identify specific poles for PMCs. Performing a spatial mapping analysis to identify a short list of poles can help save time and cost by limiting the number of site visits required. Recommended data points to consider in this analysis are listed below. The primary data are those most critical to identify which poles are best situated for charging. Equitable deployment data help identify areas where PMCs can support those with the greatest barriers to charger access. The secondary data can help narrow down locations based on a range of other attributes. It should be noted that the approach taken for site selection and the data inputs used will directly impact the ability of PMCs to foster a more accessible and equitable charging network within a city.

Primary data

- Location of utility poles and/or streetlights. This provides potential points of attachment for chargers in the city. Using the other data below, the best situated poles will be narrowed down.
- Location and type of existing on-street parking zones to determine where pole locations align with parking zones, including parking time limits, public versus residential, and metered versus unmetered parking
- Status of the local distribution grid. This includes the location of distribution transformers or other necessary infrastructure and the existing capacity available to install the charging equipment identified in Step 1
- Streetlights with LED fixtures to determine where excess available capacity may exist

Equitable deployment data

- Neighborhoods and MUDs that lack dedicated off-street parking
- Residences with dedicated off-street parking but unable to install an EV charger. Some residents have a private parking spot, but the property owner is unable or unwilling to install a charger.
- Existing public charging stations to identify both "charging deserts" and areas with sufficient public charging to determine how PMCs best fit into the existing network (Ulrich 2020)
- Existing EV drivers to identify areas with preexisting charging demand and areas facing barriers to EV uptake
- Median household incomes throughout the city to understand where underserved communities reside
- Local community input provided on optimal or preferred charger locations, informed by Step 2
- Other equity-centric data sources, such as the Mapping Inequality database (Nelson et al. 2021), the Greenlink Equity Map (Greenlink Equity Map 2020), or the Opportunity Atlas (Opportunity Insights 2020)

Develop site-specific cost estimates. Due to a range of situational factors, installation costs can vary from one site to the next. For example, at some sites a distribution transformer will have available capacity, while at others a new transformer will need to be added.

Install charging equipment. Once final sites have been identified and the charging equipment is procured, install the charging equipment with support from the project's technical and operational staff and the charging equipment vendor.

4.4 Step 4: Operating a PMC Program

Once installed, several actions can be taken to optimize PMC operation, encourage greater EV adoption, and expand a PMC network. Key steps can include:

EV signage and parking enforcement. PMC parking spots should be marked with EV signage and road paint to keep the spot open and promote EV use. Some cities have instituted fines and penalties for parked ICE vehicles and EVs parking longer than permitted to ensure the spot is open for those who need to charge (Washington State Legislature 2021; Illinois General Assembly 2021).

Monitor performance. One benefit of PMCs is the equipment can be relocated to different poles relatively easily, which can help accommodate changing priorities at the curbside, including ASI planning. Performance monitoring and data collection can inform future deployment and help make the case for additional investments.

Plan for scaled deployment. Pilot or demonstration projects are helpful to prove technical feasibility, but often lack a clear plan to scale. Identifying success metrics and pre-planning a phased approach will encourage sustained investments toward scaled PMC deployment.

5. CONCLUSION

Accelerating transportation electrification in the United States means establishing charging networks where all drivers have access to convenient and reliable charging. PMCs, using existing utility poles and streetlights to deploy EV chargers, present a strategy to site chargers in locations typically considered infeasible for ground-mounted units. Additionally, PMCs can support those that lack access to private charging infrastructure. In collaboration with end users, including local communities and TNC drivers, PMCs can also spur greater EV adoption. However, if improperly planned and deployed, retrofitting poles may cause adverse impacts on the local distribution grid, lighting, and safety issues, or lead to inequitable deployment and underutilized infrastructure.

While PMCs may seem like an ideal means to expand curbside charging in every city, it is a strategy significantly impacted by local context. In addition, the low volume of current U.S. deployments means the ability to solidify replicable best practices for PMCs is limited. More pilots and scaled installations will help identify broader factors for success and encourage participation by more diverse funding partners.

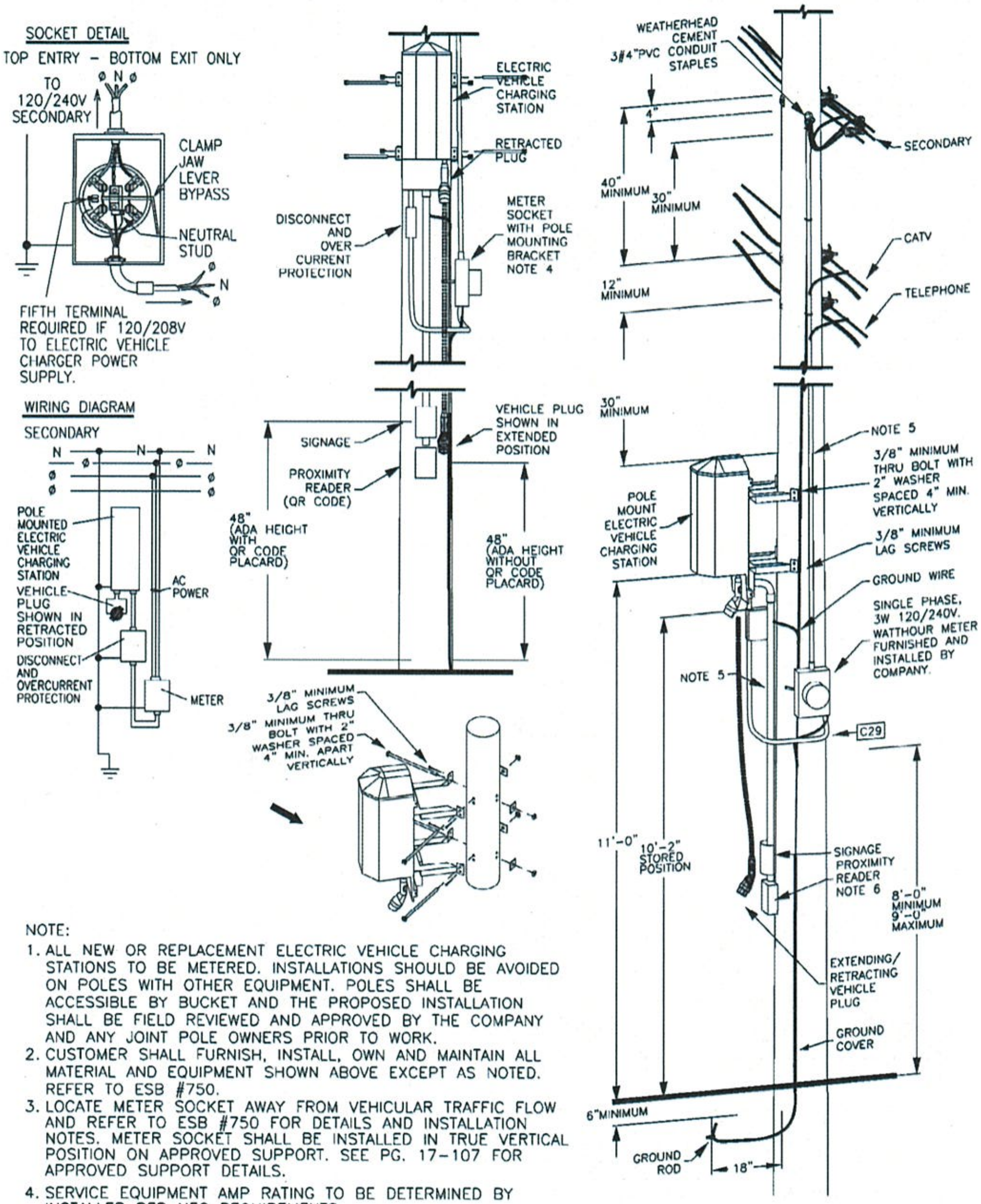
While some planning considerations are common to both utility poles and streetlights, such as charging level, charger equipment ownership, and community engagement, there are key differences, including available electrical capacity, pole ownership, and installation. We have attempted to simplify these complex considerations by developing a stepwise approach for cities and utilities to assess the viability, planning, installation, and operation of a PMC program. This information is likely to be refined and improved over time as the number of U.S. deployments increases.

Moving forward, several opportunities exist for future research and analysis. As a greater number of U.S. *and* global cities incorporate PMCs into their charging network, those experiences should be compared with existing schemes and against the information presented in this paper. Additionally, future research should focus on using a quantitative approach to identifying U.S. cities (and those in other countries) best suited for PMCs, identifying regulatory barriers, and developing suitable business models.

Pole-mounted charging offers a cost-effective and creative approach to developing more equitable public charging networks. While it may not be for all cities, it is a climate-positive solution that should not be overlooked.

APPENDIX B. NATIONAL GRID DISTRIBUTION WOOD POLE-MOUNTED EV CHARGING STATION CONSTRUCTION STANDARD

Doc. # ST. 17.00.002



NOTE:

1. ALL NEW OR REPLACEMENT ELECTRIC VEHICLE CHARGING STATIONS TO BE METERED. INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOINT POLE OWNERS PRIOR TO WORK.
2. CUSTOMER SHALL FURNISH, INSTALL, OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB #750.
3. LOCATE METER SOCKET AWAY FROM VEHICULAR TRAFFIC FLOW AND REFER TO ESB #750 FOR DETAILS AND INSTALLATION NOTES. METER SOCKET SHALL BE INSTALLED IN TRUE VERTICAL POSITION ON APPROVED SUPPORT. SEE PG. 17-107 FOR APPROVED SUPPORT DETAILS.
4. SERVICE EQUIPMENT AMP RATING TO BE DETERMINED BY INSTALLER PER NEC REQUIREMENTS.
5. ALL CONDUCTORS IN NON-METALLIC RIGID CONDUIT ATTACH TO POLE IN ACCORDANCE WITH NEC REQUIREMENTS.
6. PROXIMITY READER AND SIGNAGE SHALL BE MOUNTED FLUSH TO POLE TO AVOID MAKING THE POLE READILY CLIMBABLE.

Designer	Drawing	Date
MPR	od17201	3/3/21

7/21 - New bracket to move charging station off pole face.

DISTRIBUTION WOOD POLE MOUNTED
ELECTRIC VEHICLE CHARGING STATION – SINGLE CHARGER

ISSUE	PAGE NUMBER		
7/21	17-201	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

APPENDIX C. INTERVIEW QUESTIONNAIRES

To help guide the interviews, questionnaires were developed for each group. The authors have deleted questions that repeat for brevity.

Cities/Utilities That Have Installed PMCs

KEY QUESTIONS

City EV Charging Context

6. Does the city have an EV road map?
7. In what locations is public EV charger installation prioritized in the city? What type of public charging infrastructure is currently installed? How many public chargers are Level 2 versus Level 3?
8. Has the city been able to incorporate renewable energy into public EV charging? If so, to what extent?
9. What entity/entities operates/maintains the public charging infrastructure in your city? What role does the city play in supporting charger operation and maintenance?
10. Does the city have plans to support electrification of rideshare/delivery fleets? If so, how is the city supporting this?
11. During the process of EV charger deployment is there any data the city has needed that it has found difficult to access or obtain? If so, what were those data and why were they difficult to access or obtain?

City Pole Context

1. What entity/entities own and/or maintain the pole-mounted infrastructure in the city?
2. What is the utility supplying electricity to streetlights and/or utility poles in the city?
3. What is the voltage of the electrical connection to streetlights and/or utility poles in the city?
4. How are the city's streetlights metered?
5. Has the city converted any of its streetlights to LEDs (percentage or count)? What challenges has the city encountered when switching to LEDs? Have pole-mounted LED conversions been performed with pole-mounted charging in mind?
6. Is the city currently using poles to accommodate other types of (non-EV charging) infrastructure that also require an electrical connection (i.e., telecommunications)? If so, how are you prioritizing?

City PMC Context

1. What entity/entities own and/or maintain PMCs in the city?
2. Who is the manufacturer(s) of the pole-mounted charging equipment installed in the city?
3. How do PMCs fit into the city's greater public charging plan (location, charger level, etc.)? What are your goals as you continue to scale pole-mounted charging infrastructure?
4. What was the city's process used to determine the charging equipment that would be used? Was pole-mounted charging first presented as an option from a manufacturer or an idea that came from the city government internally?
5. What do you see as the greatest benefits of pole-mounted charging for your city? What do you see as the greatest detriments?

Pole-Mounted Charging Project Planning

1. Who was consulted early on within the city (city entities) to help inform the project planning? Who was consulted externally (non-city entities)? Please list the stakeholders that were involved during the pole-mounted charging planning process.
2. When determining where to place PMCs, what factors were taken into consideration (on-street/off-street, residential/commercial, etc.)? What tools/methods has the city used to inform this decision-making process?
3. Has the city considered the impacts that pole-mounted charging will have on promoting/ disincentivizing private vehicle ownership in cities? If so, how is this consideration being incorporated into the planning process?
4. How are the needs of lower-income people and other vulnerable groups considered when planning EV charging?
5. During the PMC planning process, what are the data sets that are necessary for decision-making? Has that data been difficult to access or obtain? If so, what were those data and why were they difficult to access or obtain?
6. Are there any stakeholders that were not originally involved in the project planning process but are now involved in supporting pole-mounted charging infrastructure? If yes, why were they brought on to support the initiative?
7. Is the electrification of for-hire vehicles/delivery fleets a factor being incorporated into the pole-mounted charging planning process? If so, how is this being done?

Pole-Mounted Charging Installation

1. What changes, if any, were made to pole-mounted infrastructure to accommodate EV chargers (e.g., timer/photocell removal, capacity upgrades)?
2. What has the city found to be the greatest challenges during the PMC installation process?
3. In your opinion, what makes one PMC model superior to another?
4. What features help make a charger easier to install?
5. What features make a charger easier to operate and maintain?
6. What features provide a better user experience?

PMC Implementation and Operation

1. Has it been necessary for the city to bring on additional maintenance crew capacity for PMCs? If so, what was the cost associated with this and how was it funded?

Charging Equipment Manufacturers (CEMs)

KEY QUESTIONS

Charging Type Context

1. Is pole-mounted charging a business opportunity the CEM is actively working to develop?
2. How does the CEM see pole-mounted charging fitting into preexisting public charging networks?
3. What charging level does the CEM offer for pole-mounted charging applications?
4. In your opinion, what types of EV users will find pole-mounted charging to be most useful?
5. What are the key selling points of a PMC compared to a comparable conventional (non-pole-mounted) EV charger?
6. In your opinion, what makes one PMC model superior to another?
7. What features help make a charger easier to install? To operate and maintain?
8. What features provide a better user experience?

Charging Deployment

1. In what cities is the CEM prioritizing charging station deployment currently? For what reasons have these cities been chosen to focus your efforts in?
2. Several U.S. cities, including Charlotte, Kansas City, Los Angeles, and New York City, have installed or are planning to install pole-mounted charging. In what locations is the CEM deploying pole-mounted charging infrastructure?
3. Are there barriers the CEM has encountered when working on projects installing conventional (non-pole-mounted) charging infrastructure that you could foresee being a barrier to pole-mounted charging? If so, what are they and how can these barriers be avoided?
4. When reaching out to potential installers of pole-mounted charging infrastructure, have people been receptive to the concept? Have cities been receptive to the concept of pole-mounted charging? Have cities expressed disinterest? For what reasons?
5. Have rideshare and last-mile delivery companies expressed an interest in pole-mounted charging installations? Do you see pole-mounted charging as an opportunity to support electrification of those fleets?
6. Within the pole-mounted charging space, has the CEM experienced a lot of competition from other charging equipment manufacturers?
7. How are the needs of lower-income people and other vulnerable groups considered when expanding the CEM's network? Do you think pole-mounted charging can help increase access?

Pole-Mounted Charging Installation and Planning

1. What role does the CEM play in the charger planning and installation process? During the planning and installation process, what entities does the charging equipment manufacturer work most closely with?
2. What types of challenges has the CEM encountered during the installation process? Based on your experience, what can be done to help overcome these challenges?
3. Has the CEM considered partnering with other private sector entities that have an interest in also using existing street poles to expand their infrastructure, such as telecommunications (Wi-Fi/5G) networks? Why or why not?
4. What type of data does the CEM need from a city or utility to support the installation of pole-mounted charging? Has the CEM encountered any issues obtaining certain types of data necessary to support pole-mounted charging projects?

Charger Operation

1. What types of data is the CEM able to provide cities on charger utilization/operation?
2. What type of support is the CEM able to provide on charger maintenance and stocking parts?

Financing

1. Cities often have limited budgets. What financing mechanisms can the CEM provide to a city with limited financial resources to help them purchase and install pole-mounted charging?
2. What types of entities do you see as the most willing and able to purchase charging stations (cities, electric utilities, private companies, etc.)?

Transportation Network Companies (TNCs)

KEY QUESTIONS

Electrification Strategy

1. Does the TNC have an EV plan or road map?
2. What percentage of the TNC's fleet is comprised of EVs currently?
3. To meet the TNC's electrification targets, how are you planning to support the development of charging infrastructure? Beyond charging infrastructure, what can be done to accelerate TNC electrification?
4. In your experience, what have been the greatest barriers to increasing access to charging for TNC drivers?
5. What types of charging solutions/strategies do you view as the best way forward to support electrification of rideshare and delivery fleets? What level(s) of charging is most useful for TNC drivers? What types of locations are most useful for TNC drivers to charge at?
6. For a driver on the TNC platform, are there certain characteristics you have identified that make the switch to an EV easier for one driver on your platform over another? Garage access, specific driving habits, or other characteristics?
7. In terms of the cities the TNC operates in, are there certain city characteristics you have identified that make it easier to electrify the vehicles on your platform in one city over another?

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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September 12, 2023

Chairman John Sellers
And Members of the Committee to Study Electric Vehicle Charging for Residential Renters
Room 201-203
Legislative Office Building
33 North State Street
Concord, NH 03301

Mr. Chairman and Members of the Committee:

Thank you for the opportunity to provide testimony to the Committee's ongoing study. The NH Department of Energy (Department) was asked to provide comment on what the Department's current role is in EV charging infrastructure development.

The Department is New Hampshire's newest state agency and was created through the biennial state budget that went into effect on July 1, 2021. The Department was designed to provide "a unified direction of policies, programs, and personnel in the field of energy and utilities." As such, the Department has a wide variety of roles and responsibilities related to energy issues and regularly engages in proceedings before the Public Utilities Commission (PUC) to represent the public interest.

From an EV policy perspective, the Department's role is relatively narrow. The Department is primarily an economic regulator that focuses on ratepayer impacts that result from state energy policy actions while maintaining a reliable electric system. Traditionally, the NH Department of Environmental Services (NHDES) has played a lead role in working with the NH Department of Transportation (NHDOT) in driving state policy changes related to EV infrastructure investments. The Department will engage in the NH General Court, the PUC, and other forums on any potential actions or policy changes that may result in an impact to NH's ratepayers.

The Department regularly participates in ongoing PUC dockets related to EV charging infrastructure. Past dockets have included the following:

- DE 19-064 – a distribution rate case for Liberty Utilities that implemented residential EV time of use (TOU) rates.
- IR 20-004 – a PUC investigation of EV rate design standards and TOU rates for residential and commercial customers.
- DE 21-078 – an Eversource petition for PUC approval of their EV make-ready and demand charge alternative proposals.
- DE 21-030 – a distribution rate case for Unitil. The docket explored proposed support for EV infrastructure, but the PUC did not approve. TOU rates were implemented.

Open dockets include:

- DE 20-170 – adjudicative dockets for TOU EV rates statewide.

- DE 23-039 – proposed revised TOU EV rates.

There have been additional federal programs to incentivize EV charging infrastructure build out. Most of these opportunities are coming down through the Environmental Protection Agency and the US Department of Transportation. Both NHDOT and NHDES are actively engaged in various EV funding opportunities at the state and federal levels that this Committee may wish to seek more information on. The Department does not maintain state or federal funding related to EV charging infrastructure.

As always, if there is additional information needed or questions, feel free to contact Griffin Roberge (griffin.j.roberge@energy.nh.gov), and the Department would be more than happy to assist the committee.

Respectfully,

Griffin Roberge
State Energy Program Manager
NH Department of Energy

As electric vehicles become more popular, home renters face a charging dilemma

October 25, 20221:15 PM ET

By
The Associated Press

PORTLAND, Ore. — Stephanie Terrell was excited to join the wave of drivers adopting electric vehicles when she bought a used Nissan Leaf this fall.

But Terrell encountered a bump in the road on her journey to clean driving: As a renter, she doesn't have a place to plug in overnight, and the public charging stations near her are often in use. The 23-year-old nearly ran out of power on the freeway recently because a charging station she was counting on was busy.

"It was really scary and I was really worried I wasn't going to make it," she said. "I feel better about it than buying gas, but there are problems I didn't really anticipate."

The transition to electric vehicles is underway for homeowners who can power up in their own garage, but for millions of renters, access to charging remains a significant barrier. Now, cities across the U.S. are trying to come up with innovative public charging solutions as drivers string power cords across sidewalks, erect private charging stations on city right-of-ways and queue at public facilities.

The Biden administration last month approved plans from all 50 states to roll out a network of high-speed chargers along interstate highways using $5 billion in federal funding over the next five years. But states must wait to apply for an additional $2.5 billion in local grants to fill in charging gaps, including in dense urban areas.
"We have a really large challenge right now with making it easy for people to charge who live in apartments," said Jeff Allen, executive director of Forth, a nonprofit that advocates for equity in electric vehicle ownership and charging access.

Cities have to understand that "promoting electric cars is also part of their sustainable transportation strategy. Once they make that mental shift, there's a whole bunch of very tangible things they can — and should — be doing."

Fast chargers, also known as DC Fast, can fill up a car in 45 minutes or less. But slower Level 2 chargers, which take several hours, still outnumber DC fast chargers nearly four to one. Charging on a standard residential outlet, or Level 1 charger, isn't practical unless you drive little or can leave the car plugged in overnight.

Nationwide, there are about 120,000 public charging ports featuring Level 2 charging or above, and nearly 1.5 million electric vehicles registered in the U.S. — a ratio of just over one charger per 12 cars nationally, according to the latest U.S. Department of Energy data.

A briefing prepared for the U.S. Department of Energy last year by the Pacific Northwest National Laboratory forecasts a total of just under 19 million electric vehicles on the road by 2030, with a projected need for an extra 9.6 million charging stations.

In Los Angeles, for example, nearly one-quarter of all new vehicles registered in July were plug-in. The city estimates in the next two decades, it must expand its distribution capacity anywhere from 25% to 50%, with roughly two-thirds of the increased demand coming from EVs, said Yamen Nanne, manager of Los Angeles Department of Water and Power's transportation electrification program.

Amid the boom, dense city neighborhoods are rapidly becoming pressure points.

In Los Angeles, the city has installed over 500 pole-mounted EV chargers — 450 on street lights and 50 on power poles — and wants to add 200 more per year, Nanne said.

Similar initiatives to install pole-mounted chargers are in place or being considered from New York City to Charlotte, N.C. to Kansas City, Missouri. The utility Seattle City Light is also in the early stages of a pilot project to install chargers in neighborhoods with limited private parking.

Other cities want to amend building codes for the electric transition. Portland is considering a proposal that would require 50% of parking spaces in most new apartment complexes to have an electrical conduit; in complexes with six or fewer spaces, all of them would be EV-ready.

Such policies are critical to widespread EV adoption because with tax incentives and an emerging used-EV market, zero-emissions cars are finally within reach for more Americans, said Ingrid Fish, who is in charge of Portland's transportation decarbonization program.

The initiatives mimic those that have already been deployed in other nations that are further along in EV adoption.

London, for example, has 4,000 public chargers on street lights. That's much cheaper — just a third the cost of wiring a charging station into the sidewalk, said Vishant Kothari, manager of the electric mobility team at the World Resources Institute.

But London and Los Angeles have an advantage over many U.S. cities: Their street lights operate on 240 volts, better for EV charging. Most American city street lights use 120 volts, which takes hours to charge a vehicle, said Kothari, who co-authored a study on the potential for pole-mounted charging in U.S. cities.

So cities must use a mix of solutions, from zoning changes to policies that encourage workplace fast-charging.

Changes can't come fast enough for renters who already own electric vehicles.

Rebecca DeWhitt and her partner string an extension cord from an outlet near their rental home's front door, down a path and to their new Hyundai Kona in the driveway. Off the standard outlet, it takes up to two days and lots of planning to fully charge their EV for a trip.

"It's inconvenient," DeWhitt said. "And if we didn't value having an electric vehicle so much, we wouldn't put up with the pain of it."

What Happens to the Old Batteries in Electric Cars?

These power sources can have many uses, CR says

By Devin Pratt

Updated February 23, 2022

Photo: Getty Images

Electric cars are becoming a more viable option for many car buyers, with almost a couple of dozen models set to debut by the end of 2024. With the EV revolution in full swing, one question keeps popping up: What happens to the batteries in EVs once they wear out?

EV batteries will slowly lose capacity over time, with current EVs averaging around 2% of range loss per year. Over many years, the driving range may be noticeably reduced. EV batteries can be serviced and individual cells inside the battery can be replaced if they go bad. But there's the risk after many years of service and several hundred thousand miles that the entire battery pack may need to be replaced if it has degraded too much. The cost can be between $5,000 and $15,000 and is akin to an engine or transmission replacement in a gas car.

The worry for most environmentally conscious people is that there isn't a system in place to deal with these decommissioned parts. After all, lithium-ion battery packs often run the length of the car's wheelbase, weigh close to 1,000 pounds, and are made up of toxic elements. Can they easily be recycled or are they destined to pile up in landfills?

"Electric car batteries aren't very difficult to get rid of because even if they've outlasted the usefulness for an electric car, they're still worth quite a lot to someone," says Jake Fisher, Consumer Reports' senior director of auto testing. "There's a strong demand for secondary-life batteries. It's not like when your gas-powered engine dies and it goes to the scrapyard. For example, Nissan is using old Leaf batteries to power mobile machines in its factories around the world."

Nissan Leaf batteries are also being used to store energy on solar grids in California, Fisher says. Once solar panels capture energy from the sun, they need to be able to store that energy. The old EV batteries may no longer be optimal for driving but they're still capable of energy storage.

Even as secondary-life batteries fully degrade after various uses, minerals and elements like cobalt, lithium, and nickel in them are also valuable and can be used to produce new EV batteries.

With EV technology still in relative infancy, the only certainty is that recyclability needs to be built into the manufacturing process to ensure that EVs remain eco-friendly throughout the entire life cycle of the product.

Despite the concern about a potential costly repair when replacing these batteries, we haven't seen it as a common issue in our exclusive car reliability data. Such problems are rare.

This article has been adapted from an episode of Talking Cars.

1. Recycle Car Batteries at a Local Auto Parts Store

In most states, you can drop off an old car battery at an auto parts store — such as AutoZone, Advance Auto Parts, and Napa Auto Parts. They'll recycle the battery for you.

AutoZone and Advance Auto Parts will usually even give you a gift card of around $10 for every old car battery you bring them for recycling. Not a bad deal.
Note: If you're buying a new car battery at the same time, the old battery will often automatically count as a credit toward the purchase of a new one. This is due to the refunding of the core charge.
Here's how to do it:

1. **Call your local auto parts store before going.** Ask if they recycle the type of auto battery you have. Most locations accept most auto batteries, but there are exceptions in some states and for some vehicles.
Tip: Before recycling your battery, measure its open circuit voltage with a multimeter and compare that number to a lead acid battery voltage chart to make sure it's actually dead. It may just need to be recharged.
2. **Remove the battery from the car.** Disconnect the negative then positive battery cables. Remove the strap that holds the battery in place. Then remove the battery from the car.
3. **Drop your battery off for recycling.** Take it your local auto parts store and drop it off at the counter. They'll take care of the recycling for you.

2. Recycle Small Sealed Lead Acid Batteries at Lowes and Home Depot

Many big-name retailers accept small sealed lead acid batteries for recycling — usually up to 11 pounds and 300 watt hours.
Here's how to do it:

1. **Go to Call2Recycle.** It's a national battery recycling program that has a lot of drop-off locations across the country — including Lowes, Staples, and Home Depot stores. In fact, Call2Recycle estimates that 86% of North Americans live within 10 miles of a drop-off location.

No excuse!
2. **Enter your location to find drop-off locations near you.** For example, I entered my zip code. It turns out there are 9 drop-off locations near me.
Tip: If Call2Recycle doesn't have any locations near you, try searching on Earth911. It has its own searchable database of drop-off locations and recycling centers.
3. **Find a drop-off location that accepts lead acid batteries.** To learn which kinds of rechargeable batteries a location accepts, click the little info icon in the search results. A popup will open telling you what kinds. For instance, a Home Depot near me recycles small sealed lead acid batteries up to 11 pounds. Check that your battery meets the location's requirements.

4. **Drop off the battery for recycling.** Drop-off locations have drop-off bins usually near the front of the store. And, while you're at it, why not recycle your other old rechargeable batteries? It's free.

3. Recycle Lead Acid Batteries at a Lead Acid Battery Recycling Center Near You

Many cities have recycling centers that accept lead acid batteries. Here's how to find one near you:

1. **Search for lead acid battery recycling centers near you.** For example, I live in Atlanta so I searched "atlanta recycling lead acid batteries" on Google. The city government's website came up with a page on how to dispose of car batteries. (Car batteries are lead acid batteries.)
2. **Find a local recycling center that accepts lead acid batteries.** I visited my city government's website and found a center near me for hard to recycle materials.

3. **Drop off the battery for recycling.** Fees may apply. The fees are usually based on the weight of the battery. You may also have to schedule an appointment, so I recommend calling ahead.

4. Use a Paid Battery Recycling Service

If none of the options above work for you, there is a final way — pay for someone to pick up and recycle your lead acid battery for you. You do this by buying a battery recycling kit.

Call2Recycle sells a Small Battery Recycling Box suited for around 20-25 pounds of batteries and a Large Battery Recycling Box suited for around 40-50 pounds. There's also a kit from The Big Green Box.

The kits usually come with a recycling container, prepaid shipping label, and the necessary permit for shipping batteries. In most cases the kits have battery weight and watt-hour limits. Check before buying.

Once the kit arrives, you simply put your batteries in the container, slap on the shipping label, and schedule a pickup. The service will pick up the container and recycle the batteries.

Paying to recycle a lead acid battery is a far cry from auto parts stores that give you a $10 gift card for old car batteries, but sometimes it's your only option.

Here's how lead acid batteries get recycled:

1. **Lead acid battery recyclers collect dead lead acid batteries from consumers.** These recyclers include auto parts stores, home improvement stores, big-box retailers, and local recycling centers.

2. **The recyclers ship them to a recycling facility.** This is an EPA-regulated facility for recycling batteries.
3. **The recycling facility inspects the shipments to make sure they're only recycling lead batteries.** It's important that they remove any lithium-ion batteries from the shipment because lithium batteries are flammable.
4. **The batteries are broken apart in a machine and the acid is drained.** The lead and plastic parts of the battery then go into a container filled with water. The plastic pieces float and the lead pieces sink, making them easy to separate.
5. **The reclaimed lead gets smelted and refined for use in new batteries.** Nearly all the lead gets recycled from this process.
6. **The reclaimed plastic pieces are cleaned and melted into pellets for use in new battery cases.** Most of the plastic gets recycled, too.
7. **Most of the reclaimed acid is converted to sodium sulfate.** Sodium sulfate is an odorless powder used to make other products such as powdered laundry detergent and glass.
8. **New lead acid batteries are made from the recycled materials.** According to the EPA, a typical lead acid battery contains 60-80% recycled lead and plastic.

Environmental Impact of Lead Acid Battery Recycling

At first glance, lead acid battery recycling seems like the crowning achievement of the recycling industry. According to trade groups, 99% of all lead acid batteries are safely recycled — making them the most recycled consumer product in America.

But when you look into *how* some lead batteries are recycled, problems start to crop up.
In many countries, unregulated small businesses recycle the lead in unsafe and polluting ways. The consequences may be greater than we had previously estimated.

According to a report from UNICEF, "children around the world are being poisoned by lead on a massive and previously unrecognized scale." One in three children — around 800 million children globally — have blood lead levels associated with developmental issues such as decreased intelligence and learning problems.
The report cites the "unsound recycling of used lead-acid batteries" as one of the most concerning sources of the lead exposure.

Of course, we shouldn't stop recycling lead batteries. But we need to recycle them better at a global scale. The public health consequences are enormous.

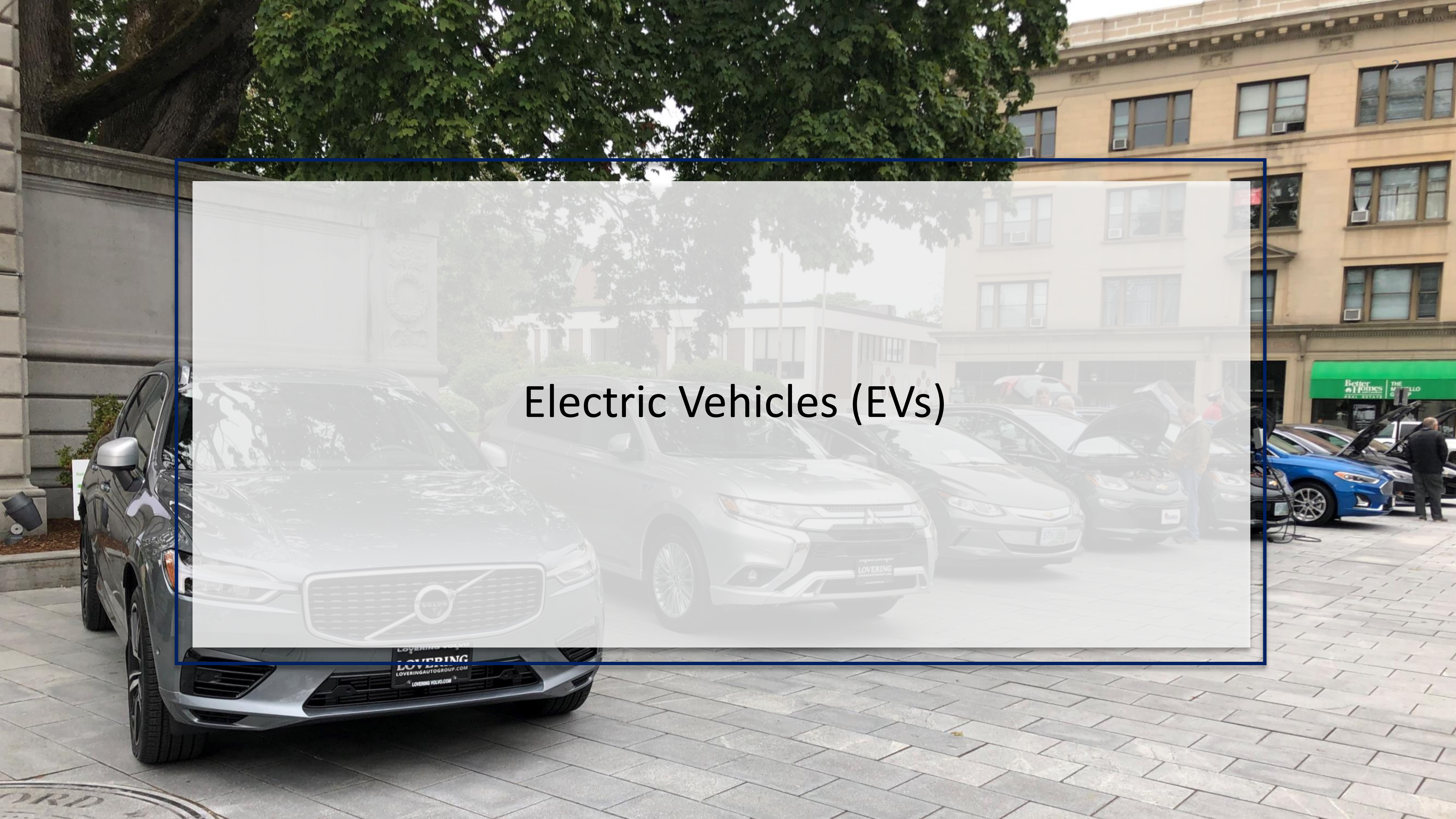
4 Easy Ways to Recycle Lead Acid Batteries - Footprint Hero

https://footprinthero.com/how-to-recycle-lead-acid-batteries

Electric Vehicle (EV) & EV Charging Overview

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Electric Vehicles (EVs)



Types of Electric Vehicles (EVs)

Battery Electric Vehicles (BEVs) powered solely by an electric battery (aka all-electric)

Plug-in Hybrid Electric Vehicles (PHEVs) powered by a combination of an electric motor and a gasoline engine

Both BEVs and PHEVs are considered Plug-in Electric Vehicles (PEVs) and require electricity to charge (or “fuel”) the electric battery.

Benefits of EVs

Environmental Benefits

- Reduced emissions of NOx, greenhouse gases, and other pollutants
- Key strategy for integrating renewables into transportation
- EVs are quieter than gasoline-powered vehicles

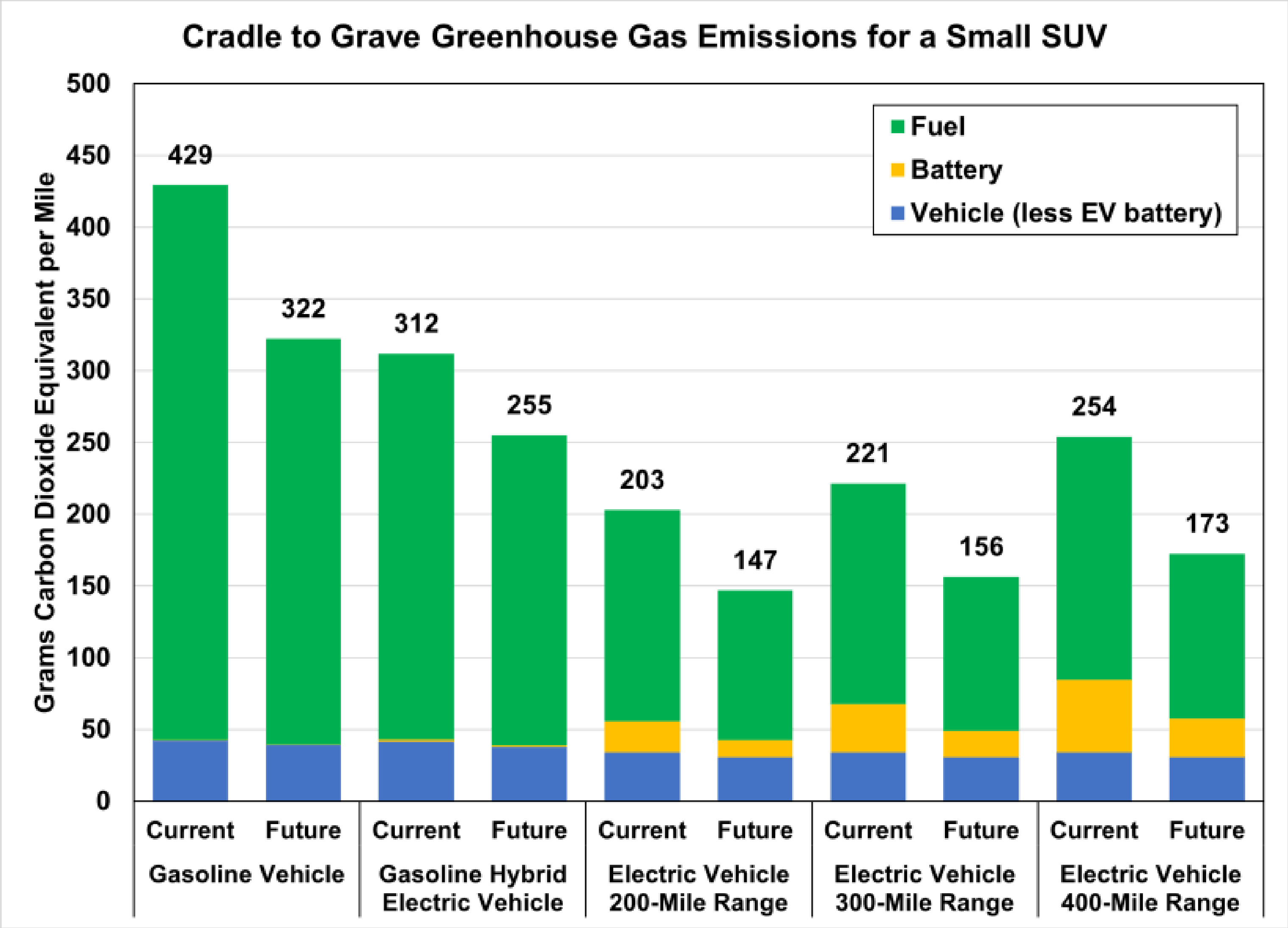
Consumer Benefits

- EVs are fun to drive
- Cheaper to fuel and maintain
- Convenience of charging overnight at home

Vehicle	Annual Fuel Use	Annual Electricity Use	Annual Fuel/Elec Cost	Annual Operating Cost	Cost Per Mile	Annual Emissions (lbs CO2)
2023 Ford F-150 Lightning 4WD EV	0 gal	5,618 kWh	$1,116	$3,221	$0.27	2,131
2023 Ford F150 Pickup 4WD Gasoline	600 gal	0 kWh	$2,213	$4,471	$0.37	14,397

Source: https://afdc.energy.gov/calc/

EV VS. ICE


Cradle to Grave Greenhouse Gas Emissions for a Small SUV
Grams Carbon Dioxide Equivalent per Mile
500
450
400
350
300
250
200
150
100
50
0
Fuel
Battery
Vehicle (less EV battery)
429
322
312
255
203
147
221
156
254
173
Current
Future
Gasoline Vehicle
Current
Future
Gasoline Hybrid Electric Vehicle
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Electric Vehicle 200-Mile Range
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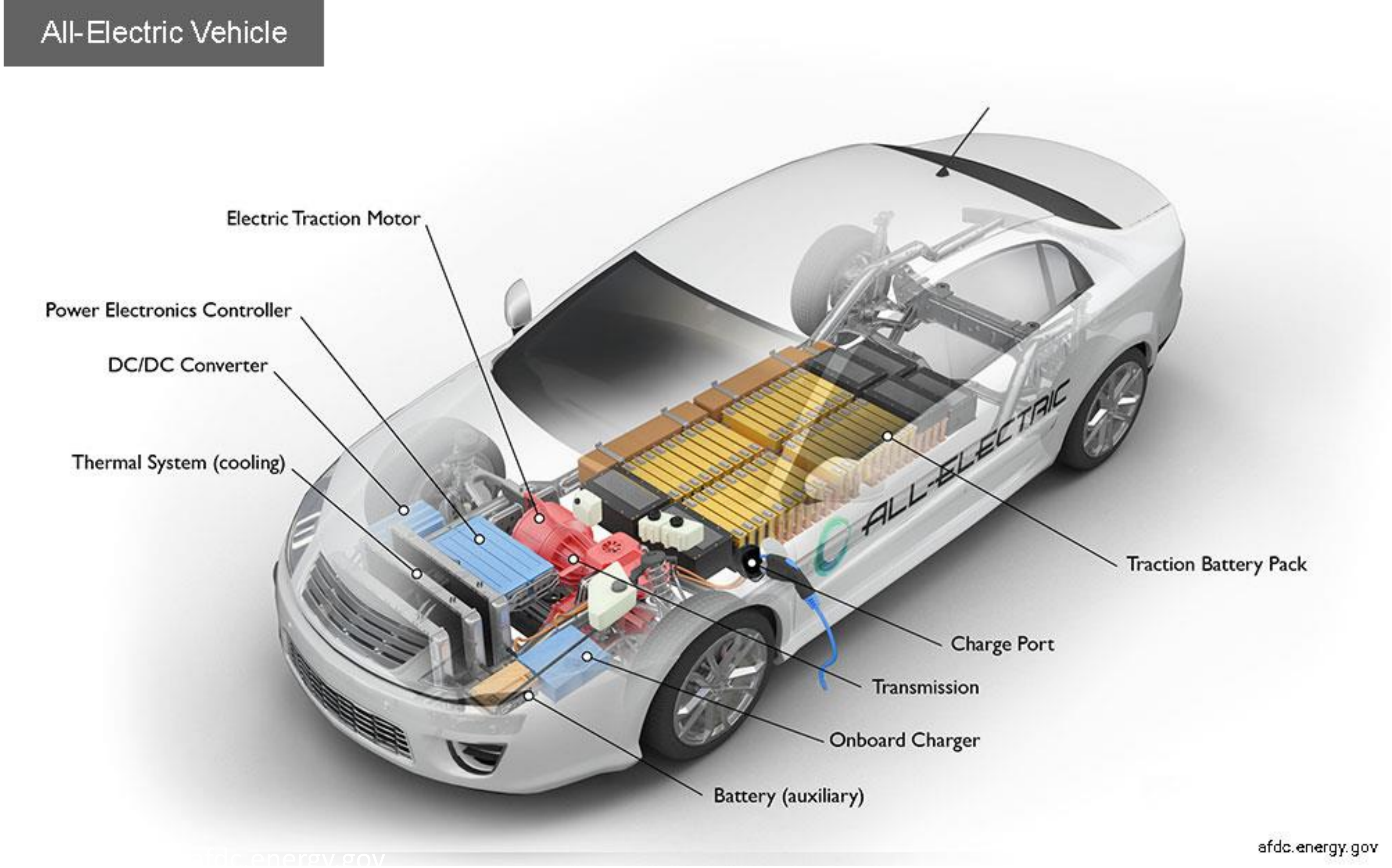
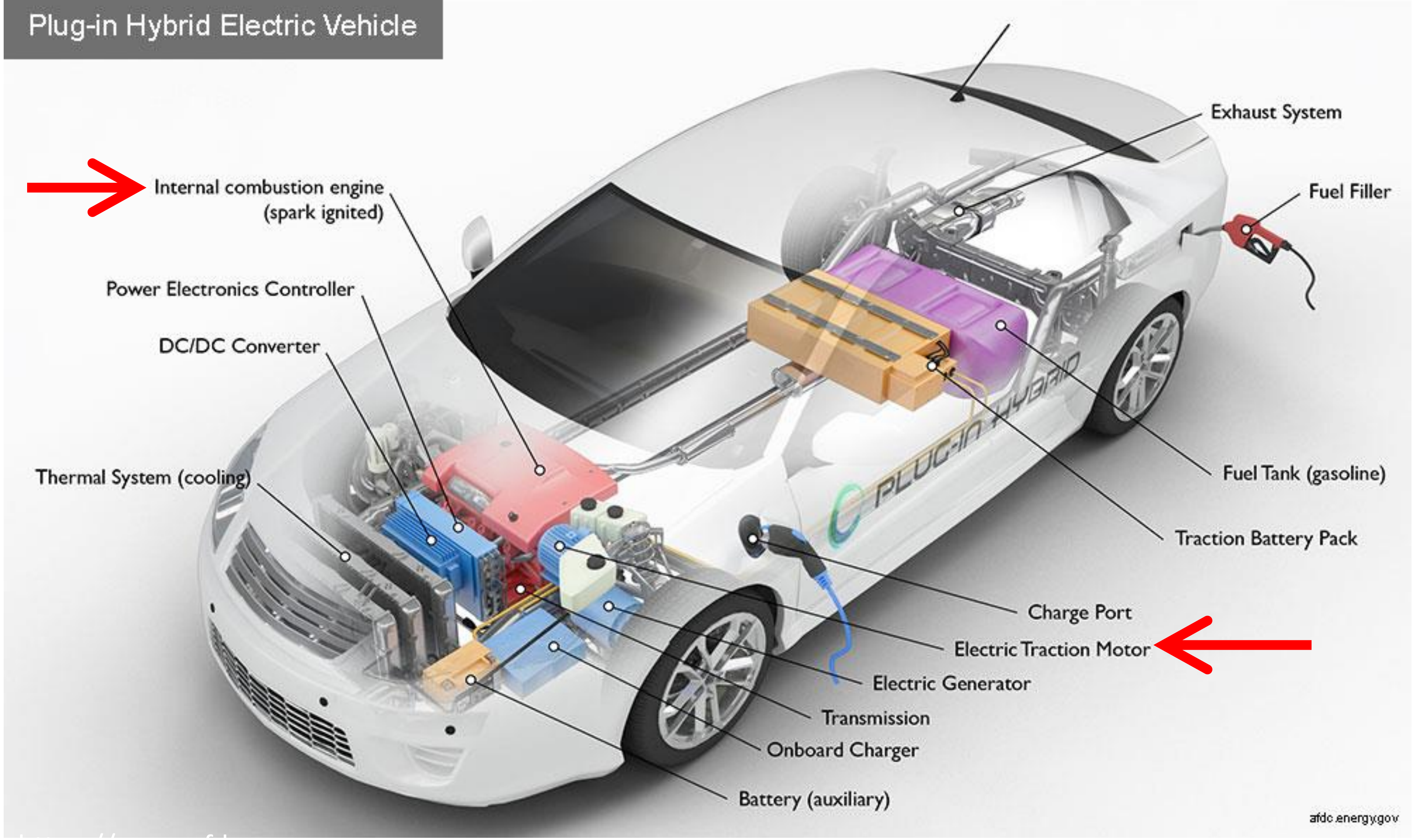
Future
Electric Vehicle 400-Mile Range



70 – 500+ miles of range

Dozens of EV models available



15 – 60+ miles just on electric

Over 50 miles per gallon

Conventional engine for longer trips





Mainstream Automakers are investing in electrification

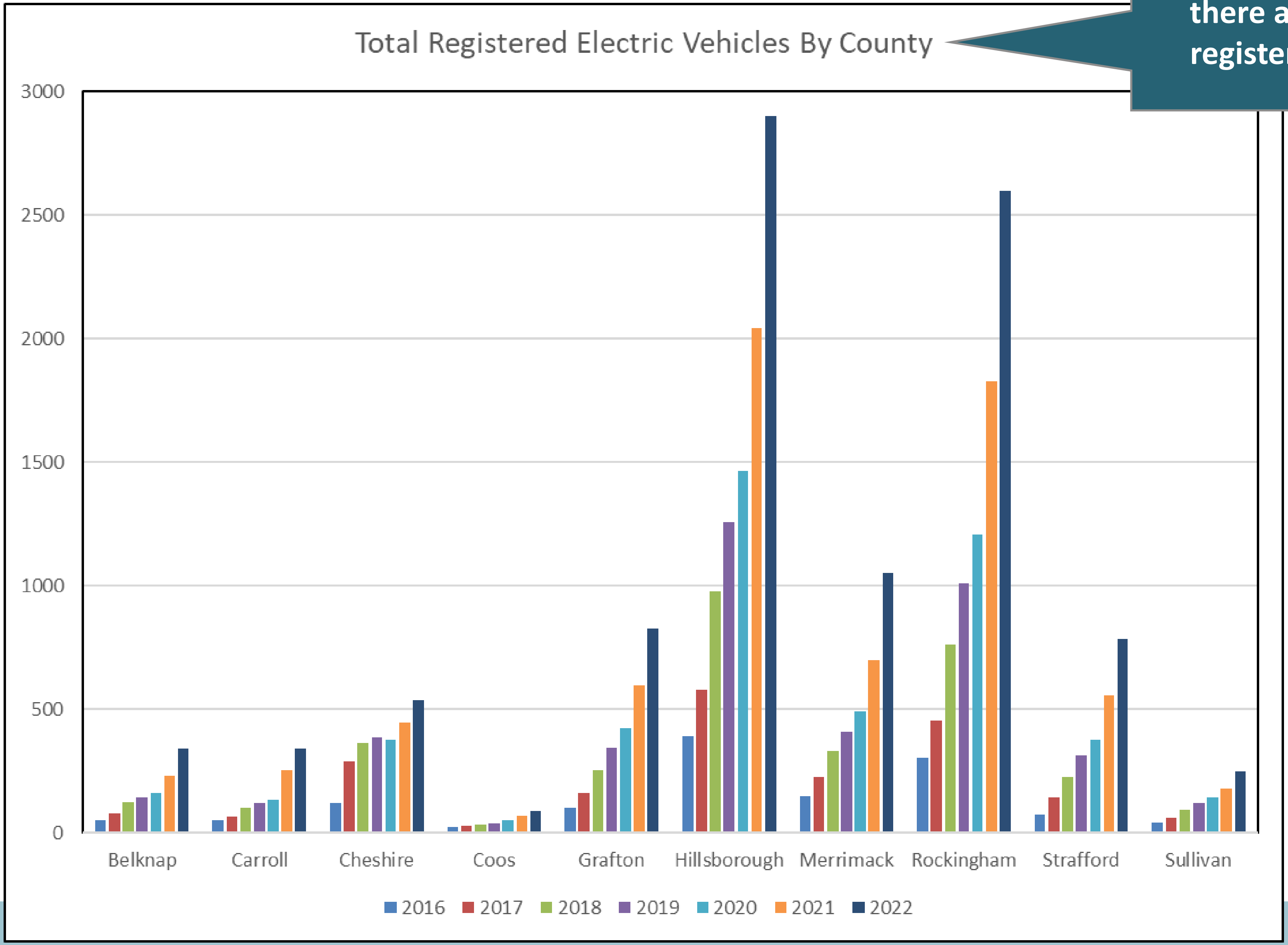
Today, there are 60+ different models of EVs available in the Northeast alone – and more on the way!

https://driveelectricus.com/explore-electric-cars/?





The Market is Growing



Per a recent analysis of DMV registration data there are over 9,700 registered EVs in NH

EVSE: Charging Infrastructure

Types of Charging

Level 1

2 to 5 miles of range per hour of charging

Standard 120v AC Wall Outlet

1.4 kW – 2.4 kW

Level 1 Charging

Level 1 Charging - Standard House Outlet

Level 2 (J1772)

10 to 25 miles of range per hour of charging

Requires 240v outlet and dedicated 40 amp circuit – the same kind used by a clothes drier or stove

3 kW to 19 kW (Avg 9.6 kW)

Level 2 Charging

ChargePoint/Coulomb Level 2 Charging Station

DCFC

60 to 80 miles of range per 20 minutes of charging*

Requires three-phase 480v AC electric circuit

Needs to be mounted on an equipment pad

50 kW – 150 kW – 350 kW

DC Fast Charging

Blink DC Fast Charge Station
photo by ECOtality

DC Fast Chargers

DCFCs range from 50 to 350 kilowatts

There are three different plug types that are used by different vehicle manufacturers:

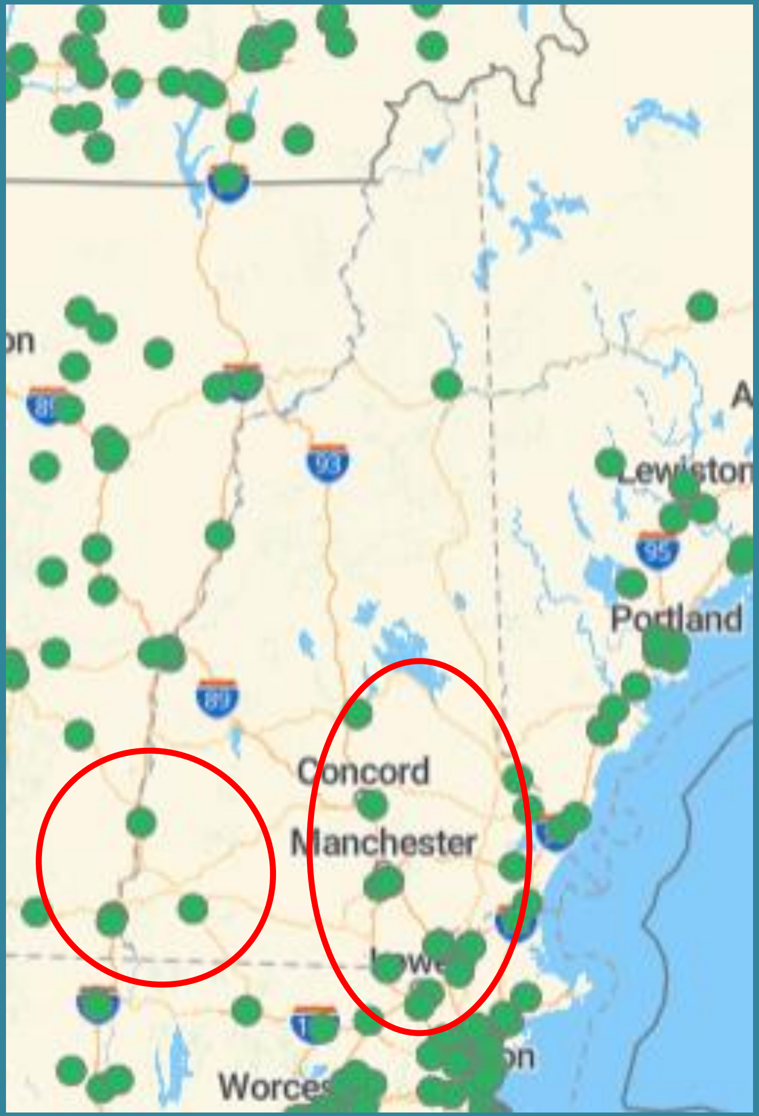
- SAE Combined Charging System (e.g., BMW, GM, VW)
- CHAdeMO (e.g., Nissan, Mitsubishi)
- Tesla (currently proprietary to Tesla, but several OEMs are adopting Tesla's North American Charging Standard)

Most new non-Tesla chargers come equipped with both SAE CCS and CHAdeMO plugs.

Learn more → USDOE Resource EV Charger Selection Guide: https://afdc.energy.gov/files/u/publication/EV_Charger_Selection_Guide_2018-01-112.pdf

*__Note__: Most existing DCFC stations are 50kW, however, new 350kW DCFC are capable of delivering 200 miles of range in 10 minutes.

DCFC Infrastructure in NH



Current data as of 08/31/2023

Source: https://afdc.energy.gov/stations/#/find/nearest

DCFC delivers the fastest charge for EV drivers, which:

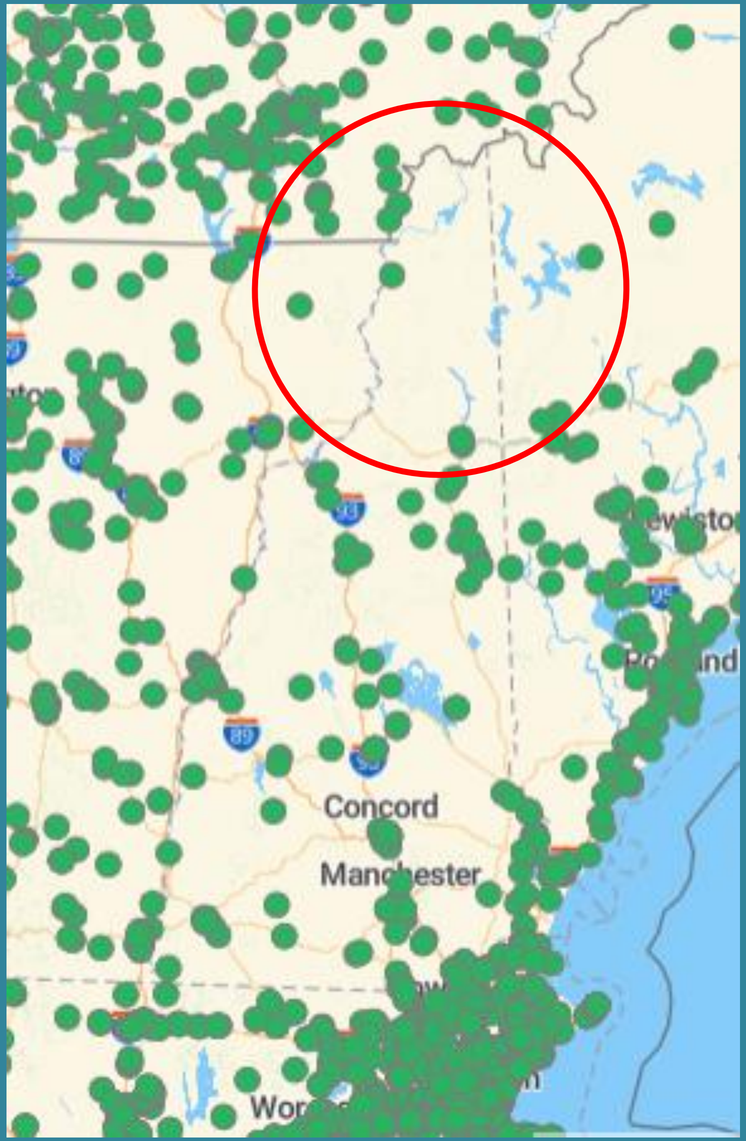
- facilitates long distance travel,
- provides an alternative to home charging, and
- allows drivers to "top off"

There are currently **26 universal DCFC locations** (*39 including Tesla*) in New Hampshire, and over 7,000 universal DCFC locations in the US, with billions of dollars of planned investment.

For reference, DCFC infrastructure in neighboring states:

- Vermont – 44 locations
- Maine – 59 locations
- Massachusetts – 110 locations

Public Level 2 EVSE in NH



Current data as of 08/31/2023

Source: https://afdc.energy.gov/stations/#/find/nearest

There are currently **156 Level 2 charging locations in NH** (*not including Tesla*).

Charging in neighboring states:

- Vermont – 275 locations
- Maine – 332 locations
- Massachusetts – 2,500 locations

EVSE Cost & Project Considerations

Equipment

Level 1*
$700 - $900

Level 2
$1,400 - $4,100

DCFC
$28,400 - $140,000

*Most EVs come with a Level 1 charger

Installation

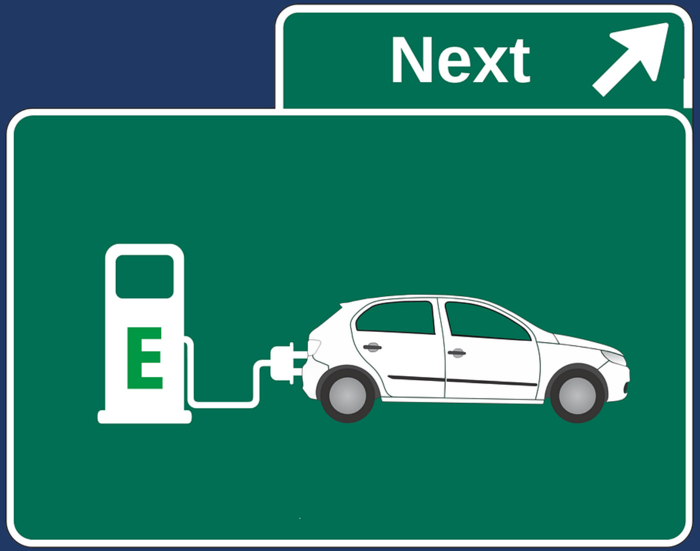
Level 1
$400 - $600

Level 2
$680 - $3,300

DCFC
$18,000 - $66,000

Networking

- Select hardware that uses the Open Charge Point Protocol (OCPP) version 1.6 or higher
- Access to a wired or wireless internet connection or cellular service



Questions?

Jessica Wilcox, Mobile Sources Supervisor
Email: Jessica.Wilcox@des.nh.gov

Thank you for the opportunity to talk a few weeks about the opportunity to speak before the Committee to Study Electrical Vehicle Charging for Residential Renters on September 12th. Unfortunately, New Hampshire Electric Cooperative is not going to be able to participate in tomorrow's committee meeting due to some scheduling challenges on our end.

I am happy, however, to provide a few broad thoughts which I hope are helpful.

1. Any effort to require substantially more residential units in New Hampshire to offer EV charging is obviously going to require infrastructure investments by the utilities which service New Hampshire residents.
2. It's hard for us to know what percentage of our members are renters, let alone whether they are long term renters (1+ year) or short-term (less than 30 days).
3. It's also important to recognize that New Hampshire Electric Cooperative is primarily involved in only one aspect of electrical utilities: distribution. We are not involved (with a few minor exceptions) in transmission or generation.
4. As a result, it's not easy from our perspective to answer the question about how much investment would be required for electrical generation, transmission, and distribution if a certain percentage of rental units offered EV charging.

We can offer additional assistance if the committee has more specific information requests. Thanks for your interest in the NH Electric Cooperative and best of luck with this work.

Regards,
Michael

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