State of Vermont

National Electric Vehicle Infrastructure Plan

Vermont Agency of Transportation

August 1, 2022

VERMONT

Contents

Introduction

The State of Vermont has ambitious goals to reduce greenhouse gas emissions from the transportation sector and transition much of Vermont's motor vehicle fleet to use electricity as a source of energy. These goals are detailed in the 2021 Vermont Climate Action Plan as well as climate action plans developed by local and regional partners across the state. The Climate Action Plan includes a priority of developing electric vehicle charging infrastructure to support transportation electrification.

As of January 2022, there were about 6,600 plug-in passenger cars in the state, or just over 1% of registered vehicles. Most EV owners charge their vehicles at home overnight, but away-from-home charging will be needed to allow longer trips and increase access to EVs for a variety of users. Availability of public charging affects consumer willingness to consider EV purchases, particularly in the case of all-electric vehicles which do not have to option to run on gasoline for extended range as plug-in hybrid electric vehicles do.

This plan is intended to help guide State investments in EV charging infrastructure primarily through the National Electric Vehicle Infrastructure (NEVI) Program, and to research and identify additional policies that may be helpful in achieving the State's EV goals. NEVI guidance requires that this plan be reviewed and updated annually to reflect lessons learned, rapidly changing conditions, new priorities and refined strategies.

The Vermont Agency of Transportation (VTrans) led the development of this initial plan with support from an interagency work group of State agencies involved in transportation electrification, assistance from the Vermont Energy Investment Corporation (VEIC), coordinators of the Drive Electric Vermont program, and feedback from many stakeholders.

The document builds on several Vermont studies and other EVSE-related activities:

- 2021 Vermont Climate Action Plan
- VTrans 2014 EVSE Plan
- VTrans 2017 DC Fast Charging Corridor Study
- State of Vermont EVSE grant programs administered by the Vermont Agency of Commerce and Community Development
- Federal alternative fuel corridor designations
- 2018 Multi-State ZEV Action Plan

This plan examines how the State of Vermont can support development of public electric vehicle supply equipment (EVSE, commonly referred to as "charging equipment"), the availability of which is critical to accelerating EV adoption in the State and broader region.

Dates of State Plan for Electric Vehicle Infrastructure Deployment Development and Adoption

VTrans anticipates meeting Plan milestones according to the following schedule:

June 2022: Initial Draft Plan reviewed with Joint Office (US DOT and DOE).

August 2022: Initial Plan submitted. Following FHWA approval, VTrans issues solicitation(s) for first year of planned EVSE deployment and upgrades.

Fall 2022: VTrans releases solicitation and selects a consultant to support VTrans with a Public Engagement Plan and help inform second year and beyond.

Winter 2022: Contracting for first round of funding is finalized.

Spring 2023: Installations begin with 2023 construction season.

Summer 2023: Annual plan is reviewed, revised and submitted to FHWA for approval.

The Agency intends to follow a rolling, iterative process of learning and planning for the NEVI program, continuously applying new lessons to future rounds of implementation. Given the many uncertainties surrounding the NEVI Program—the impact of increased demand for DC fast chargers nationwide, supply chain issues, the challenging economics of more rural locations, and more—it is likely that VTrans will learn from the first round of solicitations and quite possible these lessons cause the Agency to amend its contracting strategy.

Plan Vision and Goals

The primary purpose of this plan is to develop a deployment strategy for statewide EVSE that will enable EV adoption at levels necessary to meet the State's climate and energy goals identified in the Vermont Climate Action Plan, the Vermont Comprehensive Energy Plan and related legislation, such as the annual State transportation funding bill. It will also be used to meet federal Infrastructure Investment and Jobs Act (IIJA) eligibility requirements—the NEVI Program in particular—to advance availability of IIJA EVSE funding in Vermont, and the equitable distribution of benefits across the state, its diverse populations, communities, workforce, and economy. It is envisioned that public funding for DCFC locations in this plan will help build an accessible, reliable, equitable charging network through public-private partnerships and with increasing levels of private sector support.

Specific goals in the above plans or documents call for an increase in the total registrations of electric vehicles to 27,000 by 2025 and 126,000 by 2030 to meet necessary greenhouse gas emissions reductions. The annual state transportation bill contains goals for siting DCFC (or

Level 3 chargers) within one mile of every interstate exit in Vermont, and within at least 25 miles of the next DCFC on the state highway system. Clearly, these are ambitious targets, but worth striving to meet as quickly as possible. The NEVI program guidance laudably calls for project timeframes of six months or less from procurement to completion. Installations currently underway along Vermont's highway corridors are in some cases almost two years in the making. While many factors contributing to delays are outside the control of state government, others are not. Vermont must continue to learn and do what it can to supply the infrastructure necessary to support these important goals in a timely manner. Therefore, it shall be the goal of this initial plan to obligate all NEVI funding for Federal Fiscal Year 2022 and FFY2023 by the end of Calendar Year 2023 on contracts to install, operate and maintain the required EVSE at all proposed locations, allowing for FHWA to certify "fully built-out" status for the state's existing alternative fuel corridors, however that process might occur.

State Agency Coordination

State agency coordination has defined Vermont's past, present and future approach to building a strong public charging network. Historically, all funding decisions for EVSE have been made through the EVSE interagency workgroup, comprising the Agency of Transportation, the Department of Housing and Community Development (DHCD), the Department of Environmental Conservation- (DEC), and the Department of Public Service (DPS - the state's energy office). Chaired by staff from DHCD, this group has been directly involved in the design of state EVSE grant programs, contracting, and selection decisions, and contributed valuable feedback to the development of this plan. Likewise, a larger, more informal group—the Interagency Climate and Energy Policy Action Committee (ICEPAC)—has heard multiple presentations and provided comment on the plan at various stages. Members of this group include staff from the Department of Public Health, the Agency of Agriculture, which has responsibility for the state's Weights and Measures programs, the new Climate Office within the Agency of Natural Resources, in addition to the core staff from DHCD, DEC, and DPS involved in EVSE planning. Much of the plan relies heavily on the EVSE workgroup's experience with implementation, and many of the key rules proposed by FHWA for operations and maintenance, siting considerations, uptime requirements, data collection and reporting, and more can already be found in past grant agreements.

One requirement in the NEVI guidance that has not been a part of the interagency's adopted guidelines for deployment of fast charging stations is the Buy America provision. In the absence of any proposed waiver process, VTrans will incorporate the Buy America requirements into its contracts, with the selected third parties to assume responsibility for compliance. VTrans had expected more guidance than has been forthcoming, and continues to recommend, however, as it had in response to FHWA's earlier RFI on Buy America, that a nationwide waiver is in order. If it is found that few companies could meet current Buy America requirements, as it now seems—

particularly for DC fast charging stations—VTrans suggests a thoughtful, phased approach to the implementation of Buy America provisions based on feedback provided by industry and state DOTs. The delays that could otherwise arise out of rigid requirements would likely disproportionately impact the disadvantaged rural areas and urban neighborhoods which the IIJA has intended to prioritize. There is a real concern that strict application of Buy America provisions will lead to delayed projects across the country, and specifically leave behind rural areas like those in Vermont whose markets need more public support, as the few companies with compliant EVSE scramble to respond to State DOT solicitations for higher volume, more profitable charging projects. This unintended result of Buy America provisions should be weighed against equally valid concerns raised in the President's various executive orders, Tackling the Climate Crisis at Home and Abroad (EO 14008) and addressing Climate-Related Financial Risk (EO 14030). Future guidance issued on Buy America requirements ought to be clear, consistent, accessible, and achievable so that all relevant parties—State DOTs and EVSE manufacturers and providers—can participate on a level playing field and ensure that the benefits of this once-in-a-lifetime investment are broadly enjoyed by the American public.

Public Engagement

In the context of limited staff time and time generally to conduct meaningful public outreach and engagement, VTrans settled on an approach to its inaugural NEVI plan where most of the public engagement is expected to happen after submitting the initial plan to FHWA. As the first year of NEVI funding is so highly prescribed and it was thought that Vermont could reach "built-out" status after a couple of years, the idea was to gather public input over the course of the next year and beyond to really shape the deployment of funds when much more flexibility will become possible. That public process can itself be funded through the NEVI program and be informed by or coordinated with other parallel and possibly overlapping efforts to develop a Carbon Reduction Strategy, Sustainable Transportation Plan, and Transportation Equity Framework.

In the meantime, VTrans sought to engage with the public and as many groups identified in the guidance as possible to provide input on the plan. Staff, with the support of VEIC, presented Vermont's NEVI planning efforts to multiple meetings of the Transportation Planning Initiative (TPI) which brings staff at the Regional Planning Councils and MPO together to discuss areas of common interest. The RPCs act as conduits between state and local governments, helping to facilitate communication with city and town officials. The VTrans project manager also presented to the legislature and Drive Electric Vermont stakeholder meetings, which are held on a quarterly basis with representatives from industry, advocacy organizations, government officials and electrical utility representatives. In May, the Agency, with the support of partners like VEIC and the Vermont Clean Cities Coalition, held a longer public meeting with polls and breakout rooms for more in-depth comments and to get a better sense of what Vermonters thought

about its NEVI plan goals. There were 130 registrants/participants for the webinar representing a range of the organizations listed below and providing a variety of comments on Vermont's proposed approach. Some questioned the aggressive goal of a fast charger at every interstate exit, and many preferred to see more charging access provided to workplaces and homes in multifamily housing for those residents currently without dedicated charging.

Other forms of engagement included the design of a **webpage for the NEVI program** with a contact form for public comments. This was used primarily by private industry representatives to provide thoughts on how Vermont should or could deploy NEVI funding more effectively. Many more valuable insights came through one-on-one meetings, whether with state agency staff, private sector EV charging providers, gas station/convenience store owners, utilities or community-based organizations. Below are the parties VTrans and its team were able to engage in discussions about the NEVI program. This plan acknowledges its own shortcomings in reaching those who are the focus of the Biden Administration's Justice40 initiative, and recognizes that it will require external support for the Agency to design an extended public engagement process to inform future updates.

- Metropolitan Planning Organizations and Regional Transportation Planning Organizations;
- Counties and cities, including coordination with existing EV charging programs;
- State departments of energy, including Clean Cities Coalitions, as applicable;
- State environmental protection agencies;
- State economic development agencies;
- State public utility commissions;
- State weights and measurement agencies;
- State and Federal land management agencies;
- State public transportation agencies;
- Electric utilities and transmission and distribution owners and regulators;
- **Community-based organizations**, small business associations, Chambers of Commerce; **labor organizations**, and private entities; and
- Private sector EV charging station owners and network operators;
- Investors in EV charging infrastructure;
- Vehicle manufacturers;
- Utilities;
- **Environmental justice, equity, and other community advocacy organizations with an interest in EV charging**;
- EV industry organizations and EV advocacy groups, as applicable;
- Gas station owners and operators;
- **Ride-share drivers/taxi drivers.**

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Introduction to EVs and Charging

Benefits of Transportation Electrification

Transitioning Vermont drivers to plug-in electric vehicles (EVs) offers many collective and individual benefits, including:

- Significant reductions of greenhouse gases (GHG) and other harmful vehicle emissions;
- Drastic improvements in vehicle energy efficiency;
- Cost savings on fuel and maintenance that can reduce household transportation expenditures by more than 50%;
- A better driving experience with quiet operation and great performance; and
- Opportunities to support home and community electric grid resilience and maximize grid infrastructure investments with off-peak charging and other developing technologies.

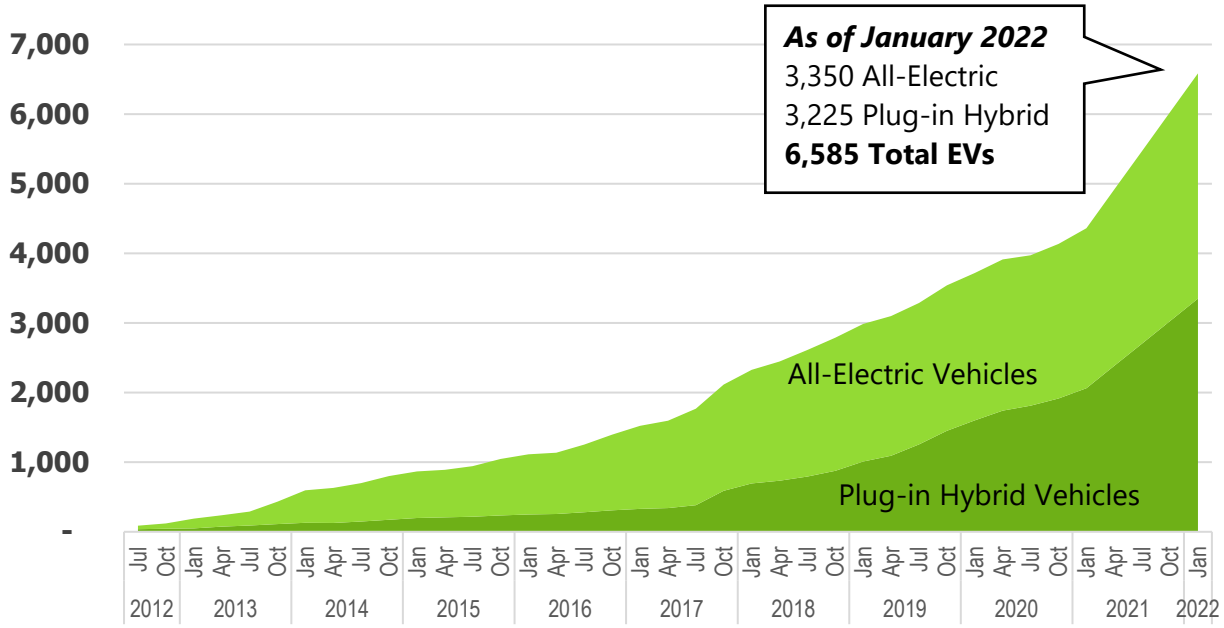
Types Of EVs

Light-duty plug-in electric vehicles fall into two main categories – all-electric vehicles (AEV), and plug-in hybrid electric vehicles (PHEV). Electric vehicles have roots in the early stages of automobile development, but did not receive serious interest from modern automobile manufacturers until the 1970s energy crisis. More viable commercial options began to appear around 2010, and the commercial availability of new vehicles in both categories has grown significantly since that time, driven by significant advances in battery technology, increased concerns about oil prices and supply, interest in reducing transportation greenhouse gas emissions, and the driving performance of EV models.

Since 2010, over 2.3 million AEVs and PHEVs have been sold in the United States. In the first half of 2021, they represented 2.4% of all new-vehicle registrations. Nearly every major automobile manufacturer in the world is focusing future production on AEVs and PHEVs (see *Current EV Trends),* and they are quickly approaching mainstream adoption.

In Vermont, EV market share has reached about 5% of new vehicle sales as of early 2022 and the State has 6,585 EV registrations across 70 unique models. Figure 1 below illustrates the growth in Vermont EV registrations over the past 10 years.

Figure 1. Vermont Electric Vehicle Registrations[1]



All-Electric Vehicles

All-Electric Vehicles (AEVs) are powered exclusively by an electric powertrain. Equipped with significantly larger batteries than PHEVs, AEVs offer a greater range between charges. An important benefit of AEVs, over both conventional gasoline-powered vehicles and PHEVs, is lower maintenance costs due to the absence of many components related to internal combustion engines. A recent study found that scheduled maintenance costs for AEVs are 40% lower than for conventional gasoline-powered vehicles.[2]

As of late 2021, there were 19 AEV models available in the US market, from both traditional automobile manufacturers (Hyundai, Audi, Nissan, Chevy, Volvo, Mini, Porsche, Jaguar, Ford, Kia, BMW) and new AEV-only manufacturers (Tesla, Polestar, Rivian). Tesla has long been the leading seller of AEVs, with over 2/3 of AEVs sold since 2018, but its market share has recently declined with the proliferation of competing options.

[1] VT Dept of Environmental Conservation / VEIC. EV registrations from Vermont Dept of Motor Vehicles registration database as of January 5, 2022.

[2] US DOE, 2021. Vehicle Technologies Office. https://www.energy.gov/eere/vehicles/articles/fotw-1190-june-14-2021-battery-electric-vehicles-have-lower-scheduled

Table 1. Commercially Available New AEVs in the US, 2021[3]

	Highest Spec	Lowest Spec
Battery Range	405 miles	110 miles
Battery Size	100 kWh	33 kWh
Efficiency	4.8 miles / kWh	2.6 miles / kWh
Price (MSRP)	$130,000+	$30,750

Plug-In Hybrid Electric Vehicles

Plug-in Hybrid Electric Vehicles (PHEVs), have both an electric motor and an internal combustion engine. The primary distinguishing characteristic of PHEVs from other hybrid style is their batteries can be charged by plugging the vehicle in and they can travel from 10-80 miles on the battery before the gasoline engine would need to turn on to provide extended range. The primary benefit of PHEVs is they offer gasoline-independence for relatively short distances while also being suitable for long-distance travel between charges. Due to their ability to run on gasoline, they are especially helpful in areas with limited public charging availability.

As of late 2021, there were over 30 PHEV models available in the US market, from both domestic (Ford, Chrysler, Lincoln) and foreign manufacturers (Hyundai, Kia, Toyota, Porsche, Volvo, Audi, Subaru, BMW, Bentley, Land Rover). Vehicle types range from small sedans to large SUVs, and are available in wide variety of features and price points. The table below summarizes the range of commercially available PHEV in the U.S. in 2021.

Table 2. Commercially Available New PHEVs in the US, 2021[4]

	Highest Spec	Lowest Spec
Battery Range	61 miles	16 miles
Battery Size	28 kWh	8 kWh
Efficiency	3.3 miles / kWh	1.2 miles / kWh
Price (MSRP)	$145,000+	$24,950

[3] EVAdoption.com. BEV Models Available in the USA. Accessed February 2022. https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/
[4] EVAdoption.com. PHEV Models Available in the USA. Accessed February 2022. https://evadoption.com/ev-models/available-phevs/

EV Charging Infrastructure

Current EV charging technologies require a fundamental shift in how EV drivers access energy for their vehicles. Most EV drivers do 80% or more of their charging at home and/or workplaces (when charging is available).[5] These locations offer greater convenience and lower pricing than most public charging options. However, availability of public charging infrastructure is critical to enable longer distance travel and to provide options for people who may not be able to charge up at home. Residential charging can be a challenge for those living in multifamily housing, those in urban areas without a dedicated parking space, and renters, who may be reluctant (or not permitted) to install equipment at a home they do not own.

EV charging is enabled through electric vehicle supply equipment (EVSE), which comes in three distinct levels:

1. **Level 1** – Level 1 charging uses the same 120 volt power found in standard household outlets and can be performed using equipment provided by EV automakers. Making this type of charging available can be as simple as using existing 120 volt outlets within 20 feet of vehicle parking. Level 1 charging typically adds 3-5 miles of range per hour of charging, so it may not be suitable for EV drivers traveling more than 50 miles per day, or those with longer range AEV models. A US Energy Information Administration (EIA) survey estimates about half of homes in New England have access to a 120 volt outlet within 20 ft of where their vehicle is parked.[6]
2. **Level 2** – Level 2 charging uses 240 volt power to enable faster charging, usually offering 10-20 miles of range per hour of charging. Level 2 charging requires installation of an EVSE unit or 240V receptacle a Level 2 EVSE can plug into. One potential barrier to accessing level 2 charging is older homes may not have adequate electric service or panel capacity to support an additional 240V circuit without a load management device or panel upgrade.
3. **DC Fast Charging** – DC fast charging provides compatible vehicles with an 80% charge in 30-60 minutes by converting high voltage AC power to DC power for direct storage in EV batteries. This higher-powered charging is much more expensive to install and operate, so fees associated with use tend to be much higher than what EV drivers might pay for home charging.

Figure 2 and Figure 3 below shows how types of EVSE differ and includes illustrations of the various plug shapes. All automakers except Tesla have standardized to use the Society of Automotive Engineers (SAE) J-1772 plug connector for Level 1 and 2 charging. Tesla uses their

[5] NREL. National Plug-in Electric Vehicle Infrastructure Analysis. Sept 2017. https://www.nrel.gov/docs/fy17osti/69031.pdf
[6] US EIA. 2015 Residential Energy Consumption Survey (RECS). May 2018. https://www.eia.gov/consumption/residential/data/2015/hc/php/hc2.7.php

own proprietary plug design, but they do have adapters available for Tesla drivers to plug into J-1772 equipment.

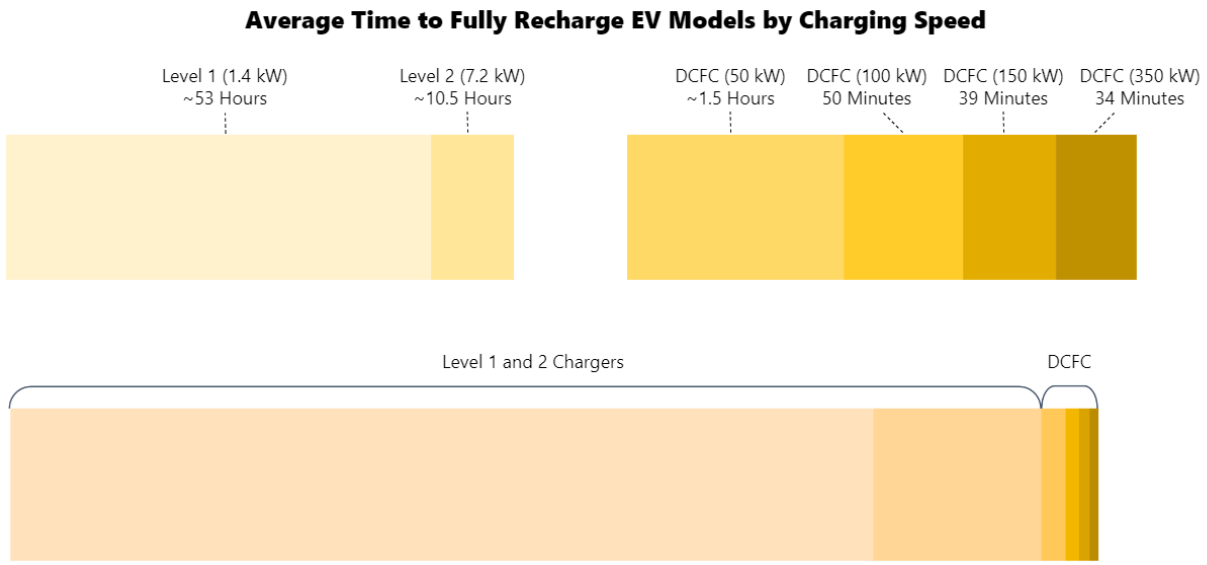


Figure 2. Time to fully recharge EV models by charger capacity. Recharge time is based off the average battery size of new model battery electric vehicles. Time estimates do not include tapering charge.

For fast charging, most automakers use a variation on the J-1772 connector called the SAE combined charging system (CCS). Nissan and Mitsubishi have used a different fast charging standard called CHAdeMO, but Nissan has indicated future vehicles will be moving to the SAE CCS standard for fast charging. Tesla also has an adaptor that allows drivers to use CHAdeMO equipme`nt and they have announced a SAE CCS adapter expected to be available in the near future. Importantly, there are no adapters available now that would allow non-Tesla drivers to access Tesla fast charging locations - commonly referred to as Superchargers. Tesla has suggested they will open their network to other EV owners in the future, and has started to pilot this capability in Europe. Future updates to this plan will consider availability of any Tesla infrastructure available to other drivers in Vermont.

Figure 3. Electric Vehicle Charging and Plug Types

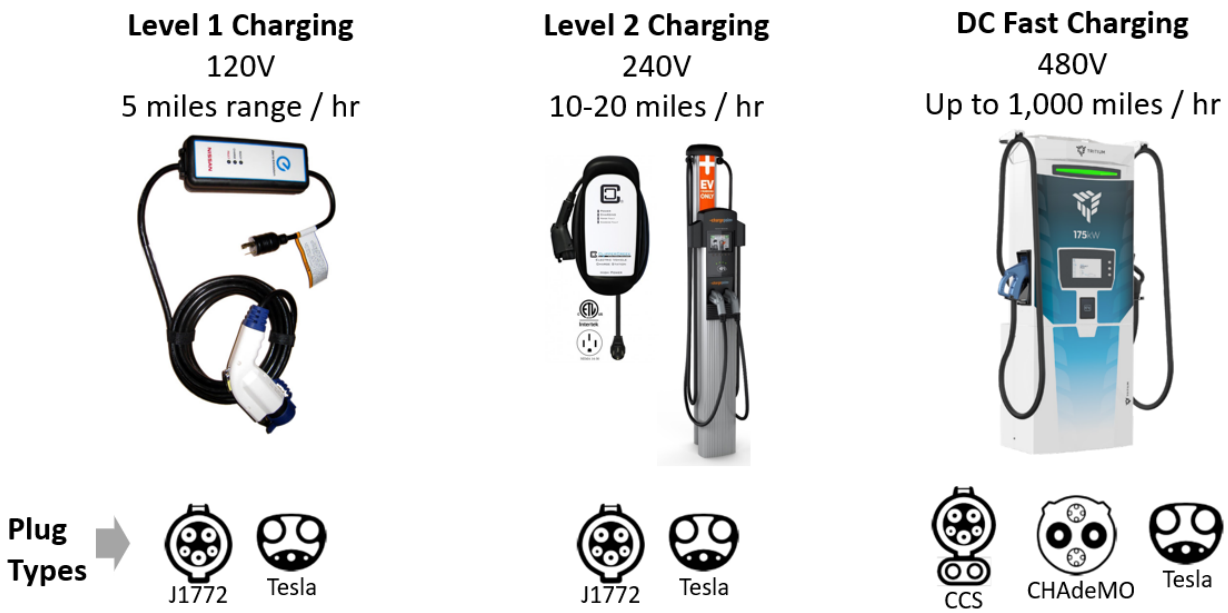


Table 3. Approximate EVSE Installation Costs

Charger Type	Labor & Supplies	EVSE Equipment	Total Cost per Port
Level 1	$200-450	$30-900	*$230 – 1,350*
Level 2	$2,000 - 12,000	$600 - $9,000	*$2,600 – 21,000*
DCFC - 50 kW	$10,000 – 25,000	$20,000 – 60,000	*$30,000 – 85,000*
DCFC - 150 kW	$15,000 - $100,000+	$75,000+	*$90,000+*
DCFC - 350 kW	$20,000 – 100,000+	$125,000+	*$145,000+*

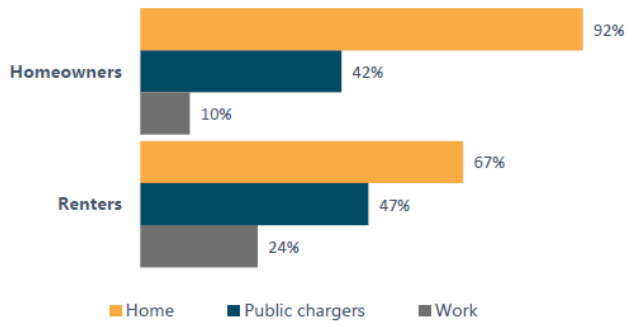
Vermont Charging Usage

In Vermont, a recent survey of recipients of the state's incentive for new plug-in electric vehicle (PEV) purchases revealed information on charging patterns across the state. The results highlighted important differences between the experience of homeowners and renters who own EVs. [7]

Consistent with national trends, most respondents to the survey charged their vehicles at home. However, while more than 92% of homeowners charged at home, the figure for renters was much lower, at 67%. Renters were much more likely to charge at work, while the rate of public charger usage was nearly identical for renters and homeowners.

[7] VEIC. Vermont PEV Recipients Survey. March 2022.

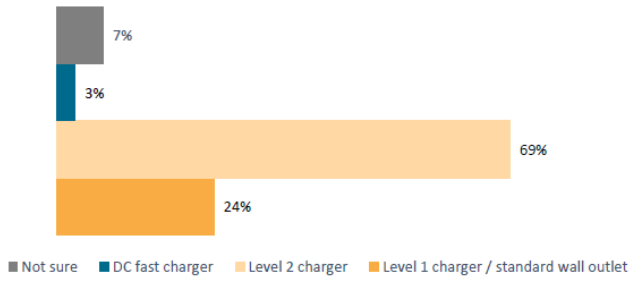
Q15 | Where do you charge your [*Car Model*]? Please select all that apply.



The survey found significant differences in the type of chargers used at work, home, and at public charging stations. At home, renters were much less likely to use Level 2 chargers (38%) than homeowners (62%), and more likely to use slower Level 1 charging. While rates of Level 2 charging at work were nearly identical for renters (70%) and homeowners (67%), renters were less likely to use DC fast chargers at work (48%) than homeowners (66%).

The survey also revealed that the vast majority of Vermont EV incentive recipients used Level 1 or Level 2 chargers at public charging stations. Only 3% of respondents reported using a DC fast charger at a public charging station. As introduced above, DC fast charging is important to facilitate long-distance travel with EVs, and to supplement home charging needs.

Q21 | [If charge at public] What type(s) of charger do you use at *public charging stations*?



	%
Level 1 charger / standard wall outlet	24%
Level 2 charger	69%
DC fast charger	3%
Not sure	7%

Vermont's EV Future

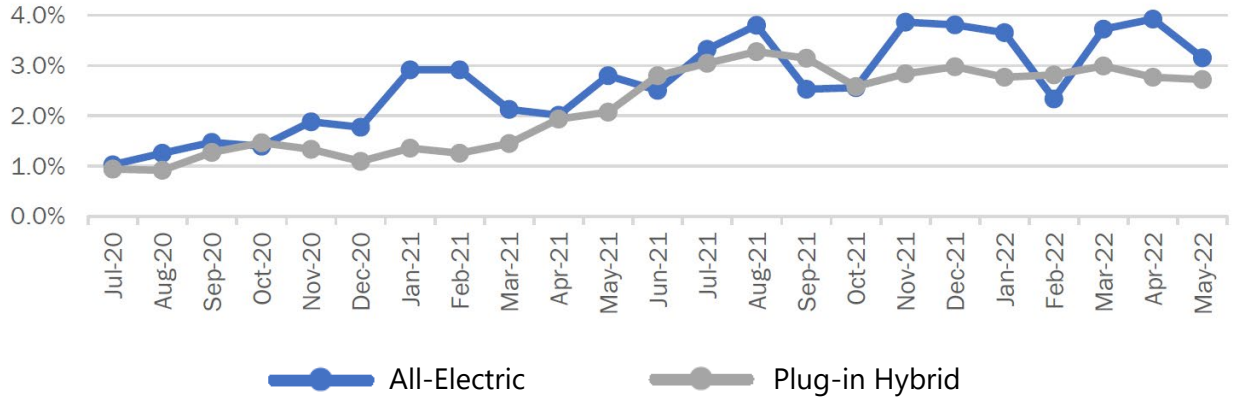
Current EV Market Trends

Vermont participates in the California-led Zero Emission Vehicle (ZEV) program enabled through Section 177 of the federal Clean Air Act. This requires auto manufacturers to sell in increasing shares of EVs over time as the "technology forcing" regulation grows increasingly stringent.

Many automakers are also making significant investments and setting their own goals for electrification of their new vehicles, with most calling for at least half of new sales to be electrified by 2030. This could include all-electric, plug-in hybrid, or in some cases conventional non-plug-in hybrid options.

Vermonters have already demonstrated significant interest in EV purchases as EV share of new vehicle purchases in the state is already a bit over 6% market share as of May 2022. Figure 4 below illustrates market share data over the past two years, as reported by the Vermont Auto Dealers Association. Introductions of several new EV models over the past few years has supported this interest. Recent EV market research undertaken by Efficiency Vermont found approximately 40% of Vermonters were interested in purchasing an EV for their next vehicle, particularly if incentives and charging infrastructure were available to support them.[8]

Figure 4. Vermont EV Market Share, by Type[9]



EV Forecasts

Forecasts of Vermont EV adoption are impacted by many factors, including availability of new EVs from automakers meeting consumer preferences (e.g. all-wheel drive, higher ground clearance, long range, fast charging, etc), supply of used EVs to Vermonters, pricing of EVs, fuel prices, incentive availability, charging availability, auto dealer ability to sell EVs, ZEV regulations,

[8] Efficiency Vermont. Are Vermonters Ready to Drive Electric? Nov 2021. https://www.efficiencyvermont.com/online-trainings/are-vermonters-ready-to-drive-electric

[9] Vermont Vehicle and Automotive Distributors Association. Vermont Auto Outlook. June 2022.

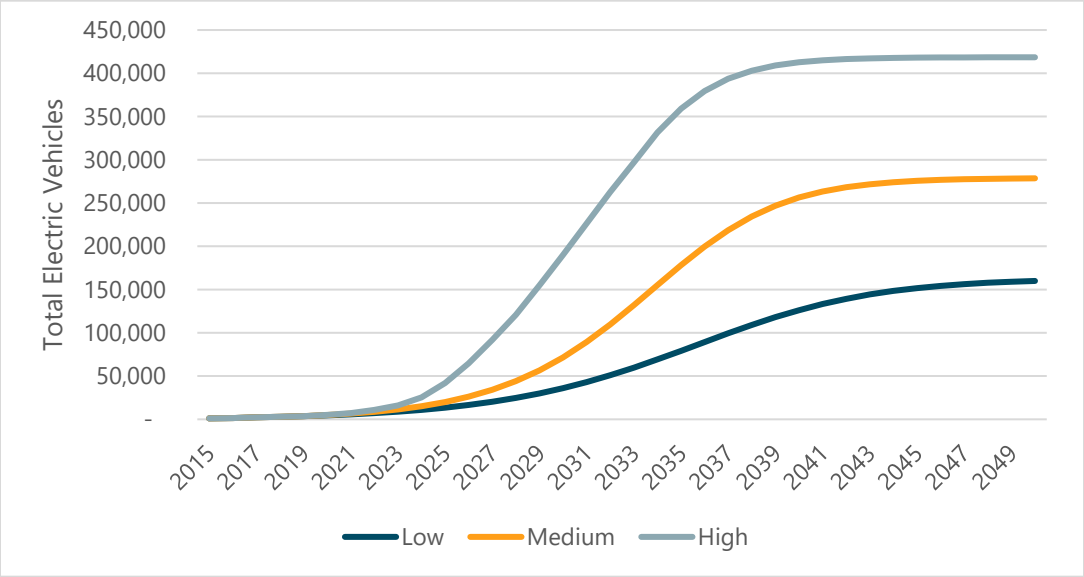
and broad economic factors. Accurate predictions of these factors is very challenging, especially in the current market conditions where ongoing supply chain issues due to COVID, a widespread shortage of microchips used in new vehicles and other factors has led to shortages of vehicles and long wait times for many new EV options.

Recent estimates of EV adoption developed for VELCO's long range transmission plan considered three distinct scenarios for EV adoption based on assumptions regarding EV market growth over time. Table 4 and Figure 4 below summarize the results of this work.

Table 4. Vermont Light Duty Vehicle EV Forecast Scenarios - Total EVs Registered

Year	Low	Medium	High
2020	4,624	4,941	5,189
2025	13,476	20,007	41,969
2030	36,080	71,624	190,125
2035	79,179	178,162	359,077
2040	126,184	256,417	412,689
2045	151,678	275,702	418,038
2050	159,931	278,561	418,464

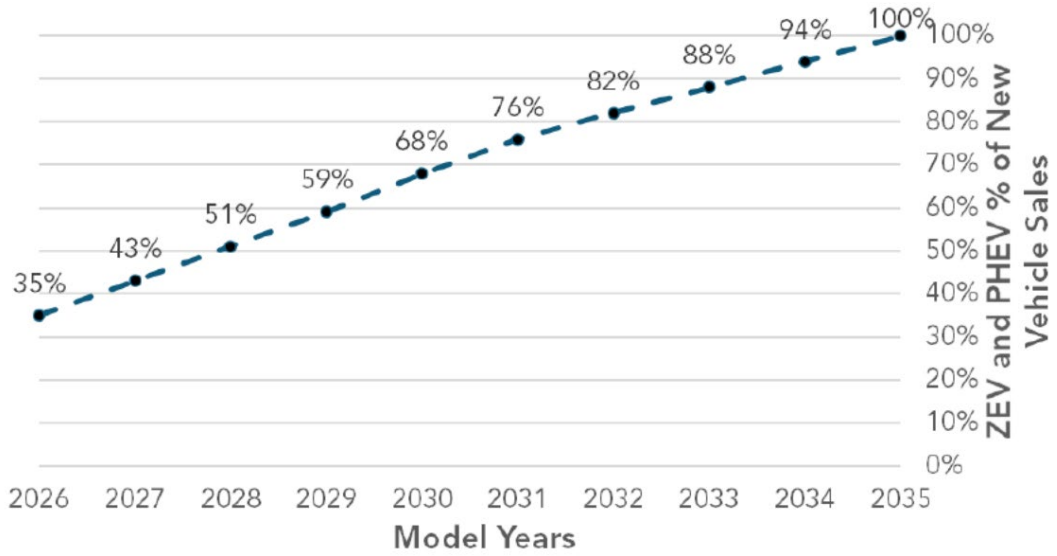
Figure 5. Vermont Light Duty Vehicle EV Registration Forecasts – Total EVs Registered



The State of Vermont Agency of Natural Resources has drafted estimates of EV market share associated with Vermont's continued participation in the California-led Zero Emission Vehicle (ZEV) program through the Advanced Clean Cars II and Advanced Clean Trucks rulemaking now underway. As Figure 6 below shows, if these rules are finalized as proposed it will significantly

advance automaker EV sales requirements, with 100% EV sales in 2035, including all-electric and PHEV options.

Figure 6. Potential EV Market Share of New Vehicle Sales[10]



Ongoing work associated with the Vermont Climate Action Plan has also created a clean energy pathways analysis suggesting one approach to meeting the Vermont Global Warming Solutions Act requirements for GHG reductions would need 27,000 EVs by 2025 and 126,000 EVs by 2030, falling between the medium and high adoption forecast scenarios described above.[11]

Future EVSE Requirements

Vermont has relatively good availability of EV charging infrastructure compared to many other states, but there are still significant needs to build-out additional infrastructure to reduce the distance between charging opportunities and increase redundancy.

How much and what type of charging will be needed in the future will need to be revisited frequently in the coming years as market conditions change and new technologies are introduced.

The US Department of Energy and National Renewable Energy Lab (NREL) developed the EVI Pro tool to provide guidance to States on EV charging needs associated with different levels of adoption. VTrans used the EVI-Pro Lite tool to estimate charging needed for the 2025 pathways target of 27,000 EVs in Vermont. Figure 7 below includes the results of this analysis, which

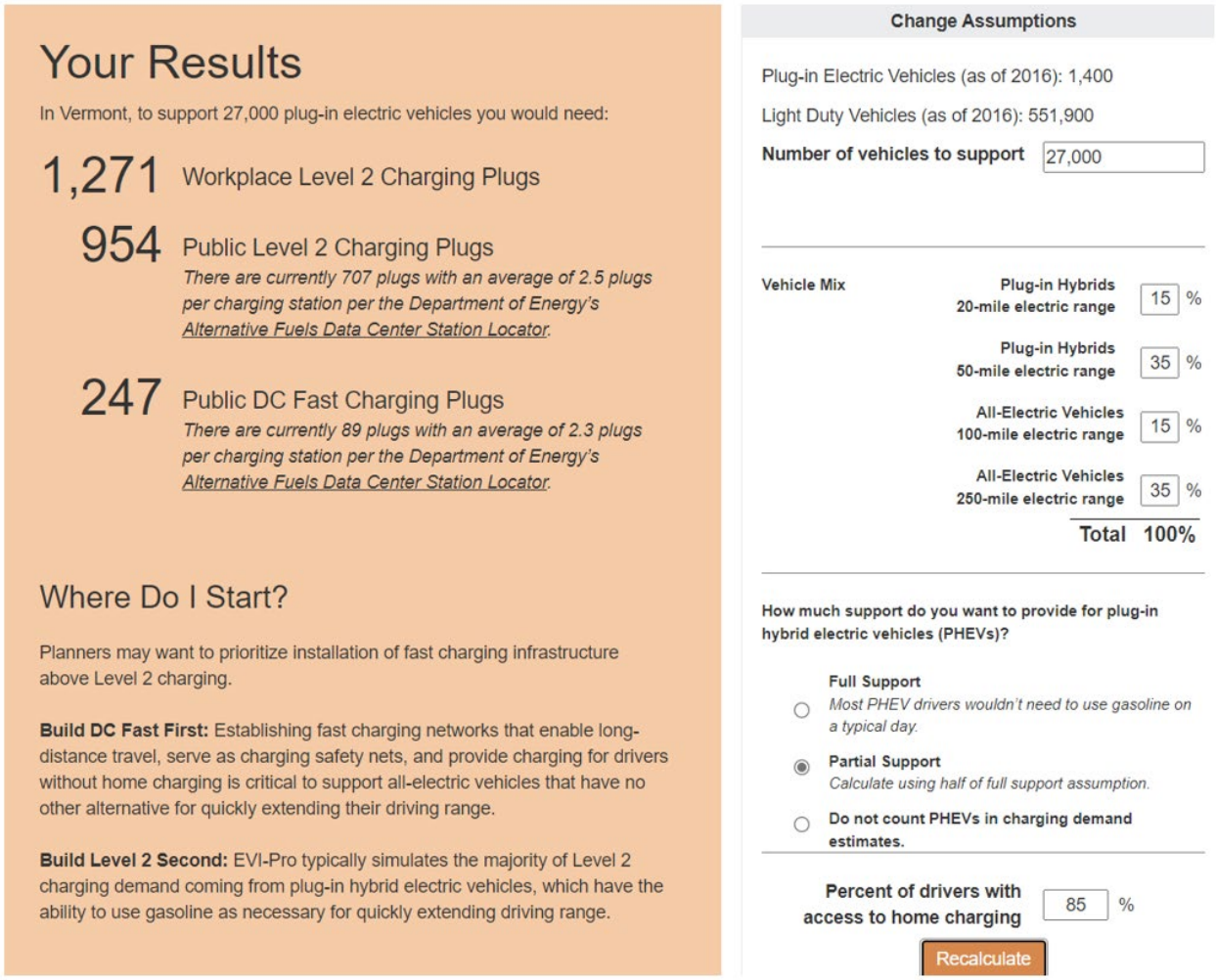
[10] VT ANR. Draft Regulation Summary Document, Advanced Clean Cars II, Advanced Clean Trucks. May 2022. https://climatechange.vermont.gov/node/442

[11] Energy Futures Group. Vermont Pathways Analysis Report 2. Feb 2022. https://climatechange.vermont.gov/node/457

assumed that about half of the EVs in Vermont would be PHEV models and 85% of EV drivers would be able to access charging at home.

Based on this analysis Vermont will need at least another 150 DCFC plugs spread across the state to ensure EV owners are able to travel freely. The significant ramp up in EV adoption after 2025 suggests charging infrastructure development will continue to be a critical need in the future.

Figure 7. Vermont Estimate of 2025 EV Charging Needs[12]



[12] US DOE Alternative Fuels Data Center. EVI-Pro Lite Statewide Analysis. May 2022. https://afdc.energy.gov/evi-pro-lite

EVSE Policy Context

Federal Policy

The recent passage of the Infrastructure Investment and Jobs Act (IIJA) has unlocked over $550 billion in new federal investments for states and local governments to build sustainable and resilient infrastructure. While final numbers are subject to change as guidance is released, Vermont is positioned to directly receive well over $100 million in formula funding over the next five years to put into community development projects with $33 million earmarked to reduce transportation related emissions, $77 million to improve public transportation options across the state, and $21 million to support the expansion of EVSE.[13] These funds are in addition to the $37 million available in funding over the next five years to increase the resilience of the State's transportation system. A summary of the various IIJA funding programs that may be relevant to EVs is included in Table 3 below.

The IIJA includes a carveout for the National Electric Vehicle Infrastructure (NEVI) Formula Program, of which Vermont will receive over $3.1 million in the 2022 fiscal year to directly support EVSE development.[14] These Alternative Fuel Corridor (AFC) Grants provide funding to install EVSE infrastructure along designated corridor-ready roadways. Of note, EVSE projects funded under provisions outlined in 23 U.S. Code on Federal-Aid Highways will be treated as a Federal-aid Highway Program project. This restricts projects that use these funds to non-proprietary equipment of acceptable industry standards that is accessible to all members of the public in forms of payment, convenience, and access.[15] In other words, private business interests that restrict access, such as nonpublic workplaces and housing developments, may not use these funds to support EVSE projects.

The IIJA also includes provisions for several billion dollars to be released through competitive grant programs. In addition to the formula funds for EVSE, states and local governments may apply for an additional pool of $2.5 billion in charging and fueling infrastructure discretionary grants to support the deployment of EVSE. The bill also includes a $15 billion expanded carveout for the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program for surface transportation projects of local or regional significance. For public transit, the IIJA expands Federal Transit Administration's programs for Low- or No-Emission buses and

[13] US Department of Transportation. The Bipartisan Infrastructure Law Will Deliver for Vermont. Jan 2022. https://www.transportation.gov/briefing-room/bipartisan-infrastructure-law-will-deliver-vermont

[14] Federal Highway Administration. President Biden, USDOT and USDOE Announce $5 Billion over Five Years for National EV Charging Network. Feb 2022. https://highways.dot.gov/newsroom/president-biden-usdot-and-usdoe-announce-5-billion-over-five-years-national-ev-charging

[15] US Congress. 23 U.S.C. 109 - Standards. 2019. https://www.govinfo.gov/app/details/USCODE-2019-title23/USCODE-2019-title23-chap1-sec109

infrastructure by over $7.5 billion while communities will be able to access a $23 billion expansion in Capital Investment Grants (CIG) for high-capacity transit projects.

The bill funds several new programs relevant to EVSE. MEGA Projects, those that support cross-cutting, multi-modal and jurisdictional projects of national or regional significance, will have $15 billion in funding through the National Infrastructure Project Assistance grant program, but is unlikely to fund Vermont-based projects. The Carbon Reduction Program will fund a broad range of activities focused on reducing greenhouse gas emissions including transportation alternatives projects supporting public transit, bike and pedestrian infrastructure, LED streetlight replacement projects, transportation demand management programs, public EVSE installations, and replacement of Agency fleet/equipment with electric alternatives. The Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program supplies $7.3 billion in formula funding and $1.4 billion in competitive grants to increase resilience of the transportation system, including funding for evacuation routes and improving infrastructural resilience. An additional $2 billion is earmarked for competitive grants to support rural surface transportation projects that increase connectivity, improve safety and reliability of the movement of people and freight, and generate regional economic growth. A separate $1 billion for the Strengthening Mobility and Revolutionizing Transportation (SMART) competitive grant program will enable states, local governments, and tribes to fund projects that improve transportation safety and efficiency. This funding is in addition to several other programs that will relieve pressure on costly, yet necessary, state infrastructure projects such as the repair and replacement of bridges.

Vermont has also been able to take advantage of other federal programs, such as the Federal Highway Administration's (FHWA) Congestion Mitigation and Air Quality Improvement (CMAQ) Program for alternative fuel vehicle projects. This fund supports publicly owned or leased refueling facilities and infrastructure for EVs where private stations are not reasonably accessible. These stations must also be located along alternative fuel corridors as designated by the FHWA and are also subject to NEPA review.

Table 5. Federal IIJA Potential EV Funding Programs

Program	Type	Funding	Project Eligibility
National Electric Vehicle Infrastructure (NEVI)	Formula	$5 billion *($3.1 million VT allocation for FY 22)*	EVSE infrastructure along designated corridor-ready roadways
	Discretionary	$2.5 billion	
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	Discretionary	$15 billion	Surface transportation projects of local or regional significance
Low- or No-Emission Grant Program	Discretionary	$7.5 billion	Low- or no-emission public transit buses and EVSE
Capital Investment Grants	Discretionary	$23 billion	High-capacity transit projects
National Infrastructure Project Assistance Program	Discretionary	$15 billion	Cross-cutting, multi-modal and jurisdictional projects of national or regional significance
Carbon Reduction Program (CRP)	Formula	$6.4 billion	Wide range of projects reducing GHG emissions from bike/pedestrian/transit infrastructure projects and TDM measures to installation of EVSE and fleet conversions
Rural Surface Transportation Grant Program	Discretionary	$2 billion	Increase resilience of the transportation system, including funding for evacuation routes and improving infrastructure resilience
Strengthening Mobility and Revolutionizing Transportation (SMART)	Discretionary	$1 billion	Projects that improve transportation safety and efficiency
Congestion Mitigation and Air Quality Improvement (CMAQ)	Formula	$13.2 billion	Medium- or heavy-duty zero emission vehicles and EVSE

Alternative Fuel Corridor Funding Eligibility

To receive formula funds from the NEVI program, stations must be located along federally-designated Alternative Fuel Corridors (AFC) and be built out to a specified degree prior to

expanding eligible uses of this funding to other areas beyond these corridors. Since 2016, FHWA has recognized several Vermont AFCs listed in Table 4 and mapped in Figure 3 below. The most recent designations occurred in 2021 and expanded AFC coverage to include US 7 south of Burlington, VT 9 and US 2 east of Montpelier as either corridor-ready or corridor-pending. Pending corridors were meant to highlight important corridors the State was working to support, but did not yet meet the coverage required at the time of the designation.[16]

The current requirements for accessing NEVI formula funds and designating future AFCs have more stringent provisions than past designations required.[17] The new NEVI guidance revised a provision that required charging stations to be located within five miles of an interstate exit or state highway intersection down to one mile with few exceptions. The guidance also requires these stations to have a minimum of four 150 kW DCFC ports per location. Vermont presently has no locations with more than two 150 kW ports, meaning all corridors will need additional fast charging availability to be designated as complete. Stations along these corridors still must be no more than 50 miles apart. After EVSE is built out according to these requirements, funds may be used to continue development in other areas. Beyond the charging equipment, NEVI formula funds may also be used for onsite renewable energy generation and storage related to EVSE infrastructure.

Table 6. Federally Designated Alternative Fuel EV Corridors in Vermont.

Route	Designation
I-89 from NH border to Quebec border	Corridor-ready
I-91 from MA border to Quebec border	Portions corridor-ready and pending
I-93 from St Johnsbury to NH border	Portions corridor-ready and pending
US 2 from Montpelier to the NH border	Portions corridor-ready and pending
US 7 from MA border to S Burlington	Portions corridor-ready and pending
VT 9 from NH border to NY border	Corridor-ready

[16] Vermont Agency of Transportation. Vermont Receives Federal Designation for Alternative Fuel Corridors. May 2021. https://vtrans.vermont.gov/sites/aot/files/press-releases/05.19.2020%20-%20Vermont%20Receives%20Federal%20Designation%20for%20Alternative%20Fuel%20Corridors.pdf

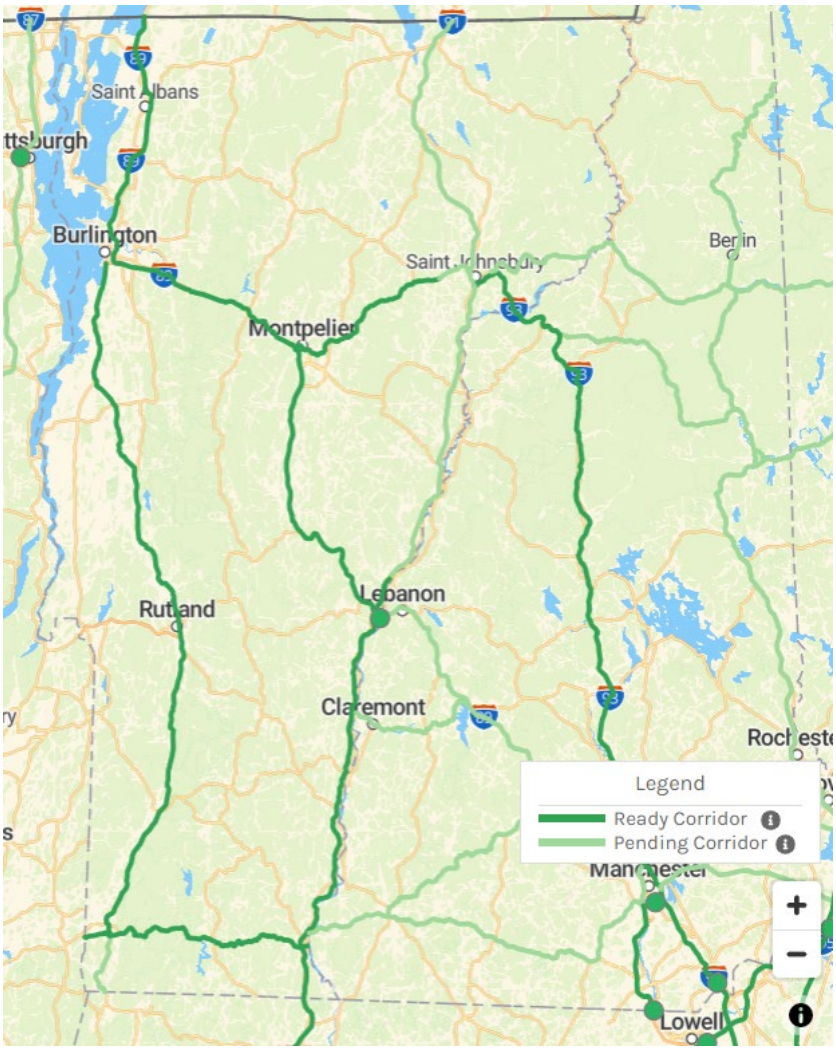
[17] Federal Highway Administration. President Biden, USDOT and USDOE Announce $5 Billion over Five Years for National EV Charging Network, Made Possible by Bipartisan Infrastructure Law. February 2022. https://highways.dot.gov/newsroom/president-biden-usdot-and-usdoe-announce-5-billion-over-five-years-national-ev-charging

Notably, funds received as part of the IIJA are also subject to "Buy America" provisions as outlined in the Act.[18] These requirements have historically applied to public-works transportation projects and water-related infrastructure but were expanded to include transmission facilities, structures and equipment of electric utilities, broadband, and property and buildings. The IIJA also expanded Buy America to include sourcing of materials as well, and now applies to copper used in electrical wiring, plastic- and polymer-based products, glass, and certain construction materials in addition to iron, steel, and some manufactured goods that were already included in the provision.

Projects supported by the IIJA will also be subject to the National Environmental Policy Act (NEPA) review process, though projects may be categorically excluded from a detailed environmental analysis if they do not significantly impact the environment (e.g., retrofitting an existing parking lot with EVSE infrastructure). The State of Vermont will ensure expenditures of NEVI or other IIJA-funded EV charging infrastructure meet all necessary regulatory requirements.

[18] Congress Research Service. Congress Expands Buy America Requirements in the Infrastructure Investment and Jobs Act (P.L. 117-58). Washington D.C., December 2021. https://crsreports.congress.gov/product/pdf/IF/IF11989

Figure 8. FHWA Designated Alternative Fuel Corridors in Vermont[19]



There are also opportunities for additional corridor funding outside of the IIJA. The expanded RAISE program supports projects that include connected, electric, and automated vehicles, shifts to reduce emissions in freight and passenger movement, and installation of zero-emission vehicle infrastructure.[20] The U.S. Department of Transportation (DOT) also administers the Community Alternative Fuel Infrastructure grant program to address gaps in the publicly accessible EVSE network in community locations, funding up to 80% of project costs including development and planning phases, acquisition of materials, and installation of infrastructure.[21]

[19] FHWA. Alternative Fuel Corridor Maps. Accessed Feb 2022. https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/maps/

[20] U.S. Department of Transportation. RAISE Discretionary Grants. November 2021. https://www.transportation.gov/RAISEgrants

[21] U.S. Department of Energy. 2021. Federal Laws and Incentives. https://afdc.energy.gov/laws/all?state=US.

EVSE Installation Federal Tax Credit

EVSE projects initiated through December 31, 2021 were eligible for the now expired Alternative Fuel Infrastructure Tax Credit.[22] This credit covered 30% of the cost of "any qualified alternative fuel vehicle refueling property" project costs up to $30,000, not including permitting and inspection fees. This provision allowed for unused business tax credits to be carried backward one year and forward up to 20 years. Consumers who had purchased qualified equipment for their residence were also covered under this credit up to $1,000.

The "Build Back Better" (BBB) framework proposed under H.R. 5376 included an extension of this program through 2031 and increased the credit to cover 30% of project costs up to $100,000.[23] The BBB proposal also included a provision covering 20% of allowable expenses in excess of the $100,000 for certain EVSE projects if prevailing wage and apprenticeship requirements are met. This would have required all laborers and mechanics employed for the construction to be paid wages at rates equal to or exceeding prevailing rates. Project eligibility for the BBB proposed program would have required EVSE to be intended for public use without an associated fee or payment arrangement, acceptance of payments via credit cards, or be intended for use exclusively by commercial or governmental fleets. While BBB does not appear to be moving forward in Congress, there are suggestions some of the clean energy provisions could advance through other bills in the future.

Prohibition on Commercial Activity in Interstate Rights-of-way

While the passage of the IIJA included significant funds to support EVSE deployment, the final version of the bill did not include provisions for charging infrastructure to be exempt from the historic prohibition of commercial activity in the interstate right-of-way (ROW).[24] This prevents charging infrastructure from being installed in areas of convenience along the interstate system, such as rest areas and travel centers within the interstate right-of-way. Presently, exemptions to this prohibition exist for certain state-operated commercial activities, such as advertising within rest facilities, items to promote tourism within the state, or vending machines. States may also permit private parties to operate these activities but cannot dictate what activities are exempt.

FHWA has developed guidance on a few limited exceptions where commercial EV charging may take place within the interstate right-of-way.[25] These limited applications include charging at

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[22] 26 U.S. Code 30 C. January 2012. https://www.govinfo.gov/app/details/USCODE-2011-title26/USCODE-2011-title26-subtitleA-chap1-subchapA-partIV-subpartB-sec30C

[23] 117th Congress. H.R. 5376 - Build Back Better Act. Washington D.C., November 2021. https://www.congress.gov/bill/117th-congress/house-bill/5376

[24] 23 U.S. Code § 111. January 2012. https://www.govinfo.gov/app/details/USCODE-2011-title23/USCODE-2011-title23-chap1-sec111

[25] Federal Highway Administration. State DOTs Leveraging Alternative Uses of the Highway Right-of-Way Guidance. April 2021. https://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/alternative_uses_guidance.cfm

Park and Ride facilities that use Federal-aid funding. In these cases, fees charged may not exceed the costs required to operate and maintain a facility.

Although interstate welcome centers are unlikely to offer much potential for EVSE availability, there may be additional opportunities to install EVSE infrastructure within *non-interstate* federal-aid highway system ROWs. States defining EVSE operators as utilities can make accommodations for utility facilities when use and occupancy does not adversely affect highway or traffic safety under authority granted in 23 CFR 645.205[26]. As in the EVSE fee requirements section below, the State of Vermont does not consider unregulated entities selling electricity by the kilowatt-hour at public EVSE locations to be under the regulatory jurisdiction of the Public Utility Commission. For this reason, it is unlikely Vermont could access this specific exclusion for non-utility owned EVSE.

FHWA has also granted an exception to federal requirements to charge for use of federal-aid ROW based on fair market value in the case of EVSE operators as is generally required for non-utility uses of these properties.[27] This could open up lower cost opportunities to site EVSE equipment along non-interstate highways. If the State does not own a ROW property outright and instead relies on an easement there may be additional considerations on whether EVSE installation would be permitted and if so what rents or fees may be required.

NIST EVSE Fee Transparency

Any product sold involving "weights and measures" in the United States is regulated to protect consumers, provide transparency, and ensure uniform standards are applied across commercial activities. The National Institute of Standards and Technology (NIST) collaborates with government officials and industry practitioners to provide technical guidance and ensure measurement systems work properly and are clear to consumers. NIST guidance is documented in handbooks covering products ranging from foods to vehicle fuels and includes inspection procedures to ensure compliance and accuracy. The State of Vermont adopts NIST guidance on weights and measures issues by reference under state statute.[28]

Electric vehicle "fuels" are also subject to standards developed by NIST, although the rapidly evolution of EV technologies has made it challenging to develop relevant standards. NIST has adopted legal method of sale requirements that require electrical energy for the purpose of EV charging is to be sold in megajoules or kilowatt-hours.[29] Although this guidance is clear many

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[26] 23 CFR 645.205. April 2010. https://www.govinfo.gov/app/details/CFR-2010-title23-vol1/CFR-2010-title23-vol1-sec645-205

[27] FHWA. Feb 2022. FHWA Frequently Asked Questions on EV Charging. https://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/ev_charging_faq.cfm

[28] 9 V.S.A. § 2653 State standards of weight and measure. https://legislature.vermont.gov/statutes/section/09/073/02653

[29] National Institute of Standards and Technology. 2020. "B. Uniform Regulation for the Method of Sale of Commodities." In NIST Handbook 130 - Uniform Laws and Regulations in the Areas of Legal Metrology and Fuel

EVSE operators continue to charge exclusively by time of use or provide a subscription service to users. NIST allows for time-based or subscription fees but stipulates they should be charged and displayed to customers separately from electric energy sales. Discrepancies between the standards and how stations are actually charging customers will likely continue until there is broader national acceptance of submetering for EV charging as Vermont has allowed.

The Vermont Agency of Agriculture Food and Markets (AAFM) is aware of the need to monitor EVSE weights and measures issues and is considering establishment of an EVSE registry as part of its weights and measures program. They are also exploring options for measurement technologies that could be used to verify kWh provided at EVSE, which can be especially challenging at high powered DC fast charging locations. AAFM may require additional resources to support this work and may also want to consider how different payment methods may impact equal EVSE access for those who may not have credit card payment options available.

State Policy

The State of Vermont specified a goal in the FY2022 Transportation Bill to have charging availability within five miles of every interstate exit and every 50 miles along state highways.[30] Vermont presently has over 300 publicly accessible chargers, equating to the highest per capita presence of EVSE in the nation.[31] The state has achieved this abundance of public EVSE in part through $3.5 million of strategic state investments since 2014.[32]

State goals for EVSE availability were re-examined in the FY2023 Transportation bill to reflect the current federal requirements and support EV adoption at levels suggested in Climate Action Plan modeling.

Quality. https://www.nist.gov/weights-and-measures/weights-and-measures-publications/handbook-130-current-edition

[30] State of Vermont. June 2021. Act 55 – FY2022 Transportation Bill, Section 30. https://legislature.vermont.gov/Documents/2022/Docs/ACTS/ACT055/ACT055%20As%20Enacted.pdf

[31] Drive Electric Vermont. 2022. Public Charging Map. https://www.driveelectricvt.com/about-evs/charging-map

[32] Vermont Agency of Commerce and Community Development. 2021. Electric Vehicle Supply Equipment (EVSE) Grant Program. https://accd.vermont.gov/community-development/funding-incentives/electric-vehicle-supply-equipment-evse-grant-program

The Vermont Agency of Commerce and Community Development (ACCD) has supported State EVSE grant programs for many years through the Vermont Department of Housing and Community Development (DHCD).

The first State-funded EVSE grants were distributed in 2014 with $200,000 in funding. This program continued to expand through the Volkswagen settlement environmental mitigation funds to support access to Level 2 and DCFC stations throughout the state.

The State has contracts in place to build out 17 new DCFC locations that should be constructed in the next two years. Once complete, nearly every Vermont resident will have access to fast charging equipment within 30 miles.[33] Although the contracted installations do not meet the minimum NEVI requirements of four 150kW fast chargers, the State is working with contractors to consider upgrades at several locations along designated AFV corridors.

Figure 9 Existing Level 2 and DCFC stations throughout the state along with planned construction in 2021-2022.

Funds from the Volkswagen settlement have also supported the electrification of school and transit buses across the state, including associated EVSE for charging these vehicles.

The FY2022 State transportation bill included an additional $1 million appropriation for development of EVSE at multi-unit dwelling housing units. This funding was available to lower income affordable housing properties with 10 or more units and non-profit housing providers and was fully subscribed.

Building Energy Code EVSE Requirements

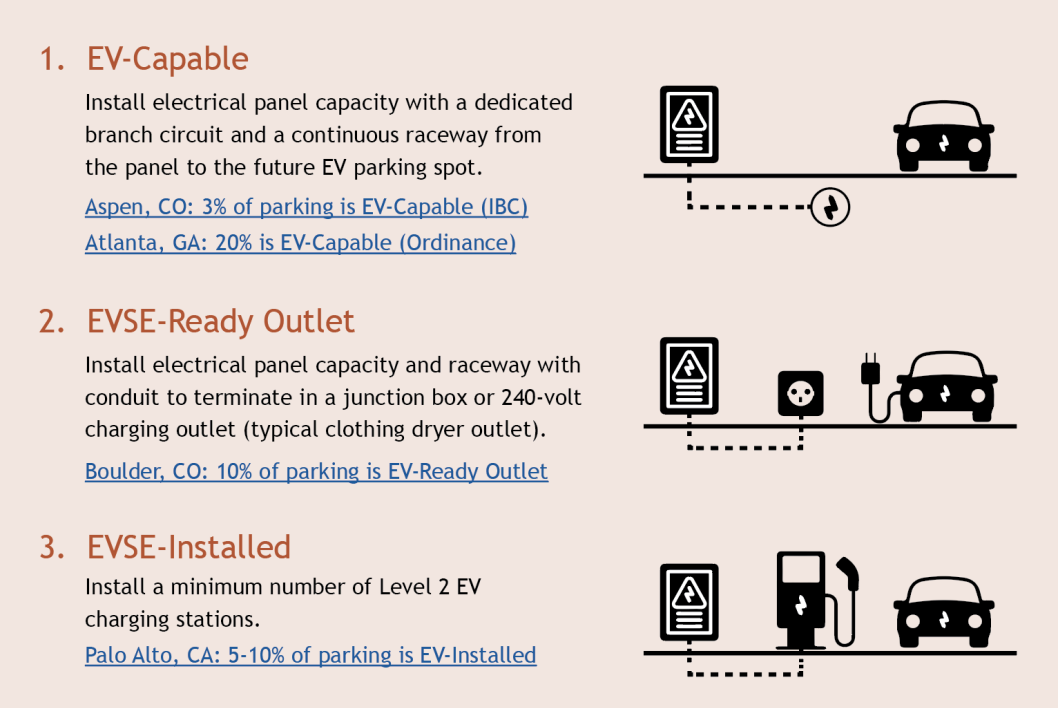
Widespread EVSE is crucial to growing EV adoption, and codes and regulations can serve to aid in this infrastructure development. New buildings last for decades or longer, so ensuring construction activity streamlines access to lower-cost EVSE is crucial. This is particularly true for multi-unit dwellings due to the convenience and lower cost of home charging availability. Ensuring ready access to home charging for renters and homeowners alike is critical to achieving Vermont's EV goals. Supportive EV-ready building codes are one way to help meet these needs.

EV-ready codes establish requirements for new construction projects to include EV infrastructure or, at the very least, the electrical panel capacity and pre-wiring to allow streamlined future installations of EV charging stations. Future proofing new construction is effective in

[33] Office of Governor Phil Scott. Governor Phil Scott Announces New Electric Vehicle Charging Stations to be Installed. February 2021. https://governor.vermont.gov/press-release/governor-phil-scott-announces-new-electric-vehicle-charging-stations-be-installed

encouraging the purchase and lease of electric vehicles to consumers and greatly reduces costs borne by the property owners in comparison to retrofits. Many municipalities across the country have established requirements for EV infrastructure to be considered in new construction, with three basic approaches outlined in Figure 5 below.

Figure 10. Examples of EV-ready building codes enacted in various cities[34]



These requirements significantly reduce costs for EV infrastructure projects. An analysis done for the City and County of San Francisco found the total cost of installation of two EVSE ports was more than four-times expensive for retrofits than if designs incorporated EVSE into new construction, with most of the cost associated with upgrades to electrical circuits.[35] Further studies done by the California Air Resources Board (CARB) found between $7,000-$8,000 could be saved per EVSE charging port if commercial lots were pre-wired to support EVSE.[36] Between 2020 and 2025, CARB estimated up to $386 million could be saved from avoided retrofit costs by incorporating EV-ready infrastructure in new construction in their state.

[34] Southwest Energy Efficiency Project, 2018. https://www.swenergy.org/cracking-the-code-on-ev-ready-building-codes

[35] Pike, Ed, Jeffrey Steuben and Evan Kamei. Plug-In Electric Vehicle Infrastructure Cost-Effectiveness Report for San Francisco. San Francisco: Pacific Gas and Electric Company, 2017. http://evchargingpros.com/wp-content/uploads/2017/04/City-of-SF-PEV-Infrastructure-Cost-Effectiveness-Report-2016.pdf

[36] California Air Resources Board. EV Charging Infrastructure: Nonresidential Building Standards. 2019. https://ww2.arb.ca.gov/sites/default/files/2020-08/CARB_Technical_Analysis_EV_Charging_Nonresidential_CALGreen_2019_2020_Intervening_Code.pdf

California has set ambitious goals for EVSE availability with plans to install 250,000 shared EVSE by 2025, of which 10,000 will be DCFC. Part of this effort includes the stretch codes within state's Green Building Code (CALGreen) to support EVSE deployment in new construction. These codes may be voluntarily adopted by local governments to require at least 10% of parking spaces to be EV-capable in new multi-unit dwellings and all new single-family homes to have capacity to support Level 2 charging. Non-residential new construction must also have 6% of spaces dedicated as EV-Capable. While at-home charging is commonplace today, workplace and commercial charging will be more important as EV ownership becomes widespread. Not every spot can be converted into an EV-charger and to avoid additional peak electric demand in the evenings, more daytime charging must be done to coordinate with energy supplied from intermittent renewable energy resources. The Pacific Northwest National Laboratory's technical brief on EVSE codes includes sample language based on International Energy Conservation Code (IECC) and ASHRAE Standard 90.1 states and municipalities may use in the development of new building codes to support EVSE. [37]

Vermont has established Building Energy Standards to meet efficiency requirements for new construction and large-scale renovations. These standards are designed to reduce greenhouse gas emissions resulting from energy consumption throughout the lifetime of a building. Moreover, they can be applied to support emissions reduction in other areas, such as transportation. The State has created distinct building energy codes for residential and commercial buildings recognizing important differences in their construction and energy consumption.

All new residential construction, including single- and multi-family properties, must comply with the latest residential building energy codes.[38] There are a few exemptions, such as multi-family properties greater than 3 stories or of a mixed-use building, though these properties must comply with commercial standards. The current residential building energy code (RBES) does not require EVSE infrastructure readiness in single family homes, though municipalities can adopt the "stretch code" to require at least Level 1 charging capabilities in new construction. For multifamily properties with at least 10 units, the property should be constructed so 4% of parking spaces have a socket capable of providing either a Level 1 or Level 2 charge with few exemptions.

The Vermont commercial building energy standards (CBES) separates EVSE requirements by occupant type and the amount of parking available. For most properties, the State requires an allotment of spaces to be EV-ready, as discussed later, with half of these spaces having dedicated and operable charging equipment upon occupancy of the building. Table 5 shows how the requirements vary by occupant type and lot size. For percentage values, the number of

[37] Salcido, V. R., M. Tillou and E. Franconi. Electric Vehicle Charging for Residential and Commercial Energy Codes Technical Brief. 2021.
[38] Vermont Public Service Department. Residential Building Standards. 2020. https://publicservice.vermont.gov/sites/dps/files/documents/2020-VT_Residential_Energy_Code_Handbook_v8.pdf

spaces must be rounded up to the nearest whole number. For example, a 4-story multifamily property that belongs to Group R-2 would need at least one Level 1 charger and three Level 2 spaces. The final two spaces would need the electrical service capacity that could easily be converted to an electric vehicle charging space at a later time.

Table 7. Vermont Building Energy Code EVSE requirements for commercial buildings.[39]

Occupant Type[40]	**Minimum Number of EVSE and EVSE-Ready Parking Spaces**					
	<25 Parking Space in Lot		≥ 25 Parking Spaces in Lot *Option A*		≥ 25 Parking Spaces in Lot *Option B*	
	Level 1	Level 2 or DCFC	Level 1	Level 2 or DCFC	Level 1	Level 2 or DCFC
Recreation, retail, food and drink, worship, and transportation facilities	0	0	0%	4%	0%	10
Office, education, industrial factories, and manufacturing buildings	1	1	3%	3%	2%	5
Inpatient care facilities	1	1	2%	4%	1%	10
Hotels, motels, and boarding houses	0	1	0%	2%	1%	10
Housing with 2 or more dwelling units	1	0	8%	0%	3%	5

Act 250

Vermont enacted a land use and development law known as Act 250 in 1970 as a response to environmental concerns.[41] The law founded nine District Environmental Commissions who oversee the development plans that result in significant environmental, aesthetic, or community impacts. Each Commission, comprised of citizens, dictates what is acceptable development in their respective communities through a set of 10 criteria including transportation, municipal services, and impacts of growth, among others.

Act 250 permits are required for commercial projects that:

- Are on more than 10 acres if the town has permanent zoning or subdivision regulations
- Are on more than 1 acre if there are no permanent zoning or subdivision regulations
- Will result in a subdivision of 10 lots or more in a 5-year period.

These Commissions may require developers to include charging infrastructure in plans consistent with building energy code requirements. Act 250 permits are typically only required for larger-scale new development activity. Existing properties with Act 250 permits may need to

[39] 2020 Vermont Commercial Building Energy Standards C405.11. https://codes.iccsafe.org/content/VTCES2020P1/chapter-4-ce-commercial-energy-efficiency

[40] For specific definitions of occupant groups, see *Occupancy Classifications* in Section C202 of the CBES

[41] 10 V.S.A. § 6086. https://legislature.vermont.gov/statutes/section/10/151/06086

amend their permit to allow for EVSE deployment.[42] This process can be streamlined for minor amendments, as is the case for most EVSE projects.

The Natural Resources Board oversees the Commissions and sets specific application requirements statewide based on statute. Of note, the Natural Resources Board outlines criteria supportive of EVSE development in the most recent guidance for Act 250 permits.[43] For example, residential buildings that require Act 250 permits must meet the most recent building stretch codes that require EV-ready infrastructure. For commercial construction, the criterion strongly encourages applicants to submit designs that are "renewable ready", including infrastructure that supports future installation of EV charging equipment.

State Infrastructure Bank financing program

State Infrastructure Banks (SIB) are sources of revolving funds for surface transportation infrastructure projects established and administered by states. SIBs have a greater capacity to lend at lower rates by leveraging Federal resources to attract public and private investments and a guaranteed reserve fund to borrow against. Financial assistance through SIBs may be offered through flexible loans with below market rate interest, short-term construction or long-term debt financing, or through various modes of credit enhancements. Funds utilized through SIBs may be used for Title 23 highway construction projects and Title 49 transit capital projects.[44]

Vermont's SIB is cooperatively run by the Vermont Economic Development Authority, the Vermont Agency of Transportation, and the Federal Highway Administration. While funds are commonly dispersed for major infrastructure projects, Vermont's SIB includes financing options for electric vehicle charging stations under certain provisions, namely that funds be used for the purchase and/or installation of publicly accessible EVSE. Following this guidance, sole proprietorships, partnerships, corporations, and municipalities may apply for up to a $100,000 loan at a low interest rate, with terms dependent on the useful life of the charger. Additionally, successful applicants will be assessed a 2% commitment fee to receive disbursements.[45]

EVSE fee requirements

Prior to the passing of the 2019 Vermont Transportation Bill, the state prohibited non-state agencies or unregulated utilities to sell electricity by the kilowatt-hour, preventing other EVSE operators from charging for costs directly associated with electrical consumption. Instead, EVSE operators typically based fees on time connected to the charging unit or through subscription

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[42] VEIC. *Electric Vehicle Charging Station Guidebook*. 2014. https://www.driveelectricvt.com/Media/Default/docs/electric-vehicle-charging-station-guidebook.pdf
[43] Vermont Natural Resources Board. Act 250 Application Guide. https://nrb.vermont.gov/sites/nrb/files/documents/Act250_ApplicationGuide.pdf
[44] Federal Highway Administration. *State Infrastructure Banks (SIBs)*. https://www.fhwa.dot.gov/ipd/finance/tools_programs/federal_credit_assistance/sibs/
[45] VEDA. *Electric Vehicle Charging Station Loan Program*. 2021. https://www.veda.org/financing-options/vermont-commercial-financing/electric-vehicle-charging-station-loan-program/

services that provide unlimited charging for a fixed monthly fee. The 2019 Vermont Transportation Bill exempted private operators of EVSE stations from Public Utility Commission oversight and allowed these unregulated EVSE operators to charge by the kWh at EVSE. [46]

As previously stated, NIST guidance supports both energy and time-based methods of EVSE cost recovery but reiterates kilowatt-hour should be primary. The state may want to consider monitoring how EVSE stations are charging customers to ensure best practices are being followed where applicable and continue to standardize a statewide approach.

If the charging equipment is owned or controlled by a Vermont agency or department, fees may be established up to equal cost of charging or to the retail rate for use of publicly available EVSE. Any fees collected must be deposited into the original fund or account that supports the installation, operation, and maintenance of the equipment. This provision is set to sunset July 1, 2025.[47]

Municipal Policy

The passage of Act 89 in 2013 authorized municipalities to adopt stretch energy codes to be used for new residential buildings. Stretch codes are locally mandated codes or compliance measures that are more aggressive in pursuing energy savings than the base code. Stretch code requirements are often precursors to the next iteration of base codes.

Vermont recently updated residential and commercial building energy standards in 2020 based on International Energy Conservation Code that applies to all new low-rise residential construction, additions, alterations, renovations, and repairs. This update to the 2015 standards includes a strategic shift toward adopting more efficient electric heating and ensuring homes are solar ready and electric vehicle charging

Supporting EVSE in Municipal Regulations

1. Define frequently used terms and ensure they are understandable
2. Allow charging stations as an accessory use and structure wherever there is parking
3. Allow charging stations as a principal fueling station in specific cases
4. Keep permit review process simple and allow for exemptions and administrative review
5. Prepare parking standards
6. Update sign standards
7. Check performance standards

[46] Vermont State Legislature. H. 529 (Act 59). June 2019. https://legislature.vermont.gov/bill/status/2020/H.529
[47] 32 V.S.A. § 604. July 2022. https://legislature.vermont.gov/statutes/section/32/007/00604

capable.[48] Furthermore, as of September 1, 2020, all residential projects requiring an Act 250 permit must comply with stretch codes outlined in the 2020 building energy standards.[49]

Figure 11. VT DHCD guidelines on local regulations for EVSE development

Equally important to building codes is the development of planning and permitting structures that can streamline EVSE deployment. Every EVSE installation, excluding some single family residences, must meet Vermont Department of Fire Safety's State Electrical Safety program permitting requirements. Other state permits are site specific, such as Act 250 permits, state environmental permits, or VTrans highway permits for sites located in the state right-of-way.[50] Each municipality may enact specific ordinances for EVSE, resulting in a mosaic of requirements that result in geographic disparities in public access. The Chittenden County Regional Planning Commission's 2014 EVSE Guidebook contains suggested language for municipal bylaws to streamline installations in communities. The Department of Housing & Community Development (DHCD) has also developed a resource to support local EVSE development, as shown in Figure 6 above.[51]

Other considerations that may impact EVSE adoption are differences among utility incentives and business practices that support EVSE (see Table 6 below). These issues may be an important factor in determining preferred EVSE locations.

One avenue that may assist municipalities and other public entities considering EVSE installations is the opportunity to access EVSE discounted pricing through the Vermont Department of Buildings and General Services (BGS) state contract for EVSE.[52] This contract could save significant time and money associated with the installation of charging equipment.

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[48] Faesy, Richard and Dave Keefe. Vermont Residential Building Energy Standards Update. February 2019. https://www.efficiencyvermont.com/Media/Default/bbd/2019/docs/presentations/efficiency-vermont-bbd-vermonts-new-2019-residential-building-energy-standards-energy-codes.pdf

[49] Vermont Public Service Department. Vermont Residential Building Standards (RBES) Energy Code Handbook. 2020.

[50] VEIC. Drive Electric Vermont Electric Vehicle Charging Station Guidebook. 2014. https://www.driveelectricvt.com/Media/Default/docs/electric-vehicle-charging-station-guidebook.pdf

[51] VT DHCD. Local Electric Vehicle Charging Station Regulation. Sept 2018. EVSE-Friendly Development Regulations.VT .DHCD .Sep2018.pdf (vermont.gov)

[52] VT BGS. EV Charging Stations. Accessed Jan 2022. https://bgs.vermont.gov/content/electric-vehicle-ev-charging-stations

Table 8. EVSE incentives offered by Vermont electric utilities

Utility	EVSE Incentive (per port)	Notes
Green Mountain Power	Free Level 2 charger (Residential)	Charger must be internet connected and share access with Green Mountain Power during peak times.
	$750 (Commercial)	Incentive that can be used for a public or workplace charger. Also offering a workplace charging program for $35-50/month.
Burlington Electric	$400 rebate on purchase of Level 2 charger	Charger must be purchased within 60 days of EV purchase.
	75% of installed cost up to $3,000 (Commercial)	Eligible for workplace installations of Level 2 chargers or higher only.
Stowe Electric	$500 rebate on purchase of Level 2 charger (Commercial)	To qualify, the charger must be for workplace or public use. Rebate is per plug.
VPPSA	$500 rebate on purchase of Level 2 charger (Commercial)	Eligible to VPPSA members[53] only. To qualify, the charger must be for workplace or public use. Rebate is per plug.
Vermont Electric Co-op	$250/$300 (Residential)	Rebates for Level 2 residential charging equipment. Customers that opt-in to utility integrated connections get an extra $50 in incentives.
	$500 (Commercial)	Publicly available charging stations qualify for $500 rebate per plug.
Washington Electric Co-op	Free Level 2 charger (Residential)	Must be co-op member participating in Powershift program to be eligible. Charger must be internet connected.

Utility Regulatory Considerations

Regulatory Considerations

The Public Utility Commission (PUC) has taken an active role in researching EV issues and developing policy guidance to support EV adoption in light of State climate and energy goals. Most recently, the PUC distributed a report to the State Legislature in early 2022 describing methods to accelerate the use of electric vehicles in the state.[54] The report contains an extensive list of recommended actions to be taken by the State government, electric utilities, suppliers,

[53] VPPSA members include Barton Village, Village of Enosburg Falls, Hardwick Electric Department, Village of Jacksonville, Village of Johnson, Ludlow Electric Light Department, Lyndonville Electric Department, Morrisville Water and Light Department, Northfield Electric Department, Village of Orleans, and Swanton Village.
[54] Vermont Public Utility Commission. Report to the Vermont State Legislature. 2022. https://puc.vermont.gov/sites/psbnew/files/doc_library/act-55-electric-vehicle-rates-2022-report.pdf

and contractors of charging equipment that would support the development of the EV market. Many recommendations outlined below are also mentioned in other sections of this report.

The PUC report identifies the role of electric distribution utilities to remove or mitigate barriers to EV charging without shifting costs to ratepayers who do not own or operate EVs. Specifically, the PUC calls out the need to develop alternative rate designs to alleviate burdens presented by demand charges, implement time-of-use rates for charging, offer incentives for EVSE through Tier III of the Renewable Energy Standards program, and to draft long- and short-term plans for advancing the EV market in each utility's service territory.[55] Utilities are required to propose rates for EVs no later than June 30, 2024. Several utilities already offer lower EV charging rates during off-peak hours, including time-of-use and direct load-control rates that provide customers incentives for granting utility control to disable charging during peak events. These programs are described in greater detail in the PUC report.

Amongst other recommendations in the report is a continued emphasis on the partnerships that will be required between public agencies and private interests. Such examples include the designs of EV and EVSE friendly rate structures cooperatively developed to meet the interests of ratepayers, EV owners, utilities, and station operators. Others include prompt consideration of utility proposals for EVSE investment by the PUC, particularly in cases where third-party involvement benefits public interest.

Renewable Energy Standards (Tier III)

Enacted in 2015, the Vermont Renewable Energy Standard requires electric Distribution Utilities (DUs) to acquire specified amounts of renewable energy through renewable attributes or renewable energy credits.[56] DUs are directed to meet the standards through total renewable energy (Tier I), distributed renewable generation (Tier II), and energy transformation projects (Tier III). Tier III may refer to additional procurement of Tier II renewable energy generation or other projects that garner fossil fuel savings. Beginning in 2017, DUs must administer energy transformation projects that result in energy savings equivalent to 2% of total annual retail electric sales, increasing by 2/3 of a percent each year until 2032.

To date, all DUs in the state are in compliance with Tier III requirements.[57] Through 2019, Green Mountain Power has exceeded the standard having met 176.2% of Tier III goals, a portion of which included supporting the purchase of EVs and investments in EV charging stations and network infrastructure. Burlington Electric Department, Washington Electric Co-op, Vermont

[55] Vermont Public Service Department. RES Tier III Evaluation Report. 2020. https://publicservice.vermont.gov/sites/dps/files/documents/2019_Tier_III_Report_20-0644-INV.pdf
[56] 30 V.S.A. § 8004. https://legislature.vermont.gov/statutes/section/30/089/08004
[57] Department of Public Service. RES Tier III Verification Report. 2020. https://publicservice.vermont.gov/sites/dps/files/documents/2019_Tier_III_Report_20-0644-INV.pdf

Electric Co-op, VPPSA and Stowe all made similar investments in EV purchase incentives, though investments in EVSE stations and infrastructure varied across utilities.

Act 56 requirements will continue to drive increased investments in EV rebates and EVSE stations through utilities. Based on retail sales projections, Green Mountain Power alone will be responsible for projects generating approximately 475,000 MWh equivalent savings in 2032.[58] While this will be achieved through a number of different initiatives, such as cold-climate heat pump investments, projected market growth of EV adoption will most likely be a strong consideration as DUs develop annual Tier III investment plans.

Demand Charges

Even with structured incentives, peak demand charges assessed by utilities for kilowatts of power used by customers during peak periods often has drastic impacts on higher powered EV charging installations and can cost EVSE operators thousands of dollars a year even in locations with low utilization. Demand charges are fees assessed to customers, usually in the commercial and industrial sectors. These fees are charged directly to end-users to support the grid infrastructure necessary to support high capacities. Utilities use the highest 15-minute average demand over the course of the month to assess fees that may then be in place for a minimum period of months. For example, if an end-user runs a process that requires 50 kW of electricity once a month, they will be assessed a fee based on that peak usage even if baseline power requirements are far lower.

While this is not a significant issue for Level 1 chargers, multi-port Level 2 and DCFC stations operate at higher power where demand charges become a significant consideration in the economic viability of EVSE. Peak EVSE power is sort of like the flow rate of gasoline – the higher the power, the faster the charge. Some DCFC chargers operate at up to 350 kW of power, adding hundreds of miles of range in 15 minutes on an EV capable of charging at this power. A few of these high-power DCFC used simultaneously can quickly exceed 1 megawatt (MW) of demand, racking up significant demand charges for the operator if their utility rate includes them.

Economic analyses have demonstrated the challenges associated with demand charges and EVSE operation. McFarlane et al. found stations operating at a peak capacity of 50 kW can almost always recover costs from demand fees if the station charges at least 10 vehicles per day.[59] Holding the number of vehicles charging constant, the cost-effectiveness of EVSE stations falls drastically as peak demand increases. Operating at a peak of 150 kW, either through one EVSE at that power or three 50 kW plugs charging simultaneously, only half of the studied locations could break even. Beyond this power, the economics demonstrate it is nearly

[58] Itron. Green Mountain Power FY22 Budget Forecast Report. 2021. https://greenmountainpower.com/wp-content/uploads/2021/06/Schedule-F-Itron-Revenue-Forecast.pdf

[59] McFarlane, Dane, et al. Analytical White Paper: Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region. 2019. https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf

impossible to recover costs in any utility's service territory with DCFC stations at EVSE utility rate structures with demand charges. For example, the study found nearly 70% of annual electrical costs are associated with demand charges for a 350 kW DCFC unit.

These findings are notable, as 10 charges per day is far above the current rate of utilization. A similar study conducted by Rocky Mountain Institute simulated scenarios based on utilization rates of 5%, 10%, and 30%.[60] These rates are representative of hourly usage in today's market, a growing market, and a mature market, respectively. In other words, a DCFC station with today's level of EV adoption can expect to be used approximately 5% of hours, or 1.2 hours of charge time daily. Under these scenarios, Fitzgerald & Nelder (2019) simulated usage of a dual-port 50 kW (100 kW total capacity). At a 5% utilization rate, 15-minute peak demand was estimated to be 58 kW and increased up to 88 kW in a mature market. Modeling the break-even point found a 50 kW system would need at least 7 charges per day, a 150 kW system 18 daily charges, and 40 charges for a 350 kW plug.

For behind the meter applications, Green Mountain Power offers a general service rate for customers up to 200 kW in peak demand. Under these rates, separately metered public EVSE are exempt from demand charges. Without this exemption, which prohibits charging operators from restricting access, the first 5 kW are $0/kW and $18.726/kW thereafter. GMP also offers a special contract for electric bus charging that exempts the demand charge up to 200 kW if the transit provider offers charging for employees and/or the public. In all cases, customers are charged $0.17945 per kWh. To date, GMP is the only Vermont utility to include an exemption for EVSE, though Burlington Electric Department has a reduced demand charge for their large general service time-of-use rate.

To estimate how current rate schedules might impact operation costs of EVSE stations, we examined six rates[61] offered by Vermont electric service providers at different levels of station utilization. These rates were representative of large populations, average costs, or offered distinct attributes that could impact the costs and business opportunities for EVSE development. Five unique EVSE location configurations were modeled reflecting different power levels of DCFC[62] along with baseline, medium, and high EVSE utilization scenarios forecasted by RMI[60] and NREL[63]. The resulting cost comparisons are shown in Figure 8, reflecting current utilization rates, and Figure 9, representative of greater future usage in a more mature EV market. The lowest and highest operating costs across all charger configurations called out for each usage case.

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[60] Rocky Mountain Institute. DCFC Rate Design Study. 2019. https://rmi.org/insight/dcfc-rate-design-study/

[61] GMP Rate 6, Burlington Electric Department EV Charging Stations (Small and Large General Service), Village of Johnson Standard Large Commercial Rate, Village of Enosburg Falls Rate 2 and Rate 3.

[62] 50 kW, dual-port; 150 kW, dual-port; 150 kW, quad-port; 350 kW, dual-port; 150 kW dual-port & 350 kW dual-port.

[63] Gilleran et al. (2021). Impact of electric vehicle charging on the power demand of retail buildings. https://doi.org/10.1016/j.adapen.2021.100062

In Figure 10 below, the minimum and maximum monthly operating costs are presented based on today's utilization rates of 2-3 charges per day. Based on Burlington Electric Department's rates, a station may qualify for the small general commercial rate if it does not exceed 3,000 kWh for three consecutive months. Even with today's low utilization rates, stations can quickly surpass this limitation and only qualify for the large general service with a demand charge. The implications are apparent with demand charges accounting for more than $6,000 per month in this case compared to a total cost of service of $240 in the small general service with only slightly lower consumption.

Figure 12. Current average EVSE estimated monthly operating costs across Vermont utility rate structures by charger type and estimated 15-minute peak demand

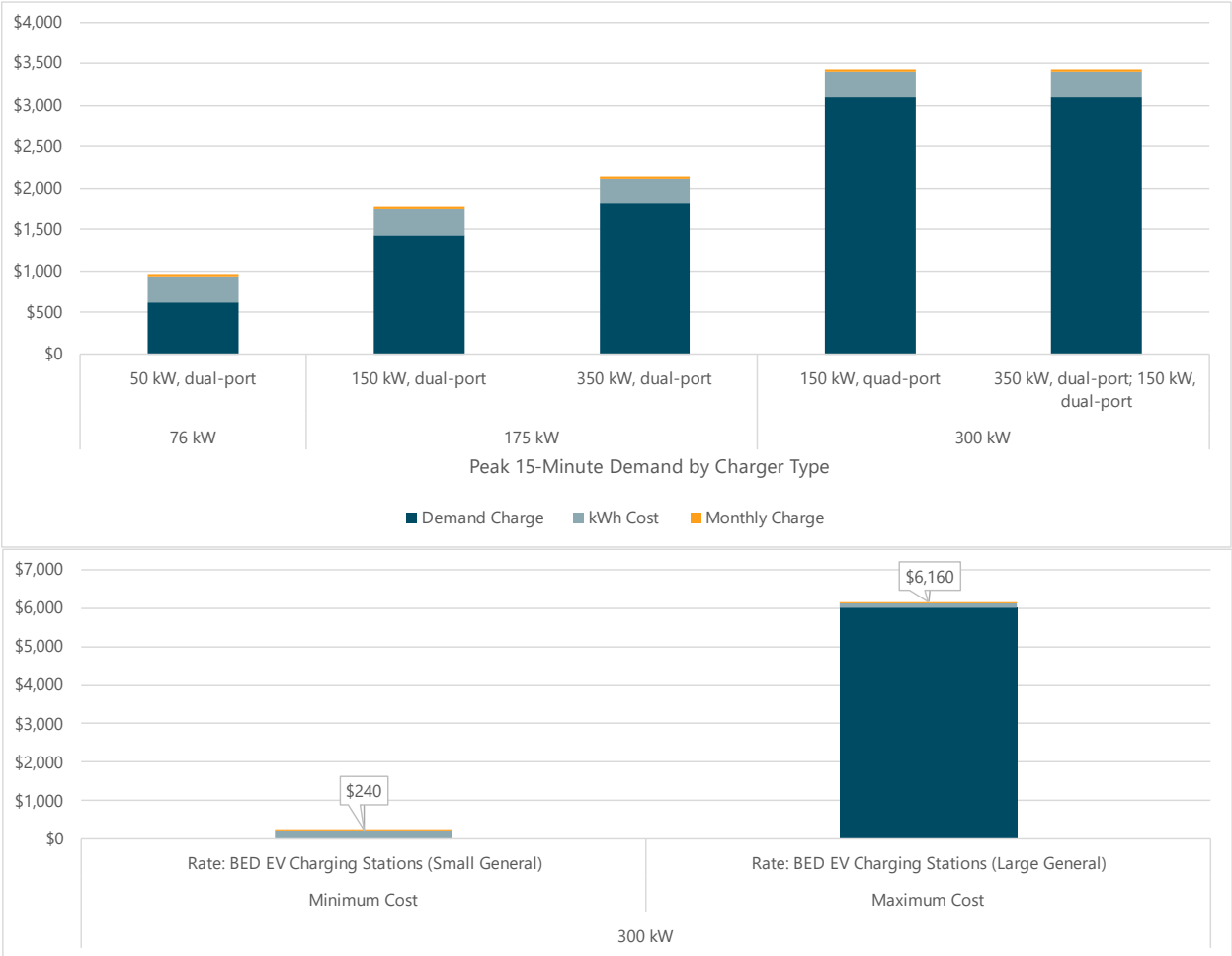
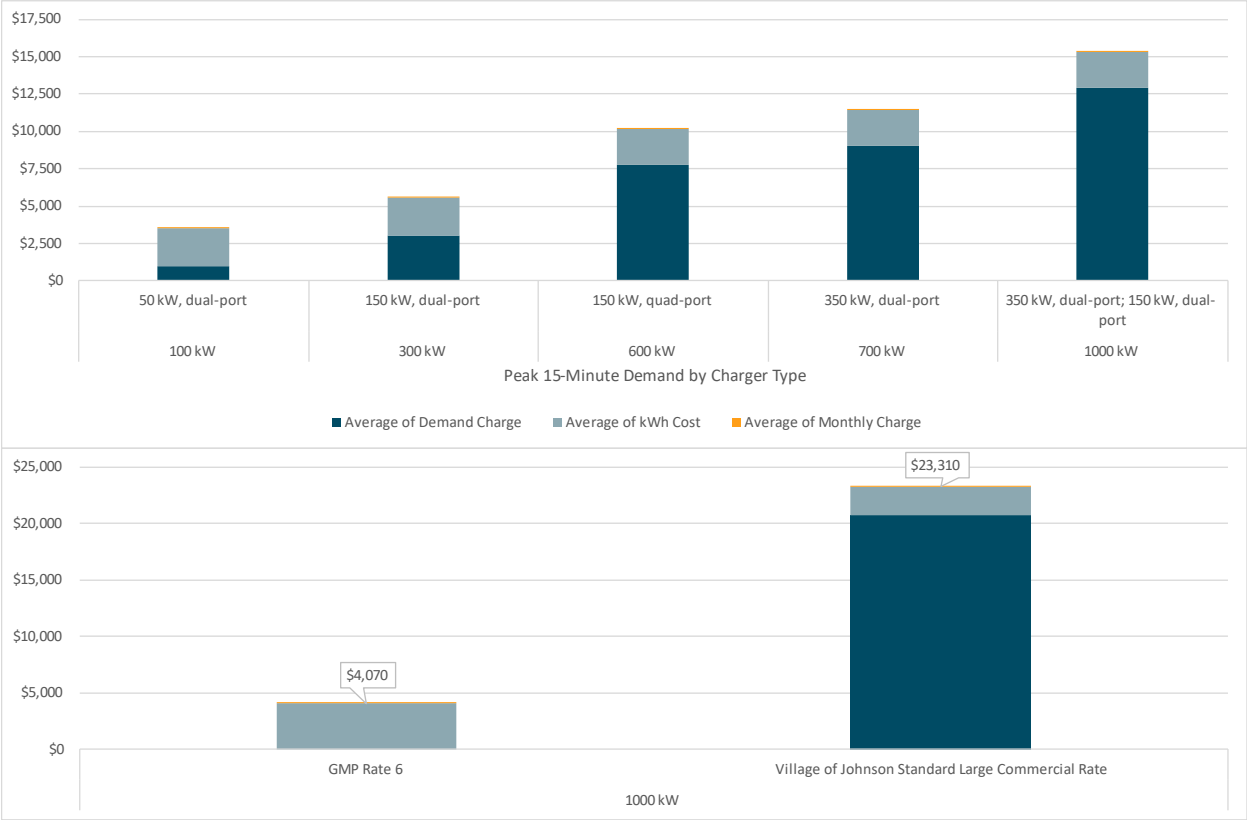


Figure 11 estimates the same costs under a future state where 16 EVs charge per day for each charger configuration. This would equate to utilization rates ranging from 9% for a 350 kW dual-port station to up to 60% for a 50 kW dual-port station. Green Mountain Power's Rate 6 is less than half the cost of the next least expensive rate schedule and more than five-times cheaper than the most expensive rate due to their current tariff structure which eliminates peak demand charges for EVSE open to the public.

Figure 13. Future EVSE estimated monthly operating costs across Vermont utilities' eligible rate structures by charger type and estimated 15-minute peak demand



The variability of demand charges across utility territories present equity concerns for access to affordable public charging. This is particularly true with low utilization rates expected over the coming years as the EV market expands. Given today's rate schedules and utilization, and without any cost recovery from station operators, EV drivers within Burlington Electric Department and Green Mountain Power territories could expect costs of $2.45 and $5.83 respectively per 100 miles of range[64] at a 150 kW quad-port station. By comparison, a station under the Village of Johnson's Standard Large Commercial rate would cost $71.53 due to demand charges levied at the estimated 300 kW of peak 15-minute demand.

While operating costs can be spread out over more consumers as the market matures, rates with demand charges are still more than three-times more expensive on average than those without under a high utilization scenario. Moreover, station visitation will not be equally spread across the state. A typically low utilization station may temporarily experience increased tourism traffic during a holiday weekend, causing a spike in demand that will be unable to be offset by the number of customers refueling. This presents a significant barrier to EV adoption at both ends. Consumers are hesitant to purchase an electric vehicle without adequate fueling infrastructure,

[64] Gohlke & Zhou (2021). Assessment of light-duty plug-in electric vehicles in the United States, 2010-2020. DOE. https://publications.anl.gov/anlpubs/2021/06/167626.pdf

while operators are unable to support costs associated with fast charging. Demand charges as described above present a serious economic challenge if left unchanged, particularly for lower utilization or higher capacity stations. Addressing demand charges associated with EVSE is a measure that must be addressed for state build out.

Opportunities to Reduce EVSE Demand Charges

One approach to reduce demand charges could utilize NEVI funds to aid in the utility upgrades needed to support high-capacity DCFC stations. DCFC requires higher voltage three-phase power to supply the power demand created from fast charging. While three-phase power is largely available in Vermont, there are still many critical areas along AFCs that have yet to be serviced by higher voltage lines. As NEVI supports infrastructure upgrades necessary to develop the DCFC network, these funds could be used to offset construction costs to extend three-phase lines along AFCs. In turn, this can create a better economic case for utilities to reduce or eliminate demand charges for EVSE stations.

On-site energy storage also presents unique opportunities for EVSE and can be supported by IIJA funds. Batteries integrated into the charging system can help offset peak demand, thereby reducing or eliminating demand charges altogether. Alternatively, they may be used to support DCFC in areas without three-phase power. FreeWire, for example, offers a battery-integrated DC charger that enables fast charging capacity in areas without supporting utility infrastructure, reducing installation costs by up to 40%.[65] While promising, both of these options remain largely untested and face challenges with Vermont's climate, as batteries operate best in above freezing temperatures.[66] Limiting use of battery storage on the coldest days may be possible, though stations funded through NEVI must maintain a 97% uptime. The State could consider pilots with battery-connected chargers in key areas to better understand the benefits and risks associated with storage integration in fast charging technologies. If proven to be a viable option, these kinds of chargers could aid in development of fast charging infrastructure in areas with limited electric infrastructure and as a means to reduce peak demand from stations.

Simple rate designs for EVSE should also be pursued to attract, rather than confuse, private market investments into charging stations. Recognizing this, some national utilities offer special EVSE rate schedules to encourage growth of the market. As described in Rocky Mountain Institute's DCFC Rate Design Study, Xcel Colorado filed an EV Tariff in 2019 that offers a uniquely structured time-of-use, critical peak, and fixed monthly pricing to reduce demand charge burdens. Under this schedule, demand charges are reduced to $5.63/kW. California's largest investor-owned utility, PG&E, proposed an EV-Large S Commercial EV Tariff that assess the demand charge as a subscription service. Here, customers choose a subscription level in 50 kW increments based on anticipated peak demand. PG&E charges a flat monthly rate of $184

[65] FreeWire Boost 150 Datasheet. 2020. https://freewiretech.com/download/989
[66] Smith, Kandler et al. Life Prediction Model for Grid-Connected Li-ion Battery Energy Storage System. 2017. https://www.nrel.gov/docs/fy17osti/67102.pdf

per 50 kW block ($3.68/kW equivalent) along with a three-tiered time-of-use pricing for energy consumption. RMI proposed their own tariff with a fixed monthly cost, generation charges that decrease with utilization, and demand charges that increase with utilization. All these models allow for utility cost recovery while lowering demand charge barriers for EVSE operators.

Green Mountain Power has also filed tariff sheets with the PUC that modified the General Services Rate Schedule 6 to include exemptions for separately metered electric vehicle charging stations. This rate waives the 200 kW service limitation and does not apply any demand charges to EVSE operation. This rate became effective October 1, 2021 for eligible customers that have publicly available charging equipment with a service meter solely dedicated for the operation of the equipment. According to the PUC approval of the filing[67], GMP reserves the right to rescind this exemption if increased costs associated with charging equipment exceed incremental revenues. This structure encourages broad EVSE development as GMP service territory covers most of the state while protecting the financial sustainability of the utility. Additionally, with the passing of H. 433[68] in 2021, all electric distribution utilities will be required to offer Plug-In Electric Vehicle rates for public and private EVSE by June 30, 2024.

Utility Programs

Goals outlined in Vermont's Comprehensive Energy Plan suggest aggressive growth of EVs in the state in the coming years. Such a transformational shift of the transportation sector will have profound interactions with utility infrastructure and electricity demand. A number of creative solutions can be explored to ensure reliability of power delivery while protecting customers from exorbitant bills resulting from electrified transit. For example, anticipated improvements in the EV space include vehicle-to-grid applications, where EVs may be used as a distributed resource of stored energy that can be dispatched to the grid during times of peak demand and charged during off-peak hours. Distribution utilities are then able to import less energy to support demand, thereby lowering retail rates for peak hours. Green Mountain Power has established two innovative pilots that will investigate vehicle-to-grid applications and frequency regulation from distributed energy resources to analyze associated costs and benefits. GMP installed its first bi-directional charger at its Colchester office in October 2020 and looks to expand availability to customers in coming years.

Though vehicle-to-grid applications may still be in early phases, utility sponsored programs are still an immediate way to appeal to customers to purchase EVs and make cost propositions more economical. Similarly, utility programs for charging infrastructure are equally as important in making a business case for station operation.

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[67] Tariff Filing of Green Mountain Power Corporation for approval to implement new public electric vehicle charging station rate schedule exemption effective on bills rendered on or after 1/30/2021. No. 20-3832-TF. State of Vermont Public Utility Commission. January 2021. https://epuc.vermont.gov/?q=node/64/154644/FV-ALLOTDOX-PTL

[68] Vermont State Legislature. H. 433 (Act 55). June 2021. https://legislature.vermont.gov/bill/status/2022/h.433

Innovative utility offerings to support EV adoption or EVSE deployment are considered an energy transformation project as outlined in Tier III requirements of Vermont's Renewable Energy Standard. Many utilities in Vermont offer rebates on the purchase of charging equipment and discounted rates for EV charging (see Table 1). In 2020, GMP expanded offerings for DCFC, offering up to $40,000 off the cost for electrical interconnections for businesses and communities in addition to state incentives. In addition, Burlington Electric Department recently partnered with EVmatch to offer a pilot program granting free level 2 chargers for multifamily unit dwelling properties with an additional $500 for installation costs if chargers are made publicly available during standard business hours. While the application period has ended, ventures into this space are an important step in demonstrating the public-private partnerships that must occur to make charging stations viable.

Utilities in other states are also offering incentives for "Make-Ready" programs that provide incentives for necessary electrical connections, conduit, and infrastructural development for charging stations. These costs are often considered to be installation costs that are unqualified expenses for most incentives listed in prior sections. New York Joint Utilities, for example, offers incentives that cover up to 100% of the electric infrastructure costs associated with non-residential EVSE.[69] The tiered incentive structure prioritizes the deployment in disadvantaged communities and fully public stations, though businesses and multifamily unit dwelling owners that have restricted access to plugs can still qualify for up to 50% of expenses to be covered. New York's EV Make-Ready program[70] is funded by investor-owned utilities in the state with the goal of supporting more than 50,000 public Level 2 and DCFC charging ports. The program became permanently established as a means toward meeting the state's climate goals in late 2021.

EVSE development does not solely fall to distribution utilities to support through programming. Vermont's electric energy efficiency utilities (EEUs), including Efficiency Vermont and Burlington Electric Department received authorization to support approved transportation electrification activities through the passage of Act 151 in 2020.[71] This Act created a three-year pilot to use EEU resources and expertise in support of expanding the state's EV market. This pilot allows Efficiency Vermont to use up to $2 million annually in existing funding for offerings that reduce greenhouse gas emissions in the thermal and transportation sectors. As outlined in a recent press release[72], Efficiency Vermont has focused their efforts on consumer EV education and awareness as well as strengthening the supply chain and relationships with automotive partners. Burlington Electric Department, the state's other energy efficiency utility, has received approval

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[69] Joint Utilities of New York. EV Make-Ready Program. 2020. https://jointutilitiesofny.org/ev/make-ready

[70] New York Governor's Press Office. Governor Hochul Announces Advancement of Program to Deploy More Than 50,000 New EV Charging Ports Across the State. November 2021. https://www.governor.ny.gov/news/governor-hochul-announces-advancement-program-deploy-more-50000-new-ev-charging-ports-across

[71] S. 337 (Act 151). September 2020. https://legislature.vermont.gov/bill/status/2020/S.337

[72] Buell, Jeff. Efficiency Vermont joins effort to reduce energy burden of transportation. July 2021. https://www.efficiencyvermont.com/news-blog/news/efficiency-vermont-joins-effort-to-reduce-energy-burden-of-transportation

from the Public Utility Commission for a proposal to use Act 151 funding to support the Green Stimulus program that bolstered incentives for EV adoption. This effort will cooperatively support ongoing programs sponsored by Efficiency Vermont and other utilities to increase adoption of electric vehicles across the state.

The emphasis of many of these programs is to cooperatively support joint efforts by many parties and agencies to expand Vermont's electric vehicle market. Green Mountain Power and Vermont Economic Development Authority, for example, have partnered to offer a turnkey package for businesses as part of the Workplace Charging pilot program. This offers businesses a simple solution to installing the equipment, with GMP handling the management and operation of the equipment with a low-cost, on-bill repayment plan through VEDA. Incentives direct to customers, such as federal, state, and utility rebates, are able to be stacked, significantly bringing down up-front costs to EV ownership. These and other public-private partnerships will be key to driving the growth of electrified transportation in Vermont.

Strategies to Increase Charging Availability

Incentives

As described above, the State of Vermont's EVSE Grant program, which began in 2014, has helped build one of the most extensive networks of public charging stations in the nation. However, additional programs will need to be considered to ensure broad and equitable access to reliable charging in the future.

The Vermont PUC report calls attention to the need for incentives to drive consumer adoption of EVs and operator commitment to charging stations.[73] While no incentive level was specifically recommended, past research by Drive Electric Vermont has demonstrated the likelihood of EV purchase increased from approximately 20-25% without incentives to 41% with a $2,500 incentive.[74, 75] This survey also found higher levels of incentives continue to drive higher demand for electric vehicles, as exemplified by an eight-fold increase in Nissan Leaf sales following a special automaker discount program offering $10,000 several years ago. Although consumers identified incentives offered at the point of sale to be more attractive than traditional rebates and tax credits, they also signified a greater willingness to wait as incentive amounts increase.

There are a variety of approaches taken by state legislatures have been pro-active in developing incentive programs to encourage the adoption of electric vehicles and the development of necessary charging infrastructure. Presently, 47 states offer incentives of some kind to support

[73] Vermont Public Utility Commission. Report to the Vermont State Legislature. 2022. https://puc.vermont.gov/sites/psbnew/files/doc_library/act-55-electric-vehicle-rates-2022-report.pdf
[74] Drive Electric Vermont Workshop 4 Presentation. No. 18-2660-INV. PUC. 23 April 2019.
[75] VEIC. Drive Electric Vermont 2016 Survey of Electric Vehicle Awareness & Interest. 2016. https://www.driveelectricvt.com/Media/Default/docs/dev_2016_consumer_survey_report.pdf

EV development[76]. While many states, like Vermont, used a portion of their Volkswagen Environmental Mitigation Trust funds to support EVSE deployments, it remains to be seen whether these programs will continue following the depletion of these funds. States such as Nevada, Washington, Maryland, and many others have established direct funding programs utilizing general funds, or in some cases leveraging existing and stable sources of federal funds.

The level of funding provided by states is typically in the range of $3,000 - $7,000 per charger for Level 2 chargers, and as high as $55,000 per charger for DCDC Level 3 charges (MD).

Tax Credits

Incentives are not the only measure to drive down costs of electric vehicles. The PUC also recognized opportunities to reduce costs through State tax breaks on the sale of EVs. This could sway consumers that are considering the purchase of a new vehicle to choose electric over a similarly priced gas-powered vehicle. Moreover, given the limited market of EV adoption presently, a 6% tax waiver on EVs would not significantly impact the State budget. This provision could be phased out as the market grows and electric vehicles garner more public support. Alternatively, the PUC recommended a 5% tax waiver and to allow for dealerships to retain the 1% tax for electric vehicle sales. Here, consumers still benefit from a significant tax break while the midstream incentive encourages dealers to actively market and sell EVs.

Several states, including Louisiana, Oklahoma, and New York, have instituted financial incentives for EVSE in the form of tax credits. These programs provide individuals an income tax credit to cover between 30% – 50% of the cost of qualifying EVSE infrastructure.

Some studies in behavioral economics have indicated that individuals may value avoiding paying taxes more than receiving a direct funding benefit, but additional research is needed to confirm this conclusion[77]. Tax credit programs can sometimes be easier to administer than direct funding programs, since beneficiaries already need to file taxes annually. However, unless a fixed dollar limit is instituted, which would add administrative costs, the cost of a tax credit program can be difficult to estimate.

Other Policies and Programs

Two states have instituted unique programs that utilize property taxes to support EVSE infrastructure. In California, the Property Assessed Clean Energy Loss Reserve (PACE) Program, enables property owners to borrow funding to install EVSE. In Florida, local governments have been authorized to assess non-ad valorem taxes to fund EVSE installations on private property.

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[76] National Conference of State Legislatures. 2021. https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx

[77] Minnesota House Research. Tax Expenditures vs Direct Expenditures: A Primer. 2018. https://www.house.leg.state.mn.us/hrd/pubs/taxvexp.pdf

However, EVSE deployment faces additional barriers beyond costs. Zoning ordinances, for example, greatly differ between communities, potentially containing codes that restrict siting of charging stations in a manner that discourages EV adoption within the community. The PUC report identifies this as an area where the State can task municipalities to review codes to encourage the growth and development of EVSE. Similarly, building codes can be crafted to require new construction to have "EV ready" electrical connections. Other states, such as California and New York, have enacted statewide requirements for some new construction to incorporate EV ready infrastructure in the planning and design of buildings.

While many of the existing initiatives for education and outreach hinge on incentive offerings, the PUC has identified opportunities to grow consumer awareness of EV ownership. The report specifically calls attention to the lack of consumer knowledge about cost-saving opportunities of EV ownership and how to take advantage of all incentives that are offered. As part of this, the PUC recommended funding be established for Drive Electric Vermont's efforts on education and outreach throughout the state. Passed soon after the report, the Energy Efficiency Modernization Act directed Efficiency Vermont to use funds from the Energy Efficiency Charge in part to expand consumer education and awareness of electric vehicle financial and societal benefits. This effort, as suggested by the PUC, will be bolstered by targeting younger Vermonters to shape a well-informed future generation of EV owners.

Barriers to Adoption

There are a number of state actions, and inactions, that present barriers to the widespread and equitable adoption of EVs. Most importantly, entities that sell electricity for EV charging need to be given the freedom to set prices without being regulated as a traditional electricity provider. In most states, this requires special action, but is essential to enabling the proliferation of a competitive private-market charging ecosystem where providers can set prices to respond efficiently to consumer demands. With the passage of Act 59 in 2019, the State of Vermont has overcome this regulatory barrier.

Certain types of incentive programs will be more effective at providing meaningful access to EVs and chargers for low-income drivers. Programs that provide funding at the time of purchase, such as vouchers or "point of sale" rebates, reduce the amount that drivers need to bring to the purchase through savings or financing. In contrast, programs that provide funding after the sale of an EV or charger, such as mail-in rebates and tax credits, still require the purchasers to provide the full purchase price in cash or financing, and may pose a barrier to lower-income drivers.

When planning for EVs and charging infrastructure, it's important to recognize that different communities may have very different transportation needs that are more or less compatible with EV ownership and different forms of EV charging. People in rural communities often drive long distances for daily activities, and have limited access to public transportation services. People in more urban areas may rely less on personal vehicles, and be less likely to have access to home

charging. It may be valuable to conduct community mobility assessments, or to leverage existing ones, when considering how and where to deploy resources to encourage EV usage.

EVSE Business Model Development

Public investments have been a "critical stopgap"[78] to supporting the growth and development of electric vehicle charging stations during the early phases of the market. Although significant funds from public sources have recently been made available to continue market expansion, more interest must be generated from private sources for sustainable operation of stations. Moreover, while grant funding has been essential to expanding the nascent EVSE network, initial station utilization, customer turnover, and revenue generation from increased traffic have been found to be more prominent factors for profitability than subsidizing station costs.[79] While this presents challenges with current market conditions, it also opens opportunities for creative business models to emerge.

As EV market share grows over the next decade, and penetrates new markets, the need for privately funded, publicly accessible EV charging infrastructure will become increasingly important. A significant number of new public DC fast charging stations will also be needed – nationally, the number of public DC fast charging stations will need to double by 2030 in order to keep up with charging demands.80 Private retail businesses, as destinations for both customers and employees, present excellent opportunities to host public EV charging stations. However, while EV charging stations can offer a range of benefits to site hosts, private EVSE operators face significant financial risks and uncertainty.

Existing stations operate under a variety of fee structures and station amenity offerings to turn profit. Many stations operate in partnership with site hosts, providing benefits and streams of revenue beyond the sale of electricity. Auto manufacturers and dealerships, for example, are able to sell more electric vehicles if consumers are confident the charging infrastructure is adequate to meet their needs. Retail site hosts, on the other hand, may attract more customers and boost brand image by providing charging stations in parking lots. The context of the site host matters in determining which business model will generate the greatest stream of revenue for partner businesses and station owner-operators alike. As such, it is difficult to ascertain the time horizon in which private investments will overtake public funds supporting the EVSE network.

While partner businesses may be concerned about free ridership from similar organizations that are not investing in charging station partnerships, those that establish themselves as known and trusted sources will inevitably benefit the most in coming years from rapid EV market growth.

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[78] California Energy Commission. 2021. Electric Vehicle Charging Infrastructure Assessments. https://efiling.energy.ca.gov/getdocument.aspx?tn=238853.

[79] Atlas Public Policy. 2020. Public EV Charging Business Models for Retail Sites Hosts. https://bit.ly/3MNFKxA

[80] National Renewable Energy Laboratory. 2021. Electric Vehicle Charging Infrastructure Trends from Alternative Fueling Station Locator: Second Quarter 2020. https://www.nrel.gov/docs/fy21osti/78486.pdf.

EVSE stations can refine existing business models to fit site needs to maximize profit potential while minimizing risk to investors. Considering this, support from state agencies and regulators for the different site types, asset ownership, and business models will be key in transitioning away from public funding sources and expanding private market investments.

Fee Structures

Partnerships with site hosts will be imperative to ensure cost recovery, particularly as public funds diminish. Stations that recover costs solely through use fees will be unable to achieve financial sustainability until the EV market is in late stages of maturation. In fact, use fees contribute quite little to station revenue in comparison to indirect sources. Strategically structuring fees and indirect revenue streams will ensure station viability without public investments even in today's low EV market presence. Each structure and fee designation influences the charging behavior of EV drivers and must be considered accordingly as to how it may impact indirect revenue streams.

Stations that were funded with significant upfront capital from grants and benefit from indirect revenue streams may opt for a no fee pricing structure to encourage high station utilization and attract EV drivers to the site location. Here, charging is provided as an amenity and there is no cost to charge vehicles. For stations that received less grant funding or that had higher fixed costs to develop the station, a nominal fee may be applied to cover costs. The fee would be set high enough only to recoup operational or installation costs. This may also offer protection to the station owner-operator for spikes in operational costs from demand charges or high utilization during peak times. As the market progresses and more capital is obtained through private investments, stations may turn to operating as a profit center. Under this structure, fees for charging are designed to profit from the sale of charging services. Fees for both nominal and profit structures may be charged through the sale of electricity in kWh, the amount of time the vehicle is connected to the charger, or a per use charge regardless of time or energy consumed.

Fees can be structured to fit unique needs of site hosts if informed by robust data analytics. Charging fees can be designed to attract more customers to the location, encourage faster customer turnover, or increase time spent at the site. A retail site host, for example, may be inclined to assess no fees associated with vehicle charging to attract more customers and support longer visits. Others may want to assess fees per kWh or charge for longer durations to encourage quick turnover. Each strategy has implications for site visitation and value generated from indirect sources. As such, host sites may be inclined to own and operate stations themselves for quality control purposes.

Business Models

In addition to fee structures, EVSE stations can be owned, operated, and maintained by different entities. Some site hosts may be inclined to act as the station owner-operator to have full control over the charging equipment, construction, operation, and maintenance. Outside service

of network software may be purchased by the site host, though the owner-operator still may assign fee structures best suited to the specific business needs and retain all profits from station operation. This model may generate vastly greater profits for the site host, though it comes with risk of unprofitability if the station is not utilized as expected.

With such high upfront costs of EVSE stations, a site host may relinquish control to a third-party owner-operator. This reduces the financial risk for site hosts while generating a consistent, albeit diminished, revenue stream. Regardless of if the station is profitable, the station would generate revenue from leasing the space. While this offsets financial risk, relinquishing control to a third-party may impact customer satisfaction as the site host does not dictate fee structures or maintenance schedules. To encourage third-party interest, site hosts may offer to subsidize some of the upfront costs or participate in revenue sharing with station owner-operators.

Strategies to Facilitate Private EVSE Site Hosts

Grant funding for installation

As discussed in the previous section, financial incentives for the purchase and installation of EVSE are an important way for the State of Vermont to support the growth of the private EVSE market. Given the risks and uncertainty facing potential EVSE site hosts, grant funding serves as a valuable hedge against early unprofitability for station owner-operators. However, given the magnitude of on-going operations and maintenance costs, grant funding is not expected to have a significant effect on the long-term profit potential for site hosts when compared to other factors81. Still, grant funding may allow sites to expand the number of chargers available, offer higher capacity chargers, or otherwise future proof sites.

Incentives for operations and maintenance

Over the life an EV charging station, the cost to operate and maintain the equipment will far exceed the up-front capital and installation costs. For this reason, programs that reduce operations and maintenance costs will be particularly effective to support the proliferation of private EVSE operators. Programs of this type include favorable rate structures from utilities, as previously discussed, that can reduce the magnitude and variability of energy costs. Additionally, programs that support the training of contractors and technicians who install, repair, and maintain EVSE equipment can have a significant effect on the long-term viability of private EVSE sites. Poor installation is a common cause of EVSE degradation, equipment failure, and downtime, and can be mitigated by ensuring local contractors have specific training related to EVSE82. Additionally, properly trained maintenance technicians will be able to reduce charger downtime by efficiently diagnosing and repairing equipment failures.

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[81] Ibid.

[82] ESource. 2022. Building an EV Charger Asset Management Plan. https://www.esource.com/436211hldn/building-your-ev-charger-asset-management-planY

Data sharing across stakeholders

One of the most important factors influencing the profitability of a private EVSE station is charger utilization. Chargers that used just a few times a day will not provide enough revenue to cover the costs associated with installation, operations, and maintenance. This becomes even more significant under a rate structure that includes demand charges83. Choices relating to charger location, charger speed, the number of chargers at a site, and pricing will all have an effect of charger utilization at a particular site. As DCFC stations are more expensive, it will take time for private investments to funnel into the ownership and operation of stations; utilization rates must rise to promote a viable business model for private entities.

To support private EVSE sites that have high utilization, the State of Vermont could consider programs that make data available on existing charger locations and utilization. This will help potential private EVSE operators make smart placement decisions, avoiding oversaturating some locations while also ensuring chargers are placed in locations where there is sufficient demand. Additionally, making informed decisions on what business model to apply becomes a challenge with limited data availability. To gather insights on best practices, the state and municipalities could pilot different ownership models rather than delay until enough data is available. Pilots should continue to be explored as the market matures in order to evolve and improve ownership structures and allow for future flexibility as new technologies and charging behavioral patterns emerge.

Regulatory

Coordination between state, regional, and local governments is vital to streamlining EVSE network development. Moreover, supporting a variety of site types, approaches to asset ownership, and charging business models is vital to expanding the market and promoting private investments. In a report by the California Public Utility Commission[78], growth of electric vehicle charging has largely been attributed to:

- CPUC's decisions to not regulate charging service providers as utilities to enable a broad range of business models that independently deliver electricity as fuel.
- Incentives funded by utilities, state programs, and settlement funds have reduced cost barriers to installation. Uncertainty around future availability of funds was cited as a concern by private investors by jeopardizing the ability to plan deployments effectively.
- The Low Carbon Fuel Standard, which offers a combination of capacity credits, base fuel credits, and incremental fuel credits, created greater financial certainty for new charger deployments and encouraged delivery of electricity as a fuel. This provides capacity credits for new DCFC deployments, base credits for delivery of electricity as a fuel, and incremental credits to encourage smart charging.

[83] National Association of Energy Officials. 2021. Demand Charges and Electric Vehicle Fast Charging.

- State and local building codes encouraged or required installation of charger make-ready equipment. This reduces the substantial costs to retrofit construction with infrastructure to support EV charging.
- Including charging infrastructure as a compliance pathway for GHG emissions reductions targets.

Indirect Revenue

Indirect sources of revenue can be a large determining factor in the financial success of stations. In an assessment by Atlas Public Policy[79], advertising revenue generated the greatest impact on profitability. Here, stations can generate an additional source of revenue through means such as stationary backlit displays on chargers. In examples simulated by Atlas Public Policy, two displays increased the average net present value by more than 150%, and all scenarios that included advertising revenue were profitable. However, value derived from stations by advertising agencies is dependent on the station's attributes. Those with high foot traffic, such as stations placed near entrances of retail locations, would generate greater indirect revenue streams than stations designed for quick stops by EV drivers. Other indirect opportunities include revenue sharing with site hosts, where a certain percentage of profits are exchanged to the station owner-operator for the increased traffic the charging stations may bring in for the site host.

Promoting Private Investments

While grant funding may not greatly impact the profitability of stations, high upfront capital costs, low rates of return, and asset risks have dissuaded significant investments from private entities. Costs are quite variable and location specific; DCFC stations can range from around $100,000 for sites built around existing infrastructure to upwards of $1,000,000 networked stations needing electrical infrastructure upgrades. Preliminary data from California's Electric Vehicle Infrastructure Project has found total project costs to average around $2,000 per kW, while public investments support nearly $1,300 per kW of installed costs[78]. While this may seem significant, the ratio of public-to-private capital expenses is lower than the amount supported by NEVI funds, signifying the state's success in encouraging private investment. Given California has the most EVs on the road, Vermont should look to the state for guidance and lessons learned.

Public funds must be used during the initial market transition to alleviate disproportionate costs by early adopting companies. Maturation of technologies and companies in this space will allow for larger capital projects to be invested in by private entities and, as the market expands, more profitable cases will arise to draw in investors. Diversifying revenue streams is vital to ensuring station profitability. With this, multiple business models and fee structures may be pursued by station owner-operators. This may include site hosts leasing spaces to third parties, site hosts acting as owner-operators, revenue sharing, or private subsidization of upfront costs. The state will have to balance allowing regulatory flexibility with price transparency for consumers.

EVSE Siting Considerations

Site Purpose

EV performance has continued to improve alongside market expansion and auto manufacturer investments. Some new BEV models entering the market have reached parity with the range of ICE vehicles, while PHEVs are able to handle local trips exclusively on battery. Despite this, range anxiety still exists amongst would-be consumers, likely due to the limited infrastructure to support long-range travel. To counter this, guidance for NEVI funds considers a fully developed network to have stations located within one mile from the Interstate Highway System and highway corridors and spaced no more than fifty miles apart. To meet this goal, stations may be located on public lands, including Federally owned lands.

Expectations for how long EV drivers will remain at a charging station is dependent on host site characteristics. Even host sites with similar purposes may benefit from customer turnover differently; one store may benefit from longer dwell times while others may prioritize customer turnover. As previously discussed, it is important to consider these discrepancies between site hosts and maintain flexibility in siting considerations while incorporating some standards to protect consumers and investments alike. Past grant opportunities from ACCD[84], for example, required site hosts to agree to at least seven years of operation and maintenance of the station. This ensured site hosts were personally invested in long-term prospects of station viability and planning.

Further NEVI guidance prioritizes buildout in areas that have existing public infrastructure such as restrooms, appropriate lighting, and sheltered areas. The ambiguity in site description encourages diverse candidates to apply for funding while limiting station buildout costs. Moreover, this ensures multiple purposes for station visits and encourages indirect funding opportunities. While the state should allow for this kind of flexibility for site hosts and business models, it also must consider consumer protections against deceptive or fraudulent business practices.

EVSE Location Planning

Coordinating station rollout with utilities must be considered for how EVSE impacts power supply. Unmanaged or unplanned for EV charging could cause utilities to incur significant costs to maintain grid reliability and create challenges for grid operators. Clusters of high-power stations may also necessitate intensive grid upgrades and buildout. Site planning may incorporate utility management of EV charging resources, particularly during times of peak

[84] Agency of Commerce & Community Development. 2021. Vermont Electric Vehicle Charging Station Grant Program – Round 4. https://bit.ly/3LEPhXl.

energy costs. This may take the form of rate designs with obvious price signals to influence charging patterns and behaviors to align with off-peak hours or peak renewable energy generation as suggested by past PUC reports on electric vehicles[85]. Planning with utility partners may streamline permitting and limit project costs and impacts to the energy grid.

Grants offered by ACCD to support EVSE stations have focused on site design. Relevant to siting considerations, supported projects must have at least three dedicated parking spaces for EVs that are accessible at all times. This exclusivity for EVs is necessary to ensure drivers can refuel their vehicles at the cost of sites with smaller footprints potentially being ineligible for consideration. The addition of EVSE also cannot impede or interfere with the flow of traffic while accommodating for different charging port locations on vehicles.

Both past ACCD grants and NEVI funds include provisions regarding "future proofing" EV charging locations as part of their design. While ACCD has only stipulated designs must incorporate electrical infrastructure accommodations to support future higher capacity chargers, NEVI will only support projects with at least four 150 kW ports that are capable of simultaneous charging. The federal funds also call for design considerations beyond this to support the expansion of higher power chargers, particularly those that may support the needs of future medium- and heavy-duty electric vehicles.

Some innovative technologies have been deployed to account for siting complexities. FreeWire, as previously discussed, has developed EVSE stations with integrated stationary energy storage. This allows for DCFC stations to be sited in areas without three-phase power or necessitate significant infrastructure upgrades. The company offers a mobile unit with an onboard battery capable of charging up to 10 vehicles at Level 2 charging capacity. While this does not meet NEVI requirements, it provides an opportunity for site hosts that have limited ability to install permanent charging ports yet would like to provide the benefit to customers or employees. Similarly, stationary energy storage can be deployed alongside stations, though use cases are limited and may not prove to be beneficial during periods of extended cold temperatures.

Drive Electric Vermont hosts a charging installation guide[86] that provides detailed information on commercial and residential charger installation. It provides examples of site plans, recommendations for design, estimates of costs, and other considerations. The guide expands upon many topics covered in this section and provides relevant resources to plan for commercial charging networks. Likewise, residents may use the guide for home charging considerations for both single and multifamily applications.

Fleet Considerations and Future Advancements

[85] Public Utilities Commission. 2019. Promoting the Ownership and Use of Electric Vehicles in the State of Vermont. https://www.driveelectricvt.com/Media/Default/docs/Vermont_PUC_Electric_Vehicle_Report_June2019.pdf
[86] Drive Electric Vermont. 2014. Charging Installation Guide. https://www.driveelectricvt.com/charging-installation-guide

Private Light-Duty Fleets

Businesses and organizations can realize cost saving benefits by transitioning fleets to electric vehicles.[87] Currently, as much as half of private EVSE ports are used for fleet charging, the majority of which being Level 2 stations. Of this amount, nearly 75% are dedicated for light duty vehicles. This number will continue to rise as infrastructure becomes more widely accessible, as the per mile cost savings of electric vehicles already presents a strong business case for electrifying fleets. Moreover, increasing competition and innovation in the EV market will drive down initial purchase costs and close the upfront affordability gap between EVs and fossil-fuel powered vehicles. By 2050, the Energy Information Administration projects that EVs will account for 31% of fleets globally, up from 0.7% today.[88]

To better understand savings potential, VEIC analyzed[89] several EV fleet case studies for Vermont municipalities and nonprofits that utilized electric vehicles as part of fleet offerings. The research demonstrated that the cost of maintenance, lease payments, insurance, and fuel costs can be lower than the federal fuel reimbursement rate ($0.54/mile) if the vehicle was driven at least 10,000 miles per year. Notably, as the report was completed in 2016, the economics have only continued to improve in favor of EVs. Challenges identified in the report, too, have continued to be addressed as the EV market matures. Winter performance, and particularly range, have significantly improved for newer EV models compared to the Mitsubishi i-MiEV's studied in the report. Improvements in these areas will enable fleets to be used in a greater capacity than identified in the report and yield even more potential cost savings.

Private Heavy-Duty Fleets

Despite making up just 4% of the total vehicle stock,[90] heavy-duty vehicles account for nearly a quarter of total transportation emissions in the United States. This hard-to-reach segment of the transportation sector requires a multifaceted approach to decarbonize and is especially concerning as emissions from heavy-duty vehicles continue to rise. Recognizing this challenge, in 2021 Vermont signed the Northeast States for Coordinated Air Use Management (NESCAUM) memorandum of understanding,[91] a multi-state agreement to accelerate electrification of trucks and buses. This agreement sets a goal for all new medium- and heavy-duty vehicle sales to be zero emission by 2050. Connecticut, Massachusetts, Maine, New York, Rhode Island, and Quebec were also part of the 17 jurisdictions that signed the agreement, providing support in neighboring areas that will be key in connecting the transportation network for electrified medium- and heavy-duty vehicles.

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[87] Brown, Abby, Alexis Schayowitz and Emily Klotz. Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: First Quarter 2021. 2021. https://www.nrel.gov/docs/fy21osti/78486.pdf
[88] Dwyer, Michael. EIA projects global conventional vehicle fleet will peak in 2038. October 2021. https://www.eia.gov/todayinenergy/detail.php?id=50096
[89] VEIC. Electric Vehicle Fleet Case Studies. 2016. https://www.ccrpcvt.org/wp-content/uploads/2018/12/V2-FINAL-CCRPC_EV_Fleet_CaseStudies_CCRPC.pdf

It is recognized that heavy-duty vehicles that travel shorter distances on predictable routes that return to a centralized fleet depot are well suited for transitioning to electric today. These types of near-term deployments will help to prove electrification of this segment of the transportation sector, while the technology and market for more challenging applications evolve. For example, with funding from the VW settlement, Casella Waste Systems has ordered two electric waste haulers. In the coming year, Green Mountain Power will be replacing two fossil-fuel vehicles with two fully electric heavy-duty vehicles, a stake truck and bucket truck, largely supported by the VW settlement fund proceeds. Additionally, two vehicle-to-grid chargers will be dedicated for the trucks, which GMP expects to generate more than $135,000 in savings for customers through peak energy reductions. Furthermore, financial models by the National Renewable Energy Laboratory (NREL)[90] have found that fully electric Class 8 tractors and Class 4 parcel delivery trucks will be competitive to conventional alternatives by 2025. Refueling and infrastructure costs were found to be the most influential on the total cost of ownership, signifying the need to prioritize work on making the transportation sector electric ready and crafting favorable policies that promote this transition.

This is corroborated by NREL's 2019 workshop on Commercial Vehicles and Extreme Fast Charging Research Needs.[91] Insights from this workshop found the greatest challenges to medium- and heavy-duty fleet electrification revolve around vehicle performance and availability, charging standards, electricity rate structures, and necessary infrastructure upgrades for both front-of-the-meter and behind-the-meter applications. The State's role in addressing these challenges will be to standardize best practices and alleviate financial burdens in the development and operation of charging stations.

These classes of vehicles have unique challenges to electrification, and therefore must have separate considerations from light-duty vehicles in the development of a charging network. Unlike private vehicles which experience extended periods of downtime and can take advantage of flexible charging schedules, medium- and heavy-duty vehicles operate under strict schedules and often require long distances between charges. This necessitates higher power infrastructure designed to allow larger vehicle access to charge larger batteries in a timeframe consistent with vehicle operating schedules. In other words, supporting medium- and heavy-duty fleets will likely require more DCFC ports than light duty fleets.

Some smaller delivery trucks may be able to use Level 2 AC charging. As background, electricity from the grid and provided by Level 1 and Level 2 EVSE, is delivered as alternating current (AC). Charging through AC EVSE requires the vehicle to have an on-board inverter to convert the AC to direct current (DC) power that can be received by the EV battery.[53] This can add additional

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[90] Hunter, Chad, et al. Spatial and Temporal Analysis of the Total Cost of Ownership for Class 8 Tractors and Class 4 Parcel Delivery Trucks. 2021. https://www.nrel.gov/docs/fy21osti/71796.pdf.

[91] Walkowicz, Kevin, Andrew Meintz and John Farrell. R&D Insights for Extreme Fast Charging of Medium- and Heavy-Duty Vehicles: Insights from the NREL Commercial Vehicles and Extreme Fast Charging Research Needs Workshop, August 27-28, 2019. https://www.nrel.gov/docs/fy20osti/75705.pdf.

weight and complexity to the vehicle that larger vehicle manufacturers are moving away from. DCFC, on the other hand, delivers DC power directly to the vehicle's battery, but requires on-site infrastructure to convert AC power from the grid.

AC EVSE can use standard voltages ranging from 120-480 Volts. DC is less standardized but can provide higher voltage levels that are better aligned with larger battery battery packs. With higher voltages, safety is a greater concern. This opens the possibility for utilities to provide DC as a service (DCaaS), as they have the expertise, equipment, and business model in place to manage this type of infrastructure. This could eliminate a potential barrier for station operators that do not want to take on the comparatively higher risk for an entity that has no other use for such infrastructure.

Utilities in other states have already made strides in supporting the transition to EV fleets with similar kinds of services. Southern California Edison's (SCE) Charge Ready Transport Program,[92] for example, offers low- to no-cost upgrades to business's electrical systems to support the installation of EVSE. As part of the program, SCE will evaluate site specific electrical infrastructure needs, develop utility and costumer cost estimates, design and manage the project, and secure all necessary permits. A separate meter will also be dedicated to the EV charging infrastructure to waive customer demand charges through 2024. Vermont should consider prioritizing innovative programs that support the development of charging infrastructure for medium- and heavy-duty vehicles and expedite the regulatory process as opportunities arise.

Other challenges arise in meeting charging needs of larger vehicles while limiting demand impacts. Co-locating onsite renewable generation and/or battery storage is a reliable method to reducing demand on the grid. Private fleet EVSE may also benefit from future V2G applications that can take advantage of vehicles' battery storage that are not in use to assist in recharging others. Considerations must also be made for EVSE to support long-range public transit networks that cross the state. These stations will require significant power capacity and would similarly benefit from onsite power generation and storage. The State should continue to investigate these opportunities, particularly around depots that can presently support medium- and heavy-duty vehicle parking. Funding for such opportunities may become available in federal infrastructure spending for freight corridors.

Bus Fleets

Public Transit

Public transit will experience similar challenges to other medium- and heavy-duty vehicle fleets. Still, efforts are already underway across the state to electrify bus fleets. These pilots will provide invaluable information to assisting in the transition to electrified transit options. In 2021, the Vermont Agency of Transportation received over $1 million to fund the purchase of four electric

[92] Southern California Edison. Charge Ready Transport Program. 2021. https://crt.sce.com/overview.

cutaway buses, charging equipment, and infrastructure improvements to serve Addison, Orange, and Northern Windsor counties.[93] This marks the fifth consecutive year Vermont was awarded the Low and No Emissions grant from the Federal Transit Administration. With the inclusion of two electric buses that will be purchased with Volkswagen Mitigation Trust funds, this will extend Vermont's public transit fleet to 18 electric buses operating or ordered in six of the seven transit organizations throughout the state. Notably, the first two electric buses in the state were delivered in early 2020 to Green Mountain Transit in Burlington.

In compliance with Act 55, the Vermont Agency of Transportation (VTrans) submitted a Zero-Emission Transition Plan to the legislature on January 31, 2022. This plan examines ways the State and its transit agencies can meet its established zero-emission targets - having 10% of the transit fleet electrified by 2025 and 100% by 2050. The plan evaluates a range of operational scenarios, including smaller vans and buses that are common throughout the state, and made recommendations for which routes could be electrified with present-day technology. The plan also makes high-level recommendations on charging infrastructure, maintenance and training, and funding strategies. The plan will serve as a living document to be updated iteratively as progress is achieved and external conditions change.

School Buses

In addition to public transit, Vermont school districts have partnered with the Agency of Natural Resources and VEIC to pilot an electric school bus program to determine feasibility of use across the state.[94] Champlain Valley School District, Franklin West Supervisory Union, and Barre Unified Union School District obtained school buses through a competitive application process and began operating two electric school buses during the 2021/2022 school year. These buses will be tracked over the course of the year as part of the pilot program to test how electric school buses perform in Vermont. VEIC includes resources on their website[95] school districts may use to understand the process of obtaining electric school buses, including guidance on getting started, comparing different models, utility bill impacts, and funding opportunities. The U.S Department of Energy's Alternative Fuels Data Center recently began hosting a series of webinars and technical trainings for K-12 school districts interested in electric school buses.[96]

Though as much as $36,000 can be saved in fuel costs across the lifetime of the bus, school districts still rely on additional funding resources to bridge the gap in up-front capital costs that presently exists between diesel powered and electric buses; electric options cost more than two-

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[93] Office of Governor Phil Scott. Agency of Transportation Receives Federal Grant for E-Buses. June 2021. https://governor.vermont.gov/press-release/agency-transportation-receives-federal-grant-e-buses.
[94] VEIC. Vermont students head back to school on electric buses. 28 October 2021. https://www.veic.org/news/vermont-students-head-back-to-school-on-electric-buses.
[95] Wallace-Brodeur, Jennifer. Electric School Bus Resources. November 2019. https://www.veic.org/clients-results/reports/electric-school-bus-resources.
[96] Alternative Fuels Data Center. Electric School Bus Education. December 2021. https://afdc.energy.gov/vehicles/electric_school_buses.html.

and-a-half times as much than conventional counterparts even before the cost of charging equipment.[97] Other challenges the buses will contend with are range and charging infrastructure. Due to Vermont's mountainous terrain and cold winters, buses are not always able to reach the 100-mile range that can be achieved in optimal driving conditions. The longest route piloted so far extends 90-miles in a day, necessitating the driver to recharge midday to complete the route.

Resiliency and Emergency Response

EVSE Infrastructure Resiliency

EVSE resiliency increases as more infrastructure becomes available. With more stations operating across geographies, an outage becomes less impactful as drivers can source from alternative locations. This is supplemented by Vermont's 2032 goal of sourcing 75% of retail electricity sales to be from renewable resources, with at least 10% coming from new facilities on customer sites generating less than 5 MW.[98] A robust network of distributed energy resources and microgrids could limit large-scale grid disruptions and enable faster restoration of services following an outage.

The state has experienced a fair number of severe weather events that have had profound impacts on infrastructure. Hurricane Irene was declared a federal emergency in nearly all counties and left well over 100,000 residents without power, while the Great Ice Storm of 1998 provided constant precipitation for several days. These kinds of events are unlikely to be isolated, as Vermont will not be immune to impacts from a changing climate, either. Along with warmer average temperatures, the state will experience increased precipitation and greater instability of weather events overall.[99] These factors play into siting and infrastructure considerations for optimal deployment of EVSE.

Operating and maintenance strategies also impact the availability of EVSE infrastructure during and after severe weather events like snowstorms. The State of Vermont uses performance standards within its contracting approach in order to ensure that EVSE providers develop plans (snowplowing and shoveling, for example) for public charging equipment and host sites to be accessible during emergencies and major climate events.

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[97] Robinson, Shaun. "Electric school buses roll out in pilot project in 3 Vermont districts." November 2021. https://vtdigger.org/2021/11/02/electric-school-buses-roll-out-in-pilot-project-in-three-vermont-districts/.
[98] Vermont Department of Public Service. Vermont Comprehensive Energy Plan. 2022. https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan_0.pdf.
[99] Crossett, Caitlin and Mahalia Clark. "Climate Change in Vermont." The Vermont Climate Assessment 2021. Ed. G. L. Galford, J. Faulkner and L. Edling. 2021.

Cold weather resilience

While EV performance is impacted by cold weather, proper weatherproofing protections on charging equipment can insulate against environmental impacts. The National Electrical Manufacturer Association (NEMA) provides standardized ratings for electrical equipment's enclosure capacity to withstand various conditions. For cold climates, EVSE should be NEMA-4 rated to protect internal components against dirt, dust, precipitation, and ice formation.[100] This also protects components from freezing during periods of extreme cold. EVSE should be purchased with reliable weatherproofing certification to protect it from Vermont's environmental conditions.

Flooding

There are no codes or ordinances that specifically prevent charging infrastructure from being built in areas that may experience flooding, though EVSE is still subject to general development restrictions that may apply to designated floodplains and flood hazard zones.[101] Electric grid infrastructure extensions to an EVSE location would also be regulated by the Vermont Flood Hazard Area & River Corridor Rule. Additionally, development that occurs within a "base flood" zone that has a 1% chance of occurring each year falls under requirements set by the National Flood Insurance Program (NFIP).[102] NFIP requires methods for minimizing damage from floods, such as preventing water from entering or accumulating in equipment and resisting flood damage. These measures are typically achieved through raising the equipment above the base flood elevation to the greatest extent possible and protecting components that are below from water damage. While charging equipment is engineered to be safe in wet conditions, areas that are prone to flooding should be avoided. Anticipated impacts of a changing climate should also be considered when siting charging stations.

Power outages

Last year, Green Mountain Power and Vermont Electric Co-op reported average outage durations of approximately 2.5 and 1.5 hours, respectively.[103] Interruptions were limited as well, averaging between 1-2 outages experienced throughout the year for customers. These numbers align with historical averages, and along with the aforementioned renewable generation goals, this suggests Vermont is well suited to supply reliable power to EVSE stations.

For instances where reliability is a must, such as along evacuation routes, charging equipment can be supplemented with energy storage technologies. Incorporating batteries as part of a

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[100] National Electrical Manufacturer Association. NEMA Ratings for Enclosures. 2016. https://www.nemaenclosures.com/enclosure-ratings/nema-rated-enclosures.html.
[101] Vermont Agency of Natural Resources. Flood Hazard Area and River Corridor Protection Procedure. 2017. https://dec.vermont.gov/sites/dec/files/documents/DEC_FHARCP_Procedure.pdf.
[102] State of Vermont. Flood Ready Vermont. https://floodready.vermont.gov/flood_protection/river_corridors_floodplains/floodplains.
[103] U.S. Energy Information Administration. Electric Power Annual. 2021. https://www.eia.gov/electricity/annual/.

charging solution will also aid in load shedding and shifting during peak times, avoiding significant demand charges for operators. However, the rated power capacity of the battery must be considered to fit the maximum potential electrical output of the charging station. For emergency situations, having a backup diesel powered generator is an option as well.

This also speaks to the need for redundancy in charging network buildout. Similar to how multiple gas stations are available where permitted, multiple options for vehicle charging should be made available along high traffic corridors. Redundancy has remained a priority for the Vermont Legislature as exemplified in recent rounds of funding to support DCFC stations along high use areas on highway corridors.[104] With greater access of charging stations across the state, power interruptions become less detrimental to electric vehicle drivers. Along with this, the State should develop plans for how an electric vehicle charging network can be supported through varying degrees of outages. Responses and support will vary depending on if the outage is an hour, day, week, or whether it is localized or statewide. Proactive planning for different scenarios will allow the state to remain prepared under any condition.

Emergency Response

With appropriate protections and planning as noted above, Vermont will be well suited to respond to emergency situations with an electrified transportation sector. In scenarios where power won't be restored for an extended period of time, several options exist. Co-located power generation, storage and EVSE are a resilient option if islanded from the rest of the grid. Charging equipment manufacturers have introduced mobile EVSE trailers that can be deployed in emergency scenarios, some of which have the capacity for DCFC ports. Alternatively, mobile backup generators can be deployed to power EVSE if sites are designed with pre-planned interconnections and space for the generator. As a final consideration, Level 2 chargers should be installed near evacuation shelters or hotels. This will shift demand from vehicles relying on DCFC while driving to areas that can be charged overnight.

First responders are also gaining access to electric options. In 2020, the Windham County Sheriff's Office received a Tesla Model 3 to pilot as a replacement for several end-of-life vehicles and is expected to deliver cost savings to the department. Electric emergency response vehicles are being tested in other states as well. Electric vehicle manufactures Lightning eMotors and REV Group, Inc. announced the co-development of an electric ambulance with units delivered to the American Medical Response and U.S. General Services Administration in late 2021. In 2020, the Los Angeles City Fire Department signed a contract to receive the first plug-in hybrid electric fire truck in North America, while the Mesa Fire and Medical Department in Mesa, AZ has coordinated with REV Group to receive a battery electric fire truck in 2022. As this market develops, emergency responders should ensure EVSE at facilities can operate reliably regardless of environmental factors.

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[104] Vermont Agency of Commerce and Community Development. Electric Vehicle Supply Equipment (EVSE) Grant Program. 2021. https://accd.vermont.gov/community-development/funding-incentives/electric-vehicle-supply-equipment-evse-grant-program.

EVSE Location Planning

Equity Issues

Identification and Outreach to Disadvantaged Communities (DACs) in the State

Figure 14 displays disadvantaged communities (DACs) in Vermont as defined in NEVI guidance as part of the Justice40 initiative. The Initiative, established under Executive Order 14008, sets a goal of directing at least 40 percent of overall benefits from certain federal investments toward DACs. DOT and DOE combined definitions of DACs to produce data relevant to NEVI funding to highlight energy and transportation-burdened communities, those facing high rates of pollution or are highly dependent of fossil energy sources, and those with high rates of social vulnerability. FHWA dictates that 40 percent of all charging infrastructure funded by NEVI does not have to be distributed to DACs, rather states must ensure a magnitude of benefits flow into these communities. This may take place through access to resources, reduced energy burden, increased penetration of renewable energy resources, or reduced vulnerability through jobs or transportation security.

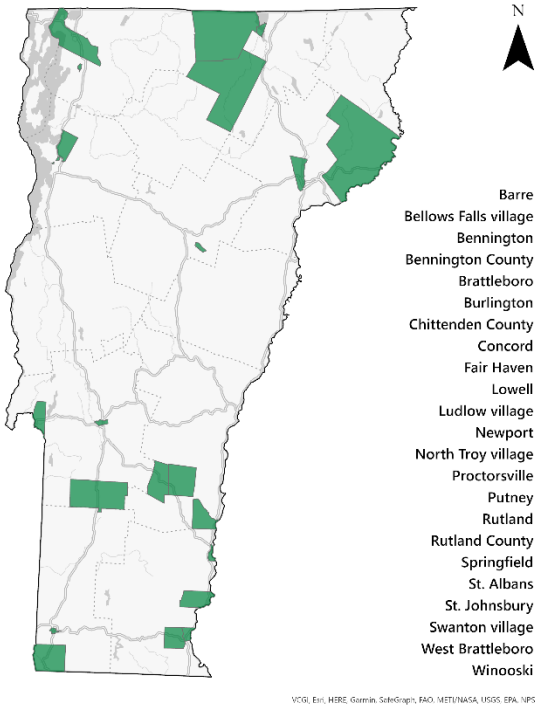


Figure 14. Disadvantaged communities in Vermont.

Process to Identify, Quantify, and Measure Benefits to DACs

Pollution resulting from the transportation and energy sectors have been disproportionately borne by disadvantaged, low-income, and otherwise underserved communities[105]. Further, these populations have historically been excluded from the benefits of clean market transitions. Considerations for developing the EVSE network must be made regarding siting, distribution, access, and affordability across all demographics. It is important to note that, as many EV drivers charge at home, those that will be utilizing the public network the most are those that do not have access to private charging infrastructure. Given the cheaper relative cost of at home charging, particularly when taking advantage of time-of-use rates offered by utilities, public chargers will be more expensive to construct, own, and operate. These costs will be passed

[105] Huether, Peter. 2021. Siting Electric Vehicle Supply Equipment (EVSE) with Equity in Mind. www.aceee.org/white-paper/2021/03/siting-electric-vehiclesupply-equipment-evse-equity-mind.

down to consumers to ensure station viability in turn harming those most susceptible to economic hardship.

Lower income and multifamily households are at a disadvantage due to this higher cost of public charging. Level 2 and DCFC stations in Vermont operated by Electrify America cost $0.43 per kWh with an additional $0.40 per minute idle fee after charging stops. Where available, Level 2 chargers cost $0.03 per minute. Comparatively, home charging under Burlington Electric Department's Residential EV Rate cost just $0.08 per kWh. This means those reliant on the public charging network must pay five times more to refuel an electric vehicle than those that have access to home charging. Multifamily households are disproportionately burdened by this and must contend with parking availability and inability to connect the vehicle to their metered electric service. Without this, and without a strongly built-out EVSE network, multifamily households are barred from the benefits EVs can provide.

Rural stations present a competing challenge of lower utilization with higher vehicle miles traveled per capita[106]. These stations may also see a greater ebb and flow of utilization in areas with high tourism traffic, impacting demand charges levied on station owner-operators. Moreover, many areas in rural Vermont do not yet have the electrical infrastructure capacity to support DCFC, adding to upfront project costs. Without these populations included in the market transition however, Vermont will be unable to achieve carbon reduction goals.

Benefits to DACs through this Plan

Some of these challenges may be addressed through policy and program design. Presently, the State of Vermont ACCD is issuing grants that prioritize EVSE projects located in affordable multifamily building complexes. The state should continue to design equity considerations into grant funding to uplift those that can benefit most from accessible and affordable charging. As upfront costs are offset, fewer costs must be passed down to the consumer. The state can design consumer protections into grants that are subsidizing costs to projects designed to benefit low-income and otherwise disadvantaged families. This will in turn expand access to electric vehicles for these populations to benefit from clean technologies. Additionally, the inclusion of EV make-ready infrastructure as part of new multifamily building codes will be a driver of lower costs and a means to reduce state funding for charging stations.

Engagement with rural residents will be critical to best understand needs and determine desirable locations for stations to be sited. While rural stations will be more dependent on public funding sources, the state can help encourage investments in rural and underserved areas through policy measures such as working with utility stakeholders, businesses and other organizations to further encourage investments. Additionally, the U.S. Department of

[106] U.S. DOT. 2022. Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure. https://www.transportation.gov/rural/ev/toolkit

Transportation has developed a Rural EV Funding Matrix[107] to help support states grow EVSE networks in rural areas.

The State of Vermont passed Act 154 in 2022 establishing a new state policy to advance environmental justice in disadvantaged communities, including development of mapping tools and engagement strategies to support this work.[108] Future iterations of this plan will consider new resources to identify DACs and consider associated EV charging needs and investments.

[107] U.S. Dot. 2022. Rural EV Funding Matrix. https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-funding-and-financing/funding-matrix

[108] Vermont General Assembly. Act 154 – An act relating to environmental justice in Vermont. May 2022. https://legislature.vermont.gov/bill/status/2022/S.148

EV Charging Geographic Analysis

There are many considerations in identifying the ideal locations for EV charging infrastructure. For NEVI funding, there are requirements to be within a certain distance of corridors. Availability of grid infrastructure, traffic volumes, and the location of disadvantaged populations are all considered in the map series below, starting with Figure 15 showing the federally designated EV corridors in Vermont and neighboring states that are the focus of this plan. Additional analysis will be performed as the State solicits stakeholder feedback on prioritizing future charging investments and makes progress in building out the designated corridors to the federal requirements.

Figure 15. Federally Designated EV Corridors

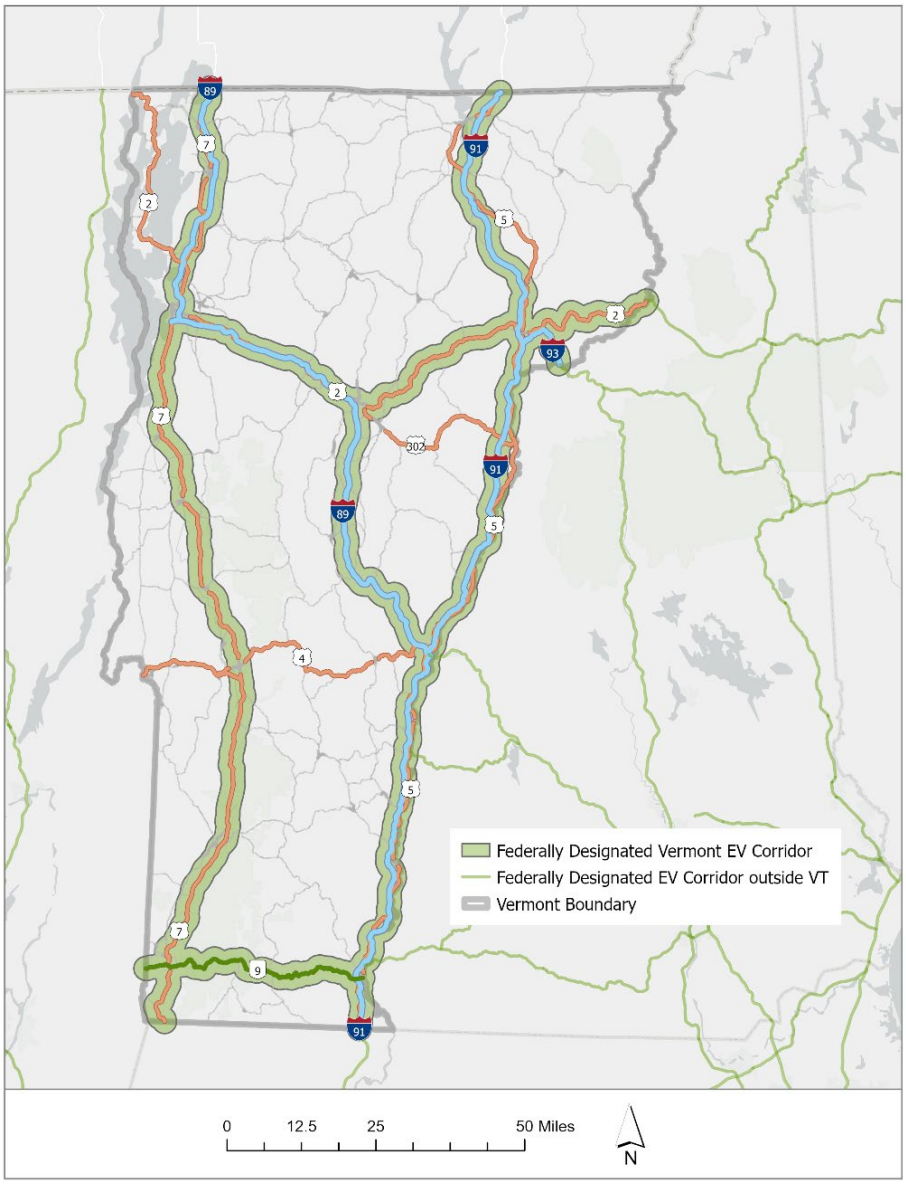


Figure below overlays current EV charging availability on the corridor locations, with distinctions made between Tesla-specific infrastructure and other non-Tesla charging locations.

Figure 16. EV Corridors with Existing EVSE Locations

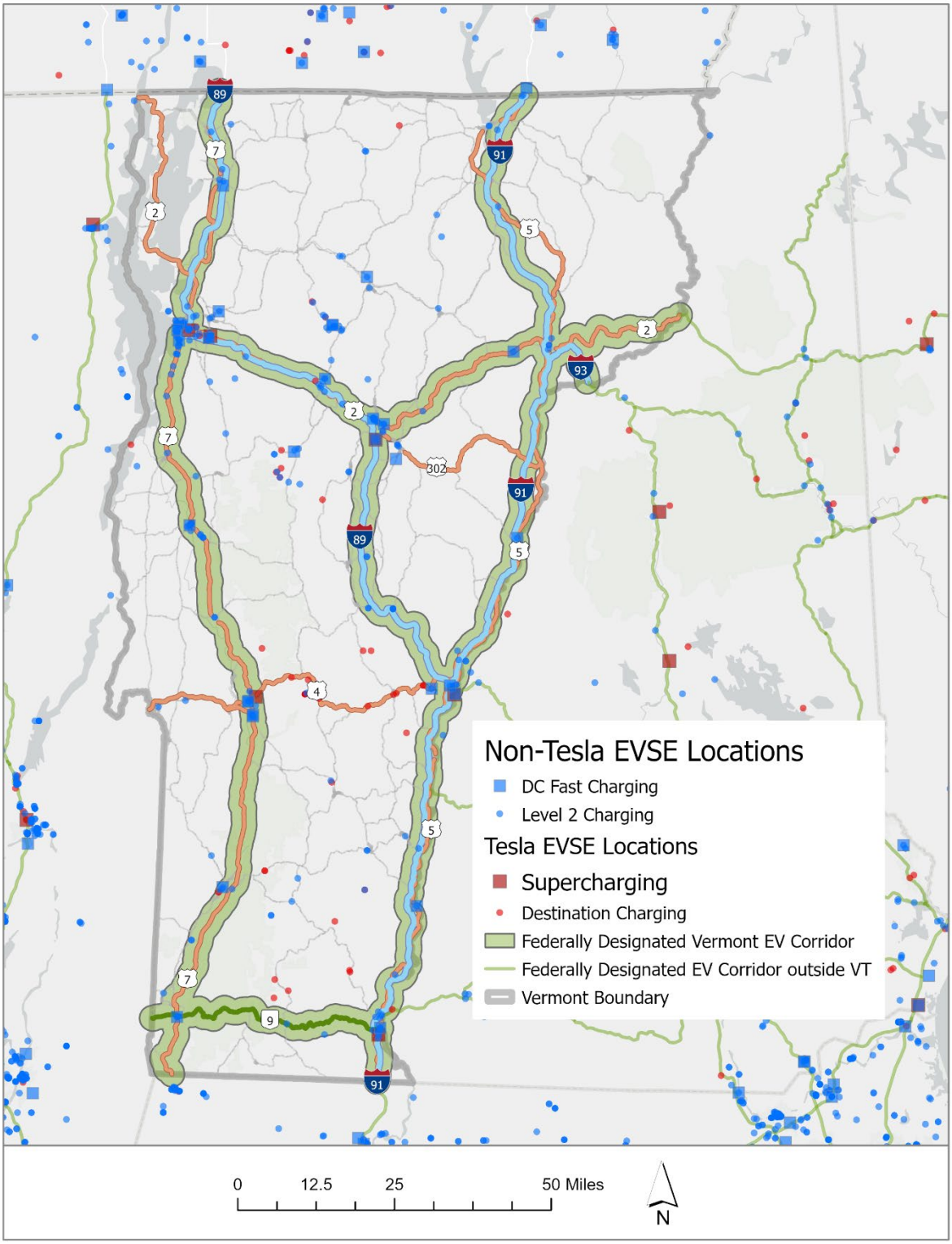


Figure 17 below summarizes general availability of 3-phase power across the State by dividing Vermont into 800-meter radius hexagonal grid cells. This unit of analysis was selected to offer localized analysis at a manageable scale as it was not feasible to perform site visits or grid assessments for thousands of potential individual locations. The presence of 3-phase power is generally regarded as a baseline requirement for installing four 150kW DCFC. The State will work with electric utilities, contractors, potential site hosts and other stakeholders as specific locations are identified and supported through NEVI funding.

Figure 17. 3-Phase Power Availability along Corridors

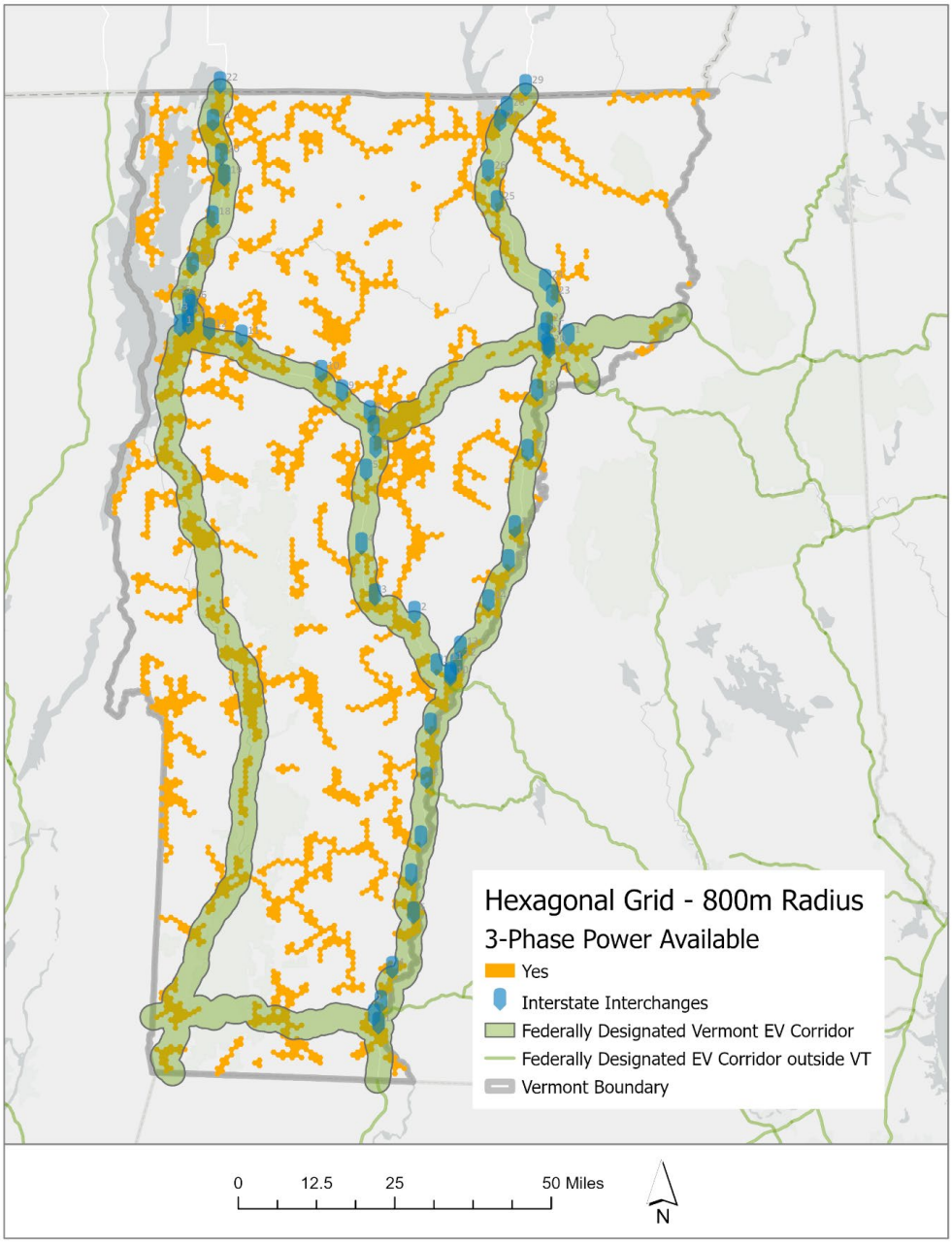
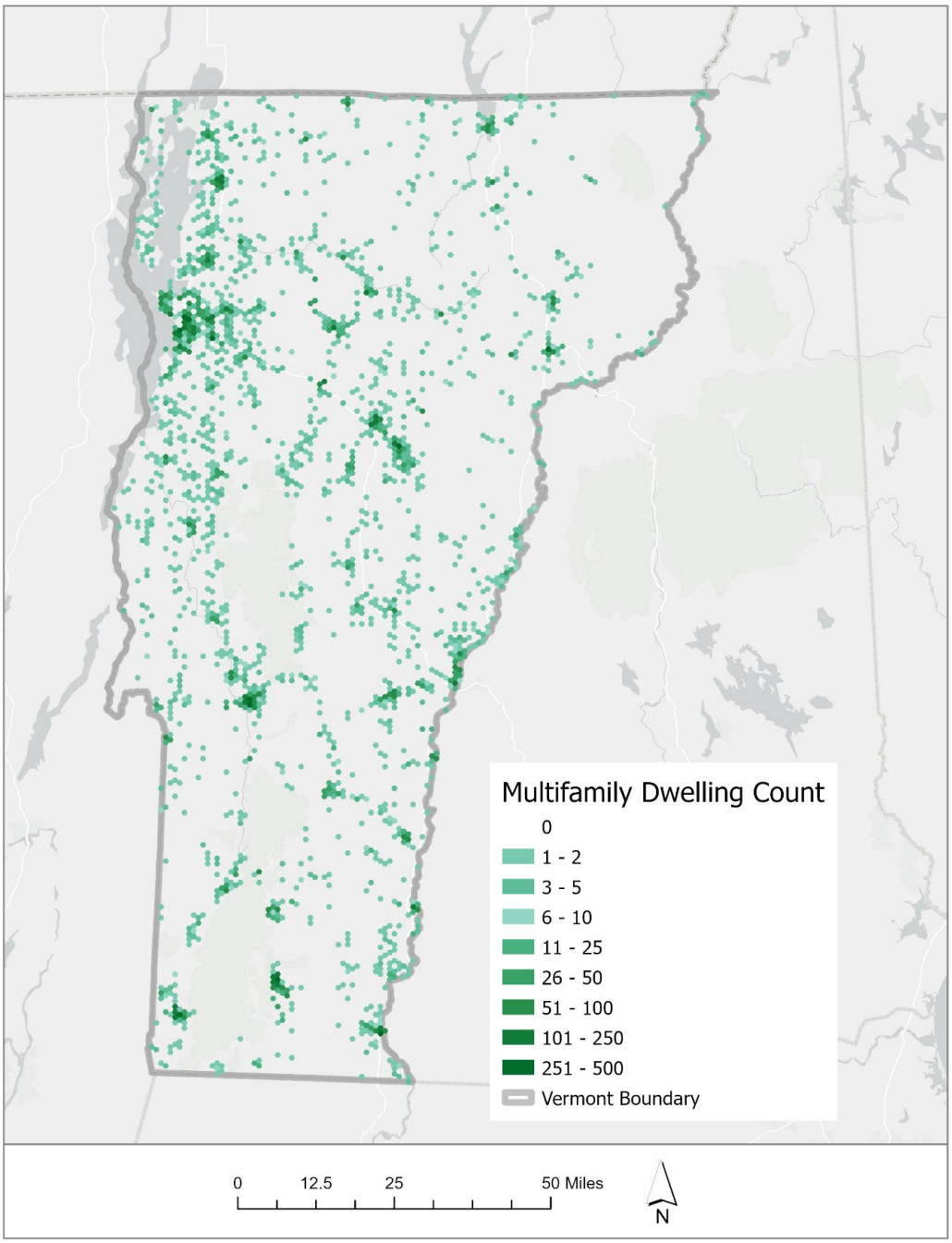


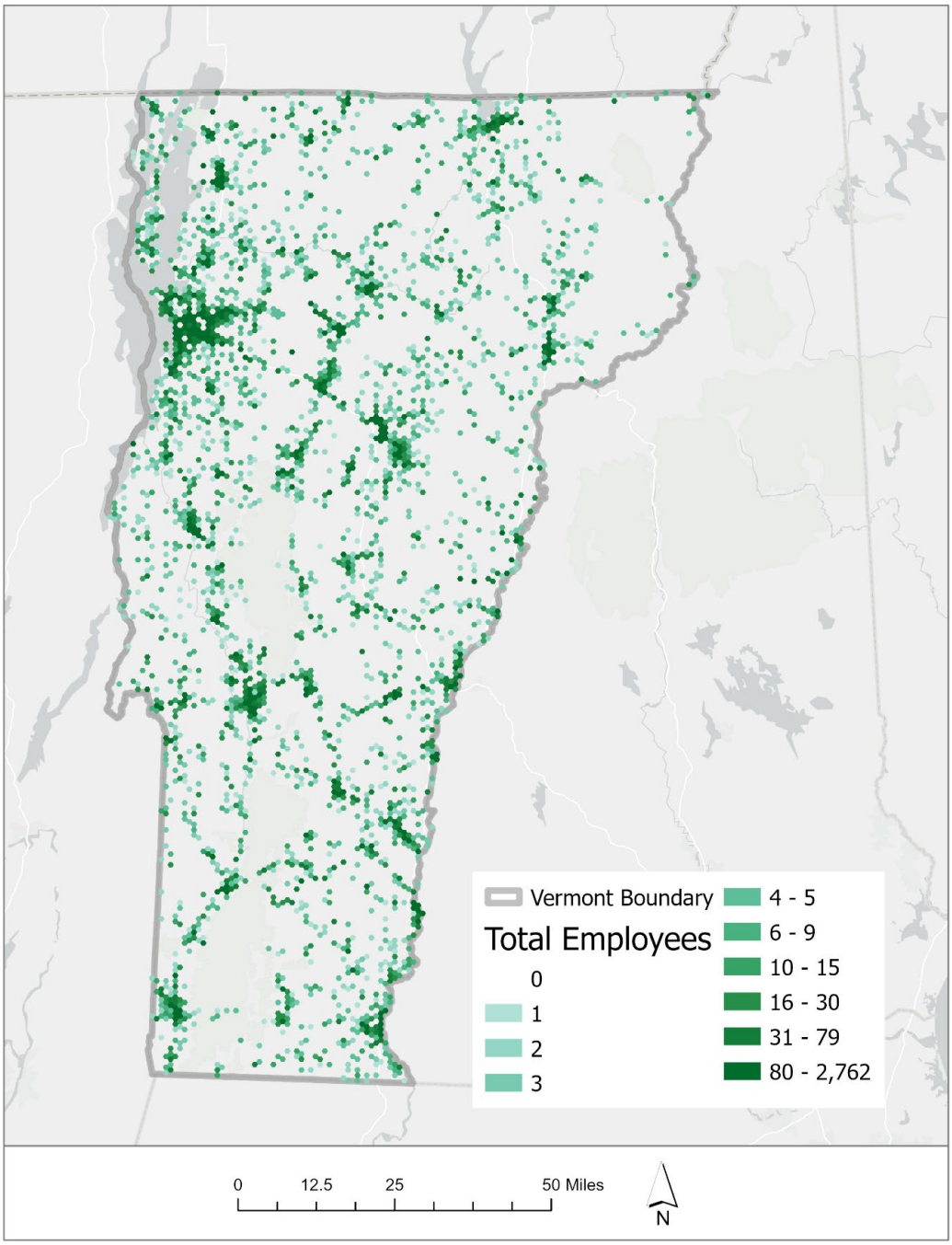
Figure 18 below assigned multifamily housing dwelling counts identified in the State of Vermont's enhanced 911 structures database to the same 800 meter hexagonal grid cells. Multifamily housing residents frequently have greater barriers to installing EV charging at home, particularly if they are renting as is often the case with multifamily housing. The statewide prioritization shown in Figure 24 took this into account by assigning a higher score to areas with higher concentrations of multifamily housing.

Figure 18. Multifamily Dwelling Locations



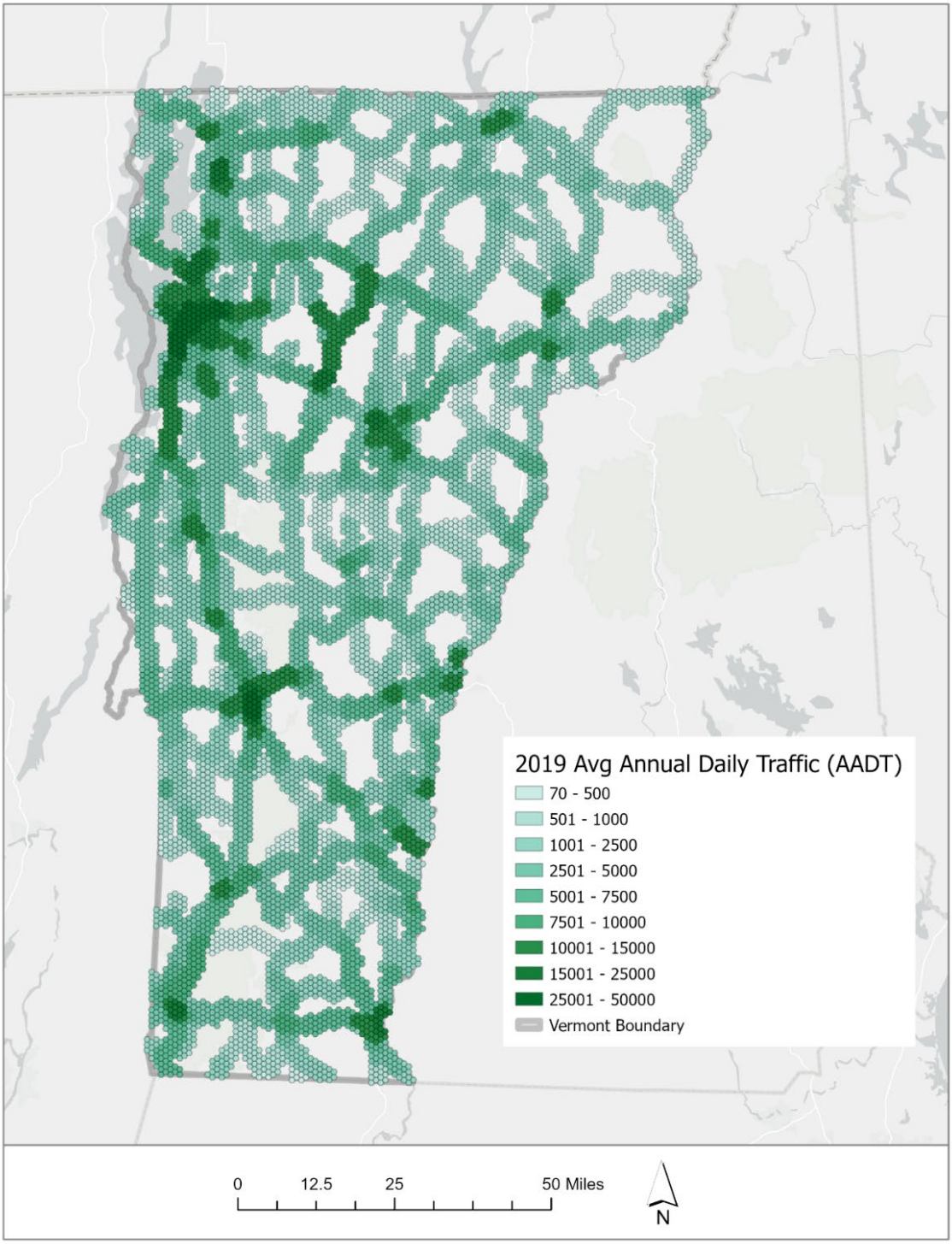
Local employment is also an important consideration siting charging infrastructure, both to serve employee and customer transportation needs. Figure 19 below shows total employment estimates by 800 m grid cell. Additional weight was given to locations with retail employment, including convenience stores, as they are more likely to offer goods and services desired by travelers.

Figure 19. Employment Locations



Traffic flows are also an important consideration in identifying areas more likely to have drivers in need of charging infrastructure. Figure 20 below includes the maximum estimated average annual daily traffic for 2019 by grid cell within 1 mile of non-limited access highways.

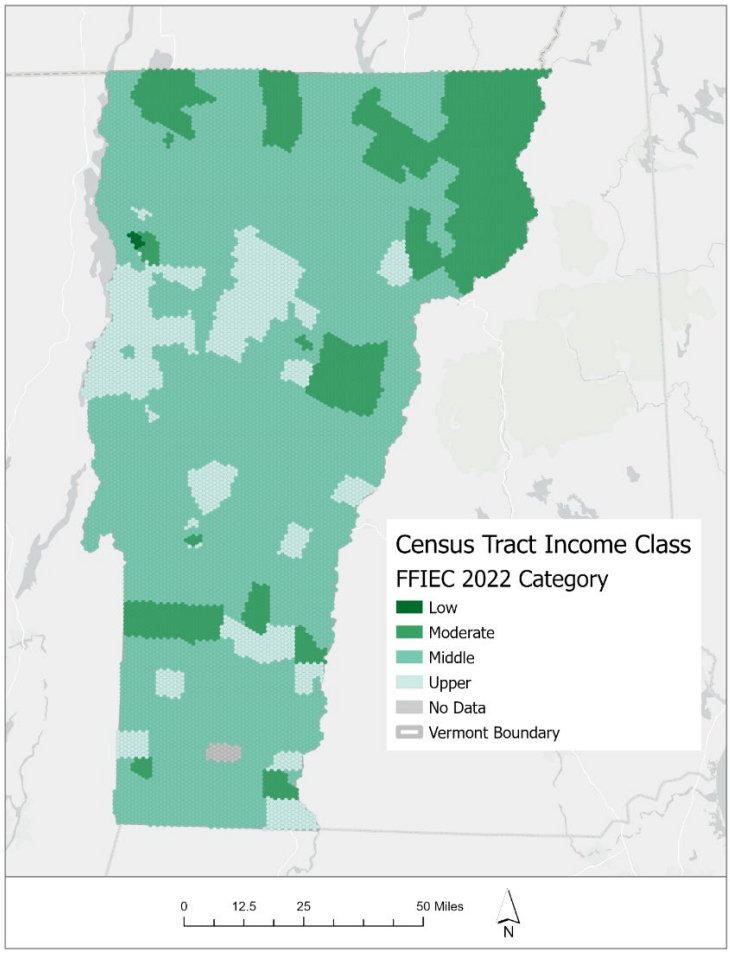
Figure 20. Traffic Volumes



Income and race are closely tied to disadvantaged and underserved areas that may require additional support to ensure equitable access to charging infrastructure. Figure 21 below assigns Federal Financial Institutions Examination Council (FFIEC) 2020 income categories by Census Tract to grid cells. Additional information on the FFIEC methodology and classifications is available at the reference footnote below.[109] Low income cells were assigned a score of 1, moderate income 0.5, and middle income 0.25. Upper income cells were excluded from scoring for this factor.

Figure 22 following presents a composite score for the number of non-white residents in each grid cell by apportioning 2020 US Census data at the block level to grid cells (which were generally smaller). The apportionment was weighted by the count of dwelling units in each grid cell. The BIPOC score was based on the square root of the estimated number of non-white residents in the grid cell divided by the square root of the maximum number across all cells in the state to better isolate areas with higher shares of non-white population.

Figure 21. Census Tract Income Categories



[109] FFIEC. FFIEC Census Flat Files. April 2022. https://www.ffiec.gov/censusapp.htm

Figure 22. Black, Indigenous and People of Color Population Score

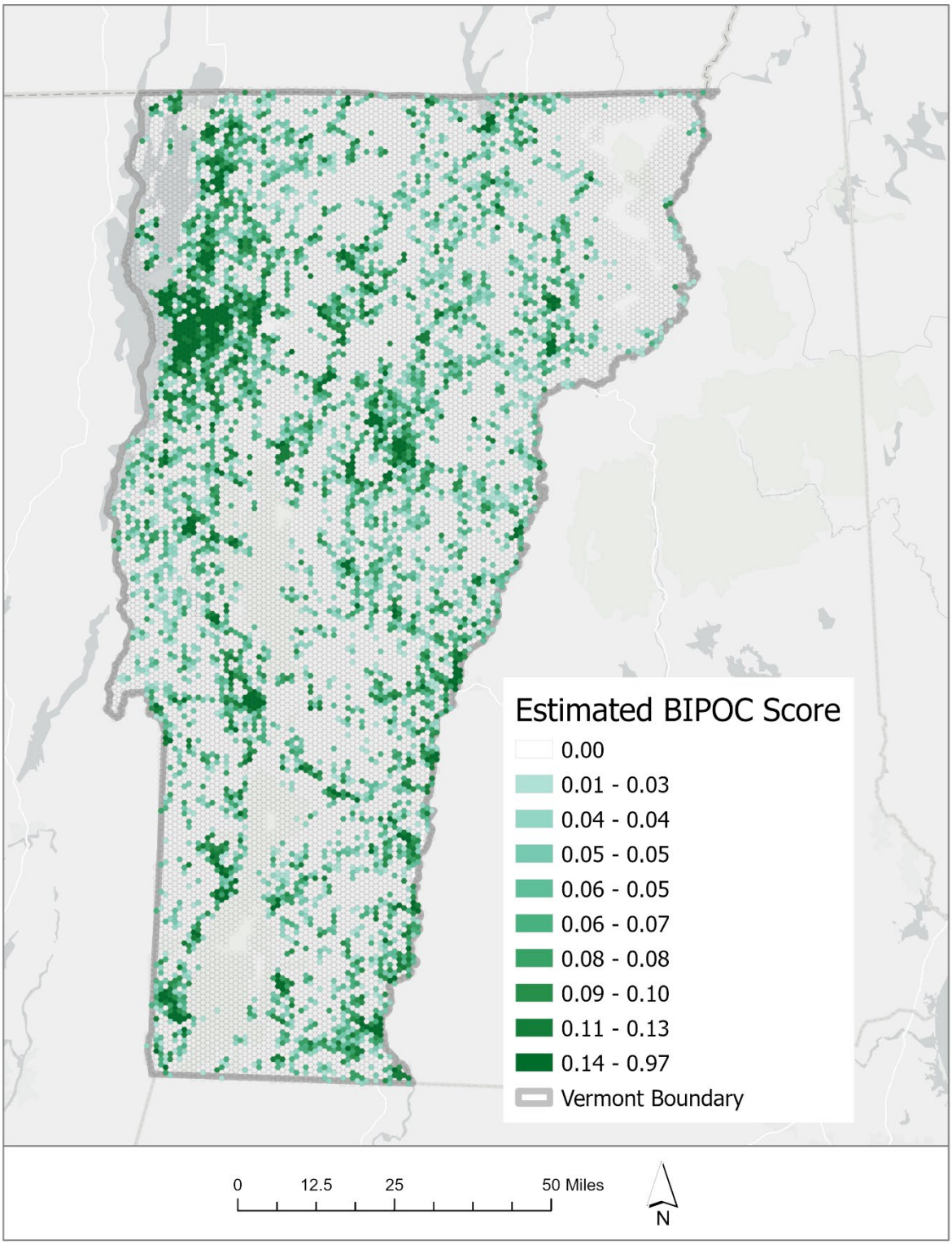


Figure 23 below identifies grid cells along roadways within 1 mile of a federally designated EV corridor, either within 1 mile of an interstate interchange, or 1 mile of a non-limited access highway.

Figure 23. Proximity to Federally Designated EV Corridor

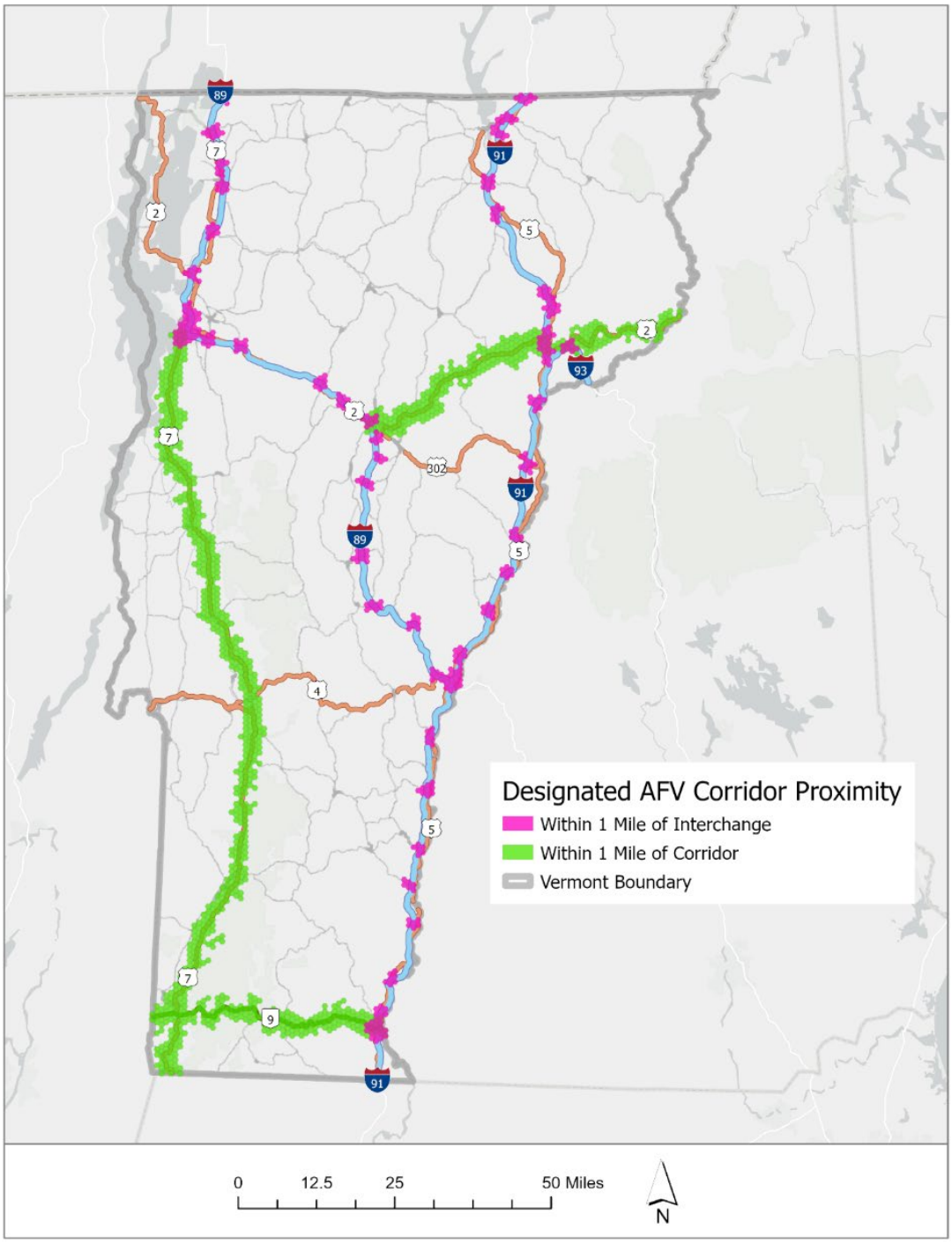
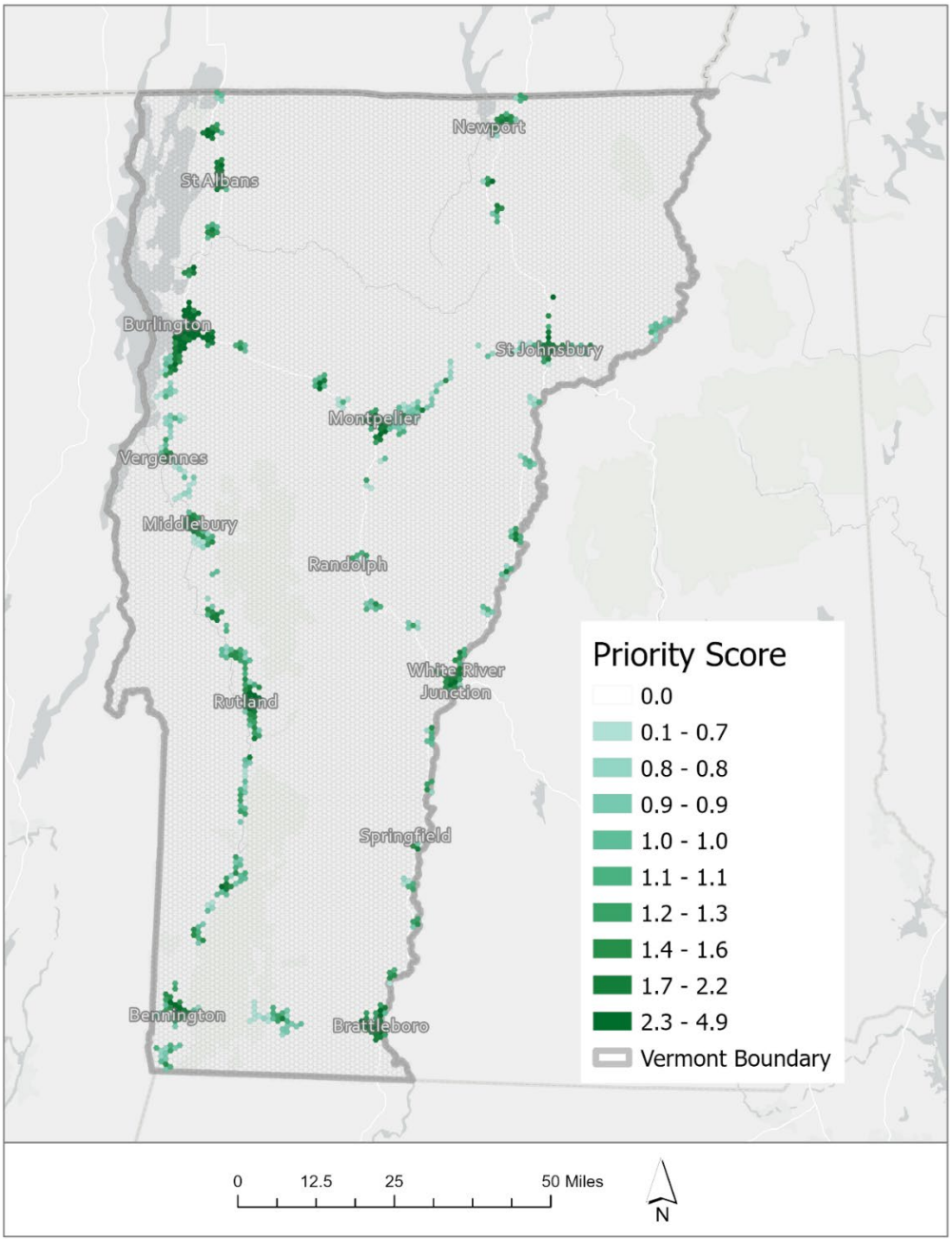


Figure 24 below summarizes the prioritization results for this initial EV charging deployment plan. The prioritization was limited to grid cells within 1 mile of corridors and offering 3-phase power as shown in Figure 23 and Figure 17. Additional prioritization factors were then normalized and combined to arrive at a single composite score. This prioritization was used to inform the plan recommendations in the following section and will be refined in future EV planning efforts as Vermont's corridors are built-out to the federally-required standards and the State gains greater flexibility on charging investments.

Figure 24. Initial EV Charging Location Prioritization Score



NEVI Location Recommendations

Figure 25 on the following page shows 15 areas prioritized for NEVI investments in FY2022 where a minimum of 4 ports of 150kW fast charging are proposed to be sited. Once complete, charging should be available within 50 miles along all of Vermont's designated corridors. These areas were selected based on the potential to serve a corridor by upgrading an existing location or one under State contract for construction. Additional areas were selected based on the geographic analysis factors described above.

Identifying willing site hosts in these areas may present challenges. As the state moves forward, minor changes in the location may be necessary. The State will strive to meet all NEVI minimum requirements, but if challenges exist serving a particular location or if more than one corridor may be served by a single location with a minor deviation from the minimum requirements then the State may seek exceptions to the NEVI requirements. The State of Vermont encourages FHWA to consider allowing more flexibility on this particular rule upfront.

Funding amounts will be refined as the State works with partners to identify appropriate funding packages, potentially leveraging additional state and private funding sources.

2022 Infrastructure Deployments/Upgrades

Table 9. FY2022 NEVI Priority Locations

State EV Charging Location Map ID	Route(s)	Location	Anticipated EV Network	Utility Territory	Status
1	I-89	St Albans	TBD	Green Mountain Power	To be constructed
2	I-89 / US 7	S Burlington	TBD	Green Mountain Power	To be constructed
3	I-89 / US 2	Berlin	TBD	Green Mountain Power	To be constructed
4	I-89	Randolph	Blink	Green Mountain Power	Potential exception for contracted installation
5	I-89 / I-91	White River Jct	TBD	Green Mountain Power	To be constructed
6	I-91	Derby	Blink	VT Electric Coop	Potential upgrade of current installation
7	I-91 / US 2	St Johnsbury	Blink	Green Mountain Power	Potential upgrade of current installation
8	I-91	Bradford	TBD	Green Mountain Power	To be constructed
9	I-91	Springfield	Blink	Green Mountain Power	Potential upgrade of current installation
10	I-91 / VT 9	Brattleboro	TBD	Green Mountain Power	To be constructed
11	US 7	Middlebury	TBD	Green Mountain Power	To be constructed
12	US 7	Rutland	Blink	Green Mountain Power	Potential upgrade of current installation
13	US 7	Manchester	TBD	Green Mountain Power	To be constructed
14	US 7 / VT 9	Bennington	TBD	Green Mountain Power	To be constructed
15	VT 9	Wilmington	TBD	Green Mountain Power	To be constructed

Figure 25. Vermont NEVI Priority Areas

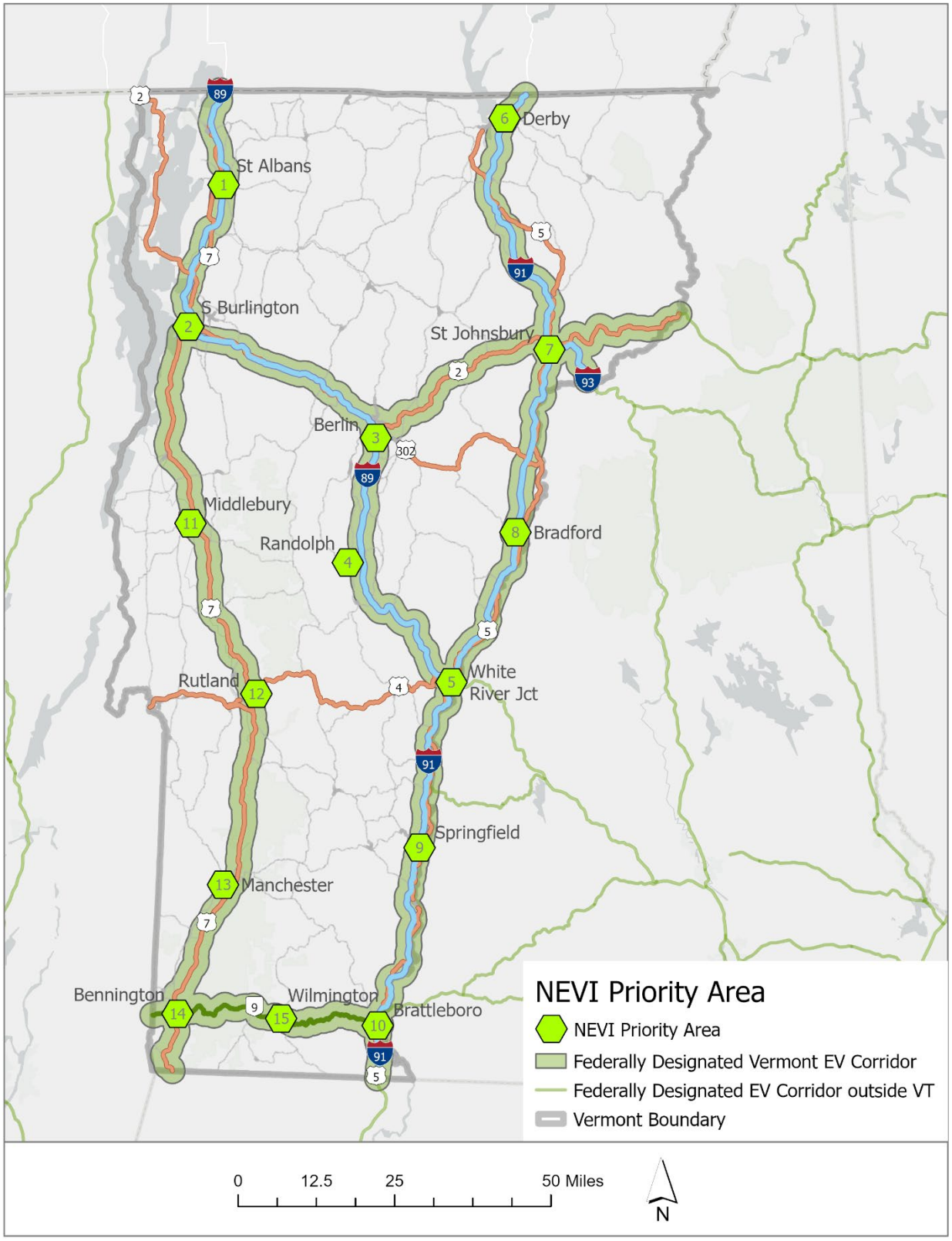


Table 10. Designated Corridor Distances

Corridor	Corridor Mile	Distance from Previous	Location ID	Location	Potential Location Distance to Corridor
I-89	*0*	*0*		*Vermont – Quebec Border*	
	17	17	1	St Albans	< 1 Mile
	42	25	2	S Burlington	< 1 Mile
	80	38	3	Berlin	< 1 Mile
	100	20	4	Randolph	3 Miles
	130	30	5	White River Jct	< 1 Mile
	131	*1*		*Vermont – NH Border*	
I-91	*0*	*0*		*Vermont – Quebec Border*	
	5	5	6	Derby	< 1 Mile
	49	44	7	St Johnsbury	< 1 Mile
	80	31	8	Bradford	< 1 Mile
	107	27	5	White River Jct	< 1 Mile
	136	29	9	Springfield	< 1 Mile
	169	33	10	Brattleboro	< 1 Mile
	178	*9*		*Vermont – MA Border*	
I-93	0	0		*Starting junction with I-91*	
	0	0	7	St Johnsbury	< 3 Miles
	11	11		*Vermont – NH Border*	
US 2	0	0		*Vermont – NH Border*	
	24	24	7	St Johnsbury	< 1 Mile
	62	38	3	Berlin / Montpelier *Corridor End*	5 Miles
US 7	0	0		*1-189 Ramp*	
	0	0	2	South Burlington	4 Miles
	33	33	11	Middlebury	< 1 Mile
	65	32	12	Rutland	1 Mile
	97	32	13	Manchester	1 Mile
	120	23	14	Bennington	< 1 Mile
	131	11		*Vermont – MA Border*	
VT 9	0	0		*I-91 Interchange*	
	0	0	10	Brattleboro	< 1 Mile
	18	18	15	Wilmington	< 1 Mile
	39	21	14	Bennington	< 1 Mile
	43	4		*Vermont – NY Border*	

FY23-26 Infrastructure Deployments

Vermont's ability to obtain "fully built-out" status for its corridor network within the first year of implementation is now less certain than at the start of the state's NEVI planning, given that initial state cost estimates were based on prior rounds of funding for DCFC, did not fully account for rising inflation, increased demand amid a limited supply of equipment and workers to install it, and the likely need for operating and maintenance assistance for many of the locations with more challenging business cases. These uncertainties around price make it difficult to project when the initial list of site locations will be built, and how far the remaining NEVI funding might be stretched to meet state goals beyond NEVI requirements.

Moreover, all states are still awaiting guidance on when corridors will be certified as "built-out"—with possibilities ranging from the point at which contracts are signed to the point at which the NEVI-compliant DCFC stations are energized and listed with the Alternative Fuels Data Center. Nor is it clear yet from federal guidance what sort of flexibility—around power levels, minimum ports per location, various use cases, etc.—will follow the certification of built-out corridors, if indeed that were to happen before the end of the NEVI program. As discussed earlier in the plan's sections on Public Engagement and Equity, while public comments and feedback have informed all aspects of this plan, it is expected that greatest opportunity for public input to shape Vermont's EV charging landscape is through a deeper engagement over the next year and beyond to determine collective priorities post-certification of Vermont's fast-charging corridors. Through its most recent transportation bill, Vermont has set even more aggressive goals for its fast-charging (Level 3) corridors: at least one DCFC station within one mile of every exit along the interstates (89, 91, 93), as well as a DCFC station within 25 miles of the next throughout the state highway system. Future NEVI engagements (in FFY23-26) may help to identify additional locations to fund within this framework, or they may point to a wholly new or different set of priorities and goals by which to evaluate potential site locations and configurations.

In any case, Vermont's prioritization analyses will need to be updated continually, based upon state Environmental Justice rules and tools currently under development, and as other factors such as EV adoption rates change. Deployment in future years will be guided by NEVI program requirements, public input and legislative goals, funding availability through overlapping state or federal sources (state transportation fund or the Carbon Reduction Program, for example), but also by evaluating the effectiveness of NEVI and similar investments to help achieve the greenhouse gas emissions reductions targets set by the Biden administration and required by Vermont's Global Warming Solutions Act.

Discretionary Exceptions

Table 11. Vermont NEVI Exception

Exception #[1]	Type[2]	Distance of Deviation[3]	Included in Round 6 AFC Nomination	Reason for Exception Request[4]
4 (as shown in Figure 25)	☐ 50 miles apart ✓ 1 mile from exit	__miles 3 miles	☐ Yes ✕ No	☐ Grid Capacity ☐ Geography ☐ Equity ✓ Extraordinary Cost

The primary exception Vermont is seeking is for the Randolph location noted above. In short, two 150 kW ports are due to be installed at 2 Pleasant Street in Randolph's downtown this summer, having been funded prior to creation of the NEVI program. As part of the original grant, it is expected that the provider plan and ready the site for future expansion. The charging location is 3 miles or fewer from Exit 4 on I-89 and makes for a good site for many reasons. And though there are multiple and varied community amenities within walking distance, upgrades to meet NEVI standards at the same site could be logistically challenging and cost-prohibitive, with little prospect of profitability in its first five years. There have already been challenges with permitting and easement issues for the existing site, with no guarantees that the host would be willing to enter into a second lease arrangement whether with this or any other contractor. Vermont proposes instead to install an additional two fast chargers elsewhere in Randolph within one mile of the corridor in order to more cost-effectively meet the goals of the NEVI program, and bring the Randolph location into near compliance. So, Vermont's request is not for an exception to build something new that fails to meet NEVI requirements; rather it is to accept together what will have been built in Randolph's downtown and what will be built two miles nearer to the interstate exit as a single, NEVI-compliant location.

Other possible exceptions would be for locations that could serve two corridors. Berlin and South Burlington are the examples highlighted in Vermont's proposed locations, where stations would meet the guidance of one mile from an interstate (I-89) exit but fall outside that radius (by 3-4 miles) for their respective US routes. These are less pressing exceptions, given the state's longer-term network goals and desire to build more redundancy, but they nonetheless could pose economic challenges and delay the more flexible use of limited NEVI funds for state priorities. As of the time of writing, it is also unclear how New Hampshire plans to build out its I-93 corridor near the Vermont border and whether those plans would render an exception a moot point. If federal guidance remains ambiguous on a particular location, it may be that Vermont decides to address it in year two after more is known.

However, VTrans does advocate for greater flexibility with the one-mile requirement. Logistically, it may be difficult to know whether an exception is necessary until there have been actual negotiations with property owners in identified priority locations, and financially those

discussions may be made more challenging with a stricter application of the standard. From past experiences, it is clear that there are likely to be leasing arrangements that fall apart, and FHWA rulemaking should recognize that possibility by providing more flexibility to states and confidence that their exceptions will still meet NEVI standards. More philosophically, there should be deference to the states and local communities hosting charging stations in deciding where that infrastructure will provide the greatest positive impacts. As states are tasked with balancing multiple goals—environmental, economic, social—in their deployment strategies, and expected to reflect the feedback heard through deep public engagement in their plans and implementation, this aspect of the program guidelines should not be so rigid so as to preclude the public from determining plan priorities and shaping outcomes or to contradict other program goals.

Implementation

Despite its size, terrain, climate and rural character, Vermont has been a leading state in deploying public charging stations to support its growing EV adoption. This is largely a result of its strong interagency relationships and external partnerships which have facilitated a coherent and coordinated approach to building out the state's entire EV charging ecosystem. Historically, funding for both community and corridor charging has been managed by Vermont's Department of Housing and Community Development (DHCD), as early rounds of grants for EVSE were focused on supporting economic development and vibrant downtowns. Years later, these remain important goals for Vermont's deployment of charging equipment, and DHCD will retain the responsibility to design and manage programs related to community charging needs in collaboration with the interagency workgroup which includes the Vermont Agency of Transportation (VTrans). However, going forward, VTrans will assume the lead role on corridor fast-charging deployment, including use of the state's $21.2 million in NEVI funds, $2 million in ARPA funds, possible Carbon Reduction Program or competitive IIJA grant funds, and additional state general or transportation funds as they become available. While interagency coordination will continue to inform state decision-making, this division of responsibilities will allow each agency to focus its staff energy and expertise where it will be most effective in building upon past successes.

Contracting

As the lead agency receiving and deploying NEVI funds, VTrans will contract with third party vendors and possibly site owners to efficiently and effectively deliver EV charging infrastructure at the state's proposed locations in this plan and new sites as public feedback informs future plans and prioritization is recalibrated to reflect new priorities, goals, or conditions. This will

slightly evolve the state's prior approach through grant agreements to single providers, opening possible funding opportunities to smaller, local businesses. Rather than issuing a grant for the installation of charging equipment with the hope of meeting grant program requirements outside of the grant period, VTrans will look at more of a longer-term contract for services model which passes through all the state and federal requirements to which these projects will be subject. Therefore, contracting is the key tool the state of Vermont holds for meeting NEVI guidelines and obtaining vendor compliance around everything from Buy America provisions, to EVSE operations and maintenance standards, accessible payment options, data reporting, ADA and Civil Rights requirements and more. By advertising a clear scoring rubric through a competitive process, VTrans can ensure that the proposals developed in response are designed to align with all program guidelines and state priorities.

For existing locations where EV charging providers have recently installed or will soon install DCFC as part of prior grant agreements, amending the scoping of those projects to include upgrades with state and VW settlement funds may prove to be a more effective path to NEVI compliance, provided that state procurement policies allow for that possibility. There are sound reasons for pursuing an amendment to existing agreements over new selection processes, because of the original bidder's experience in the location, with the local permitting process, the local utility, the site itself and site host, the existing agreement and any future-proofing work that had been performed as part of the scope. And regardless of which contracting method or methods are employed, VTrans will ensure that common and transparent standards are applied to all contracts to meet state goals and NEVI guidelines.

With the goals of maximizing federal and state funds, limiting risk, accelerating project delivery, and advancing equity, VTrans continues to have internal and external discussions around the most effective path forward, and is exploring multiple approaches like P3, IDIQ, and other innovative processes that may help to reduce overall project timelines and streamline selections from year to year. State contracting strategies may shift during or after the first rounds of funding as VTrans learns more from vendors, site owners, colleagues in partner agencies, peers in other state DOTs, community organizations and the general public. An openness to different or new approaches will allow VTrans to meet unexpected challenges in a timely and creative manner. However, this flexibility will be grounded by following Vermont Agency of Administration Bulletin 3.5: *Procurement and Contracting Procedures,* recent amendments to the bulletin for ARPA funding where relevant, federal requirements under 2 CFR 200 and 23 U.S.C 304 among others detailed in the NEVI program guidance document and NPRM.

Strategies for EVSE Operations & Maintenance

The State of Vermont does not have plans to own, operate or maintain EVSE along highway corridors or other public chargers, other than perhaps workplace stations that may be made available to the public outside of business hours. Prior granting strategies through the State of

Vermont interagency workgroup on EVSE have sought proposals from EV charging providers to work with site hosts to install, operate and maintain equipment within general areas of the state where critical gaps have been identified in the public charging network. These grant agreements have been for a duration of five to seven years, with specific performance standards like the 97% uptime requirement already well-aligned with the NEVI guidance.

For example, the state' most recent agreement with Norwich Technologies clearly defines expectations around operations, maintenance, and customer support services for each site location:

"12. Operations:

(a) The costs for any fee based EVSE must be easy to understand with fees fully disclosed to the consumer prior to initiation of a charging session.

(b) Charging stations must include appropriate safety instructions for EV drivers regarding the proper use of the charging equipment.

(c) Charging stations are required to display real-time operational status on a smartphone application, either through a network-specific application or a third-party aggregator.

(d) Rate fees must be in kW hour, and clearly displayed at the charging station.

13. Maintenance:

(a) Ensure maintenance of the chargers including; cables, ancillary equipment, and any awnings, canopies, shelters and information display kiosks for signage associated with the charging station. Equipment shall be kept safe and presentable.

(b) Charging stations must be operated, maintained, and available year-round 24 hours per day, seven days a week (including snow removal).

(c) Grantee shall address any issues such as, but not limited to, malfunctions and repairs. The grantee must propose a plan to ensure that the equipment at each EV Charging Station is operational at least 97% of the time based on a week of 24 hours a day and 7 days (no more than 5 hours cumulative downtime in a 7-day period) and include a schedule for regular inspection and maintenance of each charging station and all ancillary equipment. It is the responsibility of the grantee, and any successor-in-interest, to ensure the 97% uptime requirement is met. Any necessary repairs must be completed within 72 hours.

(d) Grantee shall include a written plan for station maintenance. This plan shall include a description of available technical resources, qualifications of personnel who will assist during maintenance events, expected response times, and any specific, foreseen challenges/barriers to maintenance and to meeting specified uptime requirements. The plan shall also provide a summary of planned maintenance activities by frequency and a communications strategy to keep DHCD informed about operations and maintenance activities. Preventative hardware maintenance and any necessary software upgrades shall be addressed within the proposed plan. Where necessary, the plan should note any special maintenance requirements unique to an individual station.

14. Customer Support Services: Provide customer service support as follows:

(a) Be available 24 hours a day, seven (7) days per week, via a toll-free telephone number posted on or near the EV Charging Station, that is clearly visible to the customer.

(b) Provide customer support for the duration of the grant term.

(c) Resolve customer issues over the telephone, or dispatch service personnel to the host site as needed to resolve the issue.

(d) Have the ability to perform remote diagnostics and the ability to initiate a charging session remotely (remote start).

(e) Provide customers with immediate assistance."

Similar language, modified to include other NEVI-specific requirements will be included in future RFPs and contracts. More than the inclusion of language in contracts, however, it will likely be important for the State of Vermont to align payment schedules with performance measures. Particularly for those sites and providers receiving additional operating assistance, new clauses may need to be structured to encourage compliance with these and other expectations.

A couple of areas where there is and may be some divergence among states centers around a discussion of accessibility to charging, both in terms of payment methods and charge port connections. Vermont's interagency workgroup has historically required debit and credit card swipe and chip reader technology in order to ensure that un- and underbanked Vermonters and those without tap card or mobile payment options are not left behind in the transition to electrify the transportation sector. Likewise, Vermont has a number of Nissan Leaf owners or drivers which it does not want to leave behind, and is exploring a requirement that at least one (possibly lower level) charger is equipped with a CHAdeMO connection along with the required 4 (four) 150+ kW ports. Although these measures might be utilized by but a fraction of travelling public, Vermont recognizes and shares the goal of the NEVI program to provide widespread public charging access to all, regardless of the size of the populations that individual sites or program requirements might serve.

Strategies for Identifying Electric Vehicle Charger Service Providers and Station Owners

Vermont has worked with a few EV charging providers for its needs already, and has had multiple conversations with others throughout the NEVI planning process. In prior rounds for fast-charging corridor grants, the state has awarded a single provider the opportunity to build out the general locations identified. Sites were analyzed for their potential profitability, with more rural sites expected to experience lower utilization. Both lower and higher demand

locations were then bundled together to encourage private providers to advance a more equitable distribution of public investments. VTrans anticipates replicating this strategy to some degree while also exploring new potential pathways for EVSE deployment that could result in a diversity of providers and owners.

Working solely with EV charging providers seemingly has the benefit of simplicity. There could just be one or a few contracts to manage, with all the details spelled out and handled by a third-party—negotiations with a site host, parking space configurations, permitting processes, electrical service evaluations, etc. However, in the state's experience, these are also the kinds of things that can contribute to project delays and last-minute changes which could pose risks to the efficient use of public funds. The issues also inevitably involve state staff to work through the various sticking points towards a resolution. One possibility to address this is to allow for site hosts to bid on projects directly, which would ensure that the locations selected do indeed meet NEVI standards and possibly avoid time-consuming and costly negotiations between providers and site hosts if everything is to be owned, operated and managed by single entities. Such a strategy of course comes with its own potential drawbacks, including potentially greater administrative costs on the Agency's part and more operating or maintenance issues due to less experienced grant recipients.

Another option is a hybrid approach of the two, whereby sites and site hosts are vetted first through an RFI process in summer/fall 2022 for their eligibility and ability to effectively carry out aspects of the NEVI program. Sites and site owners could then be selected through a competitive process or matched with qualifying EV providers through a separate bid selection process. Other models may yet emerge through a deeper public engagement process and as strategies are refined in years two through five to reflect lessons learned from the initial rounds of NEVI funding.

Strategies for EVSE Data Collection & Sharing

Vermont has included requirements for data collection and reporting in its grant agreements with past recipients, and the Department of Public Service has only this year begun receiving quarterly reports from some of those recipients. These reports are important not only to evaluate individual projects and providers, but also to understand the demand for and performance of the entire fast charging network. The following language has been included in prior State of Vermont agreements :

> "Data Capture Requirements: Each EV Charger should have network communications that, at a minimum, provide the following information about each charging transaction, at each location (usage data will be submitted quarterly to the Public Service Department, as defined in Attachment B):

(a) Charging data such as date and time of usage (start and stop time) and accurate utilization rates.

(b) Total kWh dispensed and Total kW draw.

(c) Total revenue collected.

(d) Pricing Structure.

(e) Station status and health in real time.

(f) Number of days station was online and functionable.

(g) Malfunction or operating errors.

(h) Number of charging sessions.

(i) Total cost to operate each station."

There are likely additional data points such as "peak session power by port" to be required in NEVI-funded projects as part of a common data specification discussed in the Notice of Proposed Rulemaking released on June 9th this year, but what Vermont already requires is largely aligned with the proposed data collection. Vermont supports any national effort to standardized these requirements and streamline the reporting process for the purposes of comparing pricing and performance across the country, particularly in an effort to build transparency and accountability among EVSE providers. For its own part, VTrans will also explore withholding a small percentage (5% of the project costs, for example) of NEVI funds until the last required report is received in order to ensure 100% compliance.

Regional Collaboration

In developing this initial NEVI Plan, Vermont reached out to all neighboring states (Massachusetts, New York and New Hampshire) as well as the province of Quebec to understand how their own EVSE plans might address connections with Vermont's highway corridors. All states were at varying stages in the development of a NEVI Plan, but all committed to continued coordination around common corridors. VTrans has also participated in multiple multi-state EV planning workgroups, which have provided platforms for bordering and nearby states in the region to exchange information.

Because its existing corridor-ready and -pending segments already represent significant coverage for the state and because none of those segments currently meet NEVI standards, Vermont decided to not nominate any new corridors. There have also been few new corridors in adjoining states in the latest (sixth) round of AFC nominations.

Massachusetts: Only Route 2 in Massachusetts from Cambridge to Williamstown was approved as corridor-pending, and this segment does not yet link up with Vermont's Route 7, though this

would change with investments at locations in Bennington, VT and Williamstown, MA to complete the connection. I-91 remains an important corridor between Western Massachusetts and Vermont.

New York: Currently there are no shared corridors between Vermont and New York, with I-87 in New York and Route 7 up to I-89 in Vermont running in parallel on either side of Lake Champlain. Ferries across the lake do bridge the two corridors, including potential locations in St. Albans, Burlington, and Plattsburgh within the 50 mile NEVI guidance. Other east-west routes can be explored in later nomination rounds.

New Hampshire: A number of shared corridors exist between Vermont and New Hampshire, particularly along I-91 where the interstate intersects with I-89, I-93, and NH state Route 12. A segment of US Route 2 also runs from Vermont to Lancaster, NH. Staff from New Hampshire's DOT have stressed the importance of the Hookset rest area on I-93 given traffic volumes, which certainly would support a strong corridor running from Massachusetts and south up to Vermont. Lebanon is another critical location just over Vermont's border which apparently meets NEVI guidance. As New Hampshire's planning and implementation becomes clearer, Vermont will look to coordinate investments that strengthen the states' connections at other points.

Quebec: Vermont and Quebec enjoy an important relationship which results in close collaboration on a number of fronts. While EV charging investments are made by the province's public utility—Hydro Quebec—these are informed by recommendations developed with the Ministry of Transport. Fast charging stations have recently been installed near the border in Stanstead, where Canadian route 55 runs to I-91, and Vermont has likewise invested in installations in Derby (listed above). Future plans will coordinate EVSE deployment along the I-89 corridor up to Canadian Route 133, as well as address the important issues around freight travel that will require even more collaboration and funding.

Civil Rights and Equity Considerations

The NEVI Formula Program presents an extraordinary opportunity to invest in EV infrastructure throughout the state, and the Vermont Agency of Transportation plans to work to ensure that funding benefits are broadly enjoyed across diverse communities, businesses and workers. VTrans has significant experience with Civil Rights requirements related to federal funding and can ensure compliance with State and Federal civil rights laws by following existing plans and processes for Title VI of the Civil Rights Act and accompanying USDOT regulations, the Americans with Disabilities Act, and Section 504 of the Rehabilitation Act.

The Agency's Office of Civil Rights serves as the point for equal opportunity compliance activities and functions conducted throughout the state, responsible for overseeing VTrans internal and external civil rights programs, insuring compliance with all federal and state civil

rights and non-discrimination laws and requirements, and acting to move forward the Agency's civil rights goals and objectives.

Working closely with VTrans leadership and in partnership with other Agency Divisions, the Office of Civil Rights administers the following mandatory civil rights programs: Internal and External Equal Employment Opportunity (EEO) Programs, Disadvantaged Business Enterprises (DBE) Program, Contractor Compliance Program, Supportive Services Programs (DBE and on-the-Job Training), Labor and Wage Compliance Program, Title VI Program, and ADA Program.

The Office of Civil Rights strives to be the catalyst that facilitates and supports equity principles throughout the organization utilizing a proactive, interdisciplinary strategy to fulfill the following goals and objectives:

- To proactively provide strategies and/or remedies to promote equity, inclusion and fairness.
- To engage all stakeholders respectfully and promote a culture of respect.
- To maintain state and federal compliance with all civil rights requirements.
- To ensure nondiscrimination in VTrans programs or activities receiving federal financial assistance by reviewing, consulting and monitoring our practices.
- To eliminate unlawful discrimination in contracting practices and policies.

Current initiatives include the Agency's work with a consultant on its Transportation Equity Framework which will dovetail with the development of the state's new Environmental Justice policy and will shape each phase of the project development process, how comprehensive public involvement should occur, and how public involvement should determine tools, methods, and best practices in the Vermont context to integrate equity considerations into projects. Subsequent plans and projects will be developed through the framework proposed and adopted in 2023.

Labor and Workforce Considerations

Vermont recognizes that the NEVI Program established by the Infrastructure Investment and Jobs Act (IIJ) aims to create not just better infrastructure, but better jobs, too. Labor and workforce considerations are thus closely tied to Civil Rights and Equity Considerations, as this unprecedented funding poses a unique opportunity to encourage and develop a more diverse workforce to participate in state projects. The Agency has recruited 18 -20 participants annually for its On the Job Training (OJT) Program through career fairs and other strategies found in its guide *Hiring and Retaining a Diverse Workforce* (2022). Specific outreach strategies for the NEVI program could also include activities like organizing a webinar through the state's Disadvantaged Business Enterprises (DBE) Program to encourage more participation by DBEs in NEVI projects, while also assisting contractors with their own recruitment methods.

VTrans will follow existing processes to ensure that the NEVI program, like other projects subject to Davis-Bacon rules, is providing Vermont's workforce with good wages. The state intends to work with VEIC, industry partners, labor groups and workforce development staff to support a diverse, and well-trained group of local tradespeople who can install and maintain EVSE. As much as an expected shortage of Buy America-compliant charging equipment will likely result in costly delays, it is also likely that a shortage of qualified electricians and other tradespeople could compound the problem and further delay implementation.

Beyond growing a more diverse and fairly compensated workforce, state efforts should encourage the safe, professional installation and maintenance of EVSE so that state and federal investments function as intended. Proposed rulemaking for the NEVI program would require that contractors complete the Electric Vehicle Infrastructure Training Program (EVITP) before working on NEVI projects for this purpose. The training, which is provided by a private third-party organization, takes 20 hours and costs nearly $300 to complete. Vermont finds not only that this may be a redundant standard in states where electricians must be professionally licensed and electrical work professionally inspected, but also that this requirement could pose significant delays and additional costs as it further limits the pool of contractors available to perform installations. Although ten contractors are listed on the EVITP website as certified in Vermont, none are based or actually work in the state. Thermay be states without a licensure program for electrical workers where this sort of certification is warranted, but Vermont is not one of them. However, if the requirement were to be adopted, Vermont would likely work with our partners to make workers aware of the EVITP certification and create a pool of funding to fully subsidize their participation in the program.

Cybersecurity

Understanding the potential risks to public infrastructure and the people it serves, Vermont takes cybersecurity and privacy seriously and has longstanding policies that all agencies and their contracts must follow. Vendors with the State of Vermont must certify their compliance with all of the state's **Cybersecurity Standards and Directives**. Contracts involving any IT-related concerns must be reviewed by the Agency of Digital Services and include an Attachment D*: Information Technology System Implementation Terms and Conditions.* Although prior grant agreements executed by Vermont's Department of Housing and Community Development do not contain this attachment or provisions specifying cybersecurity responsibilities, it is expected that NEVI-funded contracts will be subject to this additional review and contracted third parties will be responsible (as with other NEVI program guidance and proposed rules) for compliance with these terms and conditions.

Program Evaluation

The State of Vermont has required past funding recipients to collect data and report on a number of performance measures incorporated into their grant agreements. The Department of Public Service had been designated the point of contact and is only now beginning to receive those submissions as EVSE come online. As this data is critical for program evaluation purposes and continual improvement, a portion of the funds may be withheld to ensure timely reporting. Data submissions to DPS have varied in format and frequency, which may point to the need for designing a standard online form and shared spreadsheet, with automated reminders. Staff could then draw from the aggregated data in the spreadsheet to populate a dashboard charting the state's progress.

Performance measures already exist for the charging stations and locations themselves, but there would be nothing to measure until the first units become operational. Thus, VTrans will develop a new set of measures to understand how well the Agency is performing, tracking the time it takes for elements of the process to be delivered, the costs of contracts executed, and so on. Lastly, public engagement can be both a measure to track the Agency's progress in reaching or involving more Vermonters in overburdened, disadvantaged, or underserved populations, but also a source of important data points to reflect upon and help refine strategies to deploy more EV charging investments. In that sense, this NEVI plan simply represents the first of many drafts.