Exploring the Workforce Implications of Meeting Electric Vehicle Goals in the Vermont Climate Action Plan

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Project Purpose and Methodology

The purpose of this report is to research, describe, and estimate the workforce that will be needed to achieve the large and rapid scale up in electrical vehicle use established in the Vermont Climate Action Plan. This work will contribute to workforce development activities and initiatives underway (or planned) by Energy Action Network's Climate Workforce Network Action Team as well as various workforce development and training agencies and organizations in Vermont. The topics addressed include: estimating the workforce type and size necessary, researching the necessary training to create the workforce, and exploring the different sources of workforce growth. Methods employed throughout the project included: interviewing experts in the field, calculating workforce size ranges, and reviewing existing literature on the topic. The project involved conducting research, collecting data, interviewing professionals involved in advancing electrical vehicle use in Vermont, and documenting the findings in a written report and PowerPoint Presentation.

SECTION I: INTRODUCTION

The Global Warming Solutions Act

In September of 2020, the Vermont Legislature passed the Global Warming Solutions Act (Act 153 as Enacted), which created legally binding greenhouse gas (GHG) emissions reduction targets for the state.[1] The Act was created in response to concerns about Vermont's changing climate and the magnitude of what must be done to reduce greenhouse gas emissions. .

[1] https://legislature.vermont.gov/Documents/2020/Docs/BILLS/H-0688/H-0688%20As%20Passed%20by%20Both%20House%20and%20Senate%20Official.pdf

As shown in Figure 1, the GWSA requires Vermont to reduce greenhouse gas emissions to 26% below 2005 levels by 2025; 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. The Global Warming Solutions Act (GWSA) also requires focusing on a just transition; reducing energy burdens and minimizing negative impacts on rural and marginalized communities; and rebuilding and growing the State's economy while protecting public health, enhancing community resilience, and harnessing the power of the State's natural systems to store and capture carbon. Achieving requirements in the Act will require significant decreases in fossil fuel use in all sectors of the economy including transportation, buildings, electricity, and agriculture, as well as development of new policy, regulatory, and programmatic approaches.

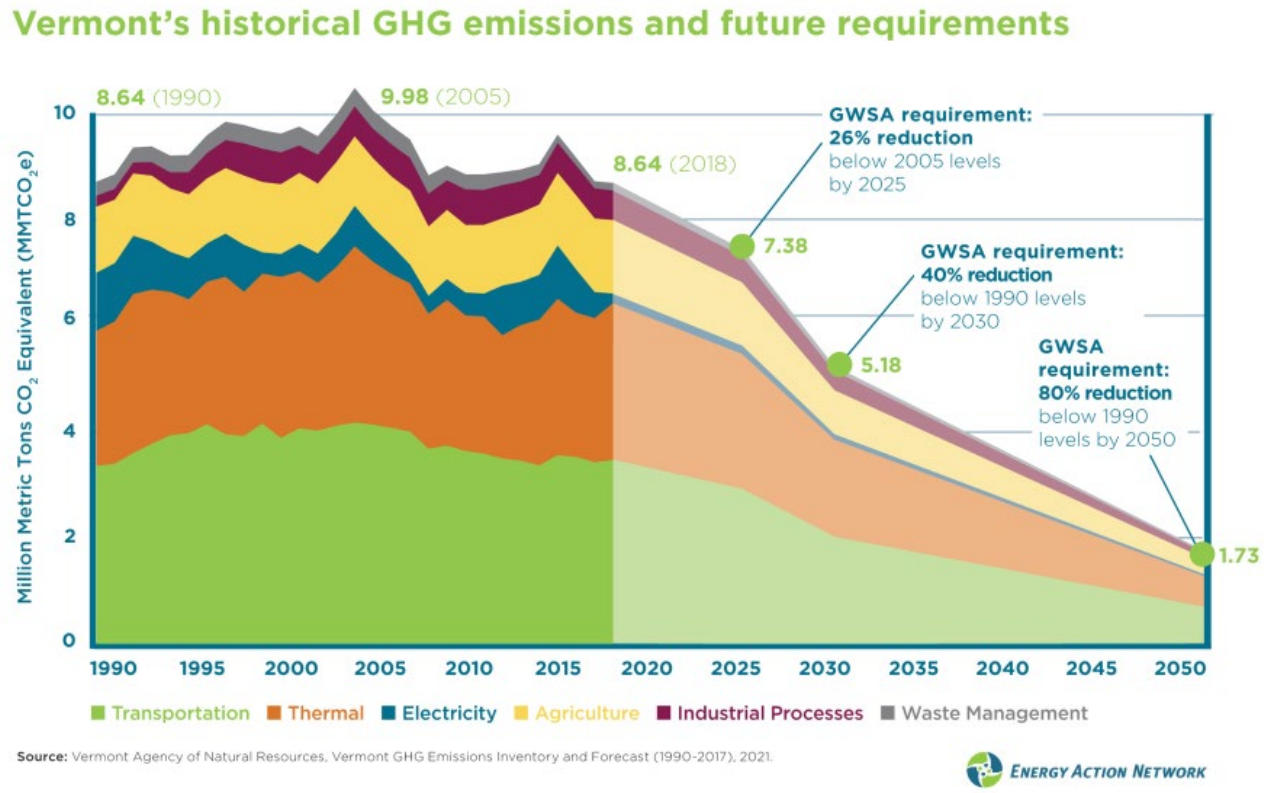

Figure 1: Greenhouse Gas Emissions Reductions Required by the Global Warming Solutions Act[2]

[2] Energy Action Network. (2021). *Annual Progress Report for Vermont 2020/2021*. https://www.eanvt.org/wp-content/uploads/2021/06/EAN-APR2020-21_finalJune2.pdf

The Climate Action Plan

As required in the Global Warming Solutions Act, the state of Vermont developed and passed a comprehensive and detailed Climate Action Plan (CAP) on December 1, 2021. GWSA requires that the plan be updated every four years; hence the first plan is referred to as the "initial" plan. The CAP includes 26 pathways for action, emphasizing: emissions reductions, building resilience and adaptation in Vermont's natural and working lands, building resilience and adaptation in Vermont's communities and built environment, and enhancing carbon sequestration and storage.[3] The pathways outline the work needed to accomplish the GHG reduction requirements established in the GWSA. In addition, the plan lays out 64 strategies and more than 230 specific steps for achieving the mandated reductions. [4] Examples of actions specified in the Climate Action Plan include:

- Reducing greenhouse gas emissions from the transportation, buildings, electricity, and agricultural sectors;
- Encouraging smart growth and related strategies;
- Achieving long-term sequestration and storage of carbon and promoting best management practices to achieve climate mitigation, adaption, and resilience on natural working lands;
- Achieving net zero GHG emissions by 2050 across all sectors;
- Reducing energy burdens for rural and marginalized communities;
- Limiting the use of chemicals, substances, or products that contribute to climate change; and
- Building and encouraging climate adaptation and resilience of Vermont communities and natural systems.[5]

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[3] Vermont Climate Council. (2021). *Initial Vermont Climate Action Plan*. Retrieved July 22, 2022, from https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2021-12/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf

[4] State of Vermont. (2021, December 1). *The Vermont Climate Council Adopts the Vermont Climate Action Plan*. The Vermont Climate Council Adopts the Vermont Climate Action Plan | Agency of Natural Resources. Retrieved July 22, 2022, from https://anr.vermont.gov/content/vermont-climate-council-adopts-vermont-climate-action-plan

[5] State of Vermont. (2022). *About: Climate change in Vermont*. About | Climate Change in Vermont. Retrieved July 22, 2022, from https://climatechange.vermont.gov/about#:~:text=Global%20Warming%20Solutions%20Act&text=The%20Act%20requires%20Vermont%20to,and%2080%25%20below%20by%202050

The Role of Transportation in Reducing GHG Emissions in Vermont

The transportation sector in Vermont contributes 40% of the state's GHG emissions, as shown in Figure 2 below. A variety of pathways are recommended in the CAP for achieving significant GHG emissions reductions from transportation. One of the most impactful pathways is to dramatically increase the use of electric vehicles as a replacement for vehicles fueled by GHG-emitting gasoline and diesel.

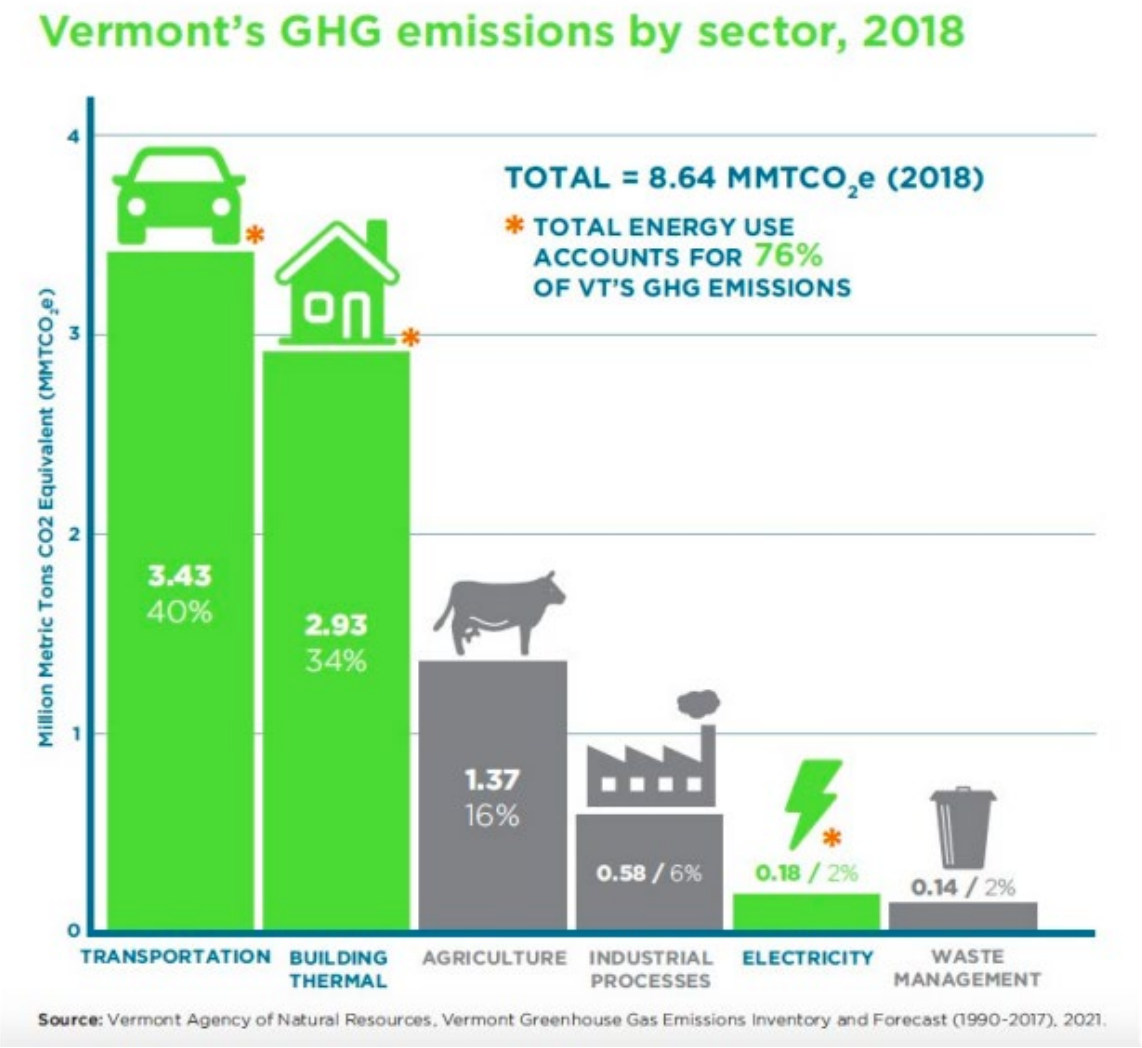

Figure 2: Vermont Greenhouse Gas Emissions by Sector, 2018[6]

[6] EAN VT. (n.d.). *Advanced clean cars II in VT: Implications for EVs and GHG emissions.* Energy Action Network. Retrieved July 22, 2022, from https://www.eanvt.org/impacts-accii/

Presented in Figure 3 are results of an analysis completed during development of the Climate Action Plan that helped inform development of strategies in the CAP for reducing GHG emissions from the transportation sector by 40%. The GHG impact within the transportation sector is organized into different types of vehicles and vehicle uses in order to illustrate the efficacy of targeting various forms of transportation.

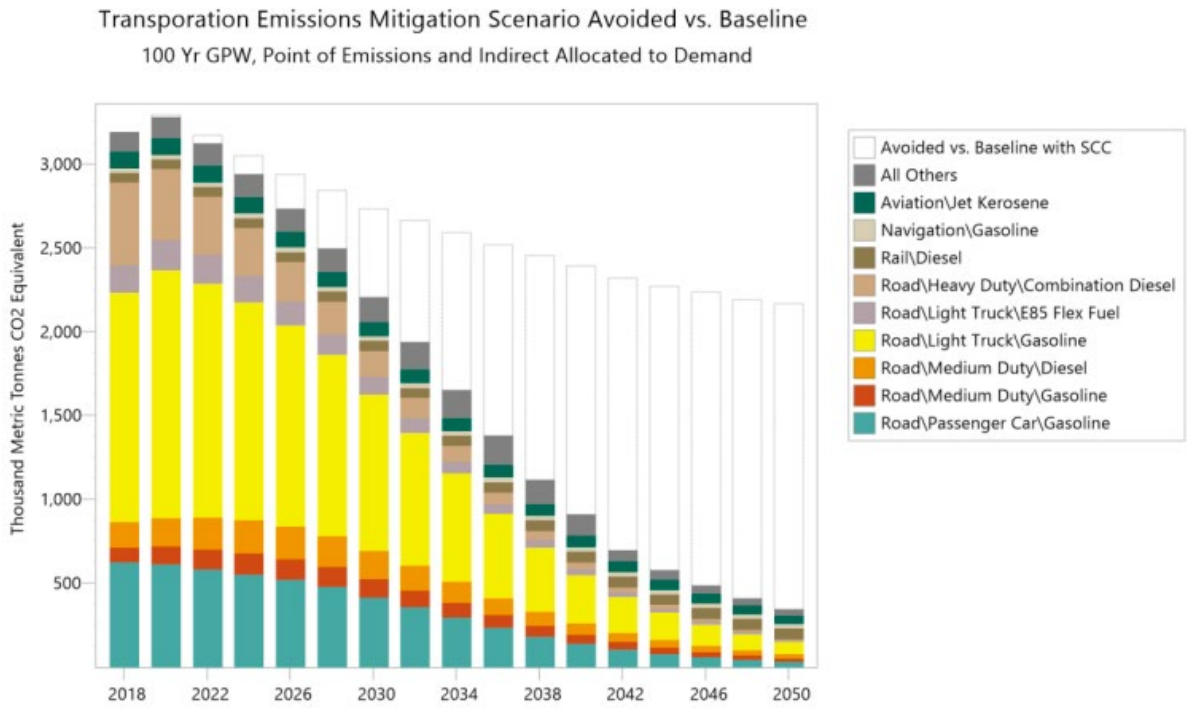

Figure 3: Transportation Sector Greenhouse Gas Emissions in Mitigation Scenario by Fuel Type[7]

As shown in the figure, reducing the transportation sector's emissions by electrifying the vehicle fleet would make significant progress in reducing Vermont's emissions, and the CAP set out goals to do so. When addressing transportation issues surrounding climate change, states can either follow federal regulations for vehicle standards, or they can opt to follow California's more stringent standard referred to as Advanced Clean Cars II (ACC II). ACC II regulations are a continuation of California's long-running program to reduce greenhouse gas emissions from conventional gas vehicles, while increasing the number of zero-emission vehicles (ZEV). ZEVs are primarily all-electric vehicles (AEV) and plug-in hybrid vehicles (PHEV). Vermont is in the process

[7] https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Vermont%20Pathways%20Analysis%20Report.pdf

of adopting the ACC II standard, resulting in a push to rapidly and significantly increase the number of EVs used in the state. In addition to Vermont, other states have signaled their intent to move forward with the adoption of ACC II in 2022.

Adopting ACC II as a key strategy for reducing GHG emissions in the transportation sector in Vermont will require that 100% of all new vehicles sold in Vermont be zero-emission electric vehicles by 2035. The ACC II guidelines will begin to apply to all new vehicles sold in Vermont starting in model year 2026. In addition to implementing ACC II in Vermont, the Climate Action Plan calls for increasing the value of and expanding the availability of tax incentives for consumers purchasing electric vehicles. ACC II will also include more stringent criteria pollutant emissions standards, a robust vehicle durability standard, warranty provisions, battery state of health standardization, battery labeling, and availability of repair information for independent repair shops.[8]

As explained by the Transportation Task Group in a recent memo on transportation policy options for Vermont, simply ensuring EV availability within the state does not necessarily mean that the vehicles will be purchased, or that modeled transportation emissions targets will be met.[9] Additional complementary policies and actions will be needed, for example dedicating increased public investment to charging infrastructure expansion and expanding purchase incentives for EVs. While ACC II is a strong start towards getting cleaner and more efficient vehicles on the road, it will not be sufficient on its own. Although ACC II will increase the number of EVs available, "complementary policies and programs will still be needed to ensure that those vehicles are affordable, with the necessary supporting infrastructure at scale."[10]

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[8] EAN VT. (n.d.). *Advanced clean cars II in VT: Implications for EVs and GHG emissions.* Energy Action Network. Retrieved July 22, 2022, from https://www.eanvt.org/impacts-accii/

[9] https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Transportation%20Policy%20Next%20Steps%20Memo.pdf

[10] The Transportation Task Group is comprised of several members of the Vermont Climate Council's Cross-Sector Mitigation Subcommittee. The Task Group provides policy and program recommendations for achieving GHG reductions in the transportation sector, for consideration by the Subcommittee as they prepare their recommendations for the Council overall. *Transportation Policy Next Steps Memo*. Home | Agency of Natural Resources. (2022, March 14). Retrieved July 22, 2022, from https://anr.vermont.gov/

The Importance of Understanding Workforce Changes

One of the most crucial pieces in assisting Vermont to electrify its vehicle fleet will be understanding the changes in workforce demands sparked by the transition. Fluctuation in workforce type and size will play a central role in the growth of electric vehicles in Vermont. Fleet electrification is unique because in order to accomplish it, the policy and regulatory mechanisms already exist due to the concrete nature of ACC II. Auto manufacturers are going to be required to introduce a certain number of EVs to Vermont. That said, a variety of factors will need to be in place to ensure rapid adoption and scale up, including for example:

- Trained and informed EV dealers and service companies;
- Consumer awareness and acceptance;
- Affordability, including availability of both used and new EVs; and
- Sufficient charging infrastructure.

Given that this shift is coming, a crucial question for policymakers is how the shift will be managed. As Barrett and Bivens argue, "policy can transform this industry upheaval into a new beginning for U.S. producers and the rebuilding of a foundation for good jobs."[11] For example, as Freeman et al. explain in their report on the emerging clean transportation workforce, the lack of EVs on the road at present is largely due to a lack of the right infrastructure. Freeman notes a recent study that found the limited availability of rapid-charging stations to be the biggest barrier to EV adoption. The lack of adequate electric vehicle supply equipment also heavily influences consumer preference, and has been cited as a major barrier to consumer EV acceptance by the National Renewable Energy Lab alongside concerns about EV range (i.e. the distance traveled on a single charge) and upfront purchase cost. As O'Neill-Vivanco explains, "the upside to this finding is that build-out of EVSE has been accelerating since 2011, and will continue to do so as the EV workforce expands.[12]

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[11] Barrett, J., & Bivens, J. (2021, September 22). *The Stakes for Workers in How Policymakers Manage the Coming Shift to All-Electric Vehicles*. Economic Policy Institute. Retrieved July 22, 2022, from https://www.epi.org/publication/ev-policy-workers/

[12] Freeman, G., McRae, G., & O'Neill-Vivanco, P. (2018). *The Emerging Clean Transportation Workforce*. Northeast Transportation Workforce Center. Retrieved July 22, 2022, from https://www.uvm.edu/sites/default/files/media/Emerging-Clean-Transportation-Workforce-White-Paper12202018.pdf

EV Use in Vermont to Date

Before assessing the workforce type and size necessary to support Vermont's transition to electric vehicles, it is important to understand current and future EV use in the state. Vermont has made significant progress compared to most states and is ranked as the 5th most EV-friendly state.[13] According to the US Department of Energy, as of the end of 2017, Vermont was ranked 5th in the United States for having the highest number of plug-in electric cars per 1,000 people.[14]

An analysis completed by Cadmus and Energy Futures Group during development of the Climate Action Plan projects that one pathway for meeting Vermont's GWSA requirements is to achieve the use of 27,000 EVs (across all vehicle classes) by the end of 2025, with EVs accounting for 17% of total vehicle sales and 5% of the statewide total vehicle miles traveled (VMT). By the end of 2030, the pathway envisions a total of 126,000 EVs in use in Vermont, with EVs accounting for more than 68% of vehicle sales and 23% of the statewide total VMT.[15] As of February, 2022, there were 6,585 EVs registered in Vermont.[16] These projections are summarized in Table 1.

Table 1: Projected EV Sales and Use Needed in Vermont to Help Achieve Greenhouse Gas Reduction Targets for 2025 and 2030[17]

	End of 2025	**End of 2030**
Number of EVs in Vermont	27,000	126,000
EV Share of Vehicle Sales	17%	68%
EV Share of Vehicle Miles Traveled	5%	23%

[13] Gorzelany, J. (2021, July). *The Most EV-Friendly States in the U.S.,* MYEV.com. Retrieved July 22, 2022, from https://www.myev.com/research/comparisons/most-ev-friendly-states

[14] Kane, M. (2018, December 12). *State-by-State Look at Plug-in Electric Cars per 1,000 Residents.* InsideEVs. Retrieved July 22, 2022, from https://insideevs.com/news/341522/state-by-state-look-at-plug-in-electric-cars-per-1000-residents/

[15] Energy Futures Group and Cadmus. (2022, February 11). *Vermont Pathways Analysis Report 2.* https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2022-03/Pathways%20Analysis%20Report_Version%202.0.pdf

[16] Drive Electric VT. (2022, February 4). *January 2022 EV Registration Updates - Drive Electric Vermont.* Retrieved July 22, 2022, from https://www.driveelectricvt.com/Media/Default/docs/maps/vt_ev_registration_trends.pdf

[17] Energy Futures Group and Cadmus. (2022, February 11). *Vermont Pathways Analysis Report 2.* https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2022-03/Pathways%20Analysis%20Report_Version%202.0.pdf

SECTION II: WORKFORCE TYPE AND SIZE NECESSARY

Nationally, the transition to EVs is predicted to bring about significant increases in job demand. As electric vehicle sales ramp up, employment in electric vehicle manufacturing is expected to expand. The use of electricity is projected to increase as well to support new electric loads from vehicle charging, and employment in the construction and maintenance of wind, solar, battery storage, and the electric grid infrastructure is projected to increase dramatically. A reduction in auto repair and maintenance jobs is expected, but it is generally believed that those reductions will be offset by gains in economy-wide induced jobs and increased power sector jobs.[18] It is important to note, however, that these projections are based on a national analysis. Similar analysis has not been done in Vermont so the question of how this is expected to play out in Vermont remains unanswered.

Areas of Workforce Changes

There are three major components of a well-established EV infrastructure and marketplace in Vermont, each with its own workforce needs. These include electric vehicle:

- Charging infrastructure;
- Dealerships and sales; and
- Repairs and service.

The main focus of this research project was on estimating the workforce type, size, and skills needed for charging infrastructure, dealerships and sales, and repairs and service for automobiles. Since no automobiles are manufactured in Vermont, the state is unlikely to see a surge in manufacturing in response to ramp up in EV use. [19] Similarly, the power sector is predicted to experience some increases in demand for electricity. It is not certain that the expected increase in demand for electricity will result in the need for increased generation capacity. It may, instead, be met through load shifting.[20] As a result of home charging, homeowners will need to install

[18] Gridlab. (2021, April 16). *Switching to electric cars & trucks would support 2 million green jobs in 2035*. 2035 The Report. Retrieved September 1, 2022, from https://www.2035report.com/transportation/green-jobs/

[19] Lopez, N. (2022, May 24). *Going Electric: California car mandate would hit mechanics hard*. CalMatters. Retrieved September 1, 2022, from https://calmatters.org/environment/2022/05/california-electric-cars-mechanics-jobs/

[20] Personal Communication, Liz Miller, Green Mountain Power, Colchester, Vermont, July 2022.

home chargers which may require the upgrading of electrical panels, potentially requiring an increased demand for electricians. In addition, a two-way electrical grid with both intermittent resources and EVs will require a new level of software engineering and workforce capacity and utilities. This could be an opportunity for higher paid and more skilled positions. Lastly, some have argued that the need for gasoline station employees may decrease as EV use increases. However, assessing these relationships was beyond the scope of this project.

The Charging Infrastructure Workforce Anticipated for Vermont

A key element of the transition to EVs will be building the charging infrastructure necessary to sustain growth in the electric vehicle fleet. Developing a robust and effective EV charging infrastructure requires a variety of activities including: design, engineering, permitting, and installation. In this report, installation of EV charging stations is the central focus for estimating the type and size of workforce needed.

The Different Types of EV Charging

As shown in Table 2, there are three types of EV charging each of which requires different infrastructure to operate.

Table 2: Electric Vehicle Charging Infrastructure Specifications in the United States

Charging level	Voltage	Typical power	Electric vehicle miles of range per charging hour	Location
Level 1	120 V AC	1.2–1.4 kW AC	3–4 miles	Primarily home and some workplace
Level 2	208 V–240 V AC	3.3–6.6 kW AC	10–20 miles	Home, workplace, and public
DC fast	400 V–1,000 V DC	50 kW or more	150–1,000 miles	Public, frequently intercity

Note: AC = alternating current; DC = direct current; kW = kilowatt; V = volt

- **Level 1** charging is equivalent to plugging into a standard electrical outlet. It can be convenient for home use, but offers a slower charge time of about 5 miles per hour of charging. Level 1 is most useful when a vehicle will be parked for several hours.
- **Level 2** charging equipment can be installed at home, at the workplace, and at public locations like shopping plazas, train stations, and other destinations. Level 2 charging can charge cars at roughly 12

and 60 miles of range per hour,[21] depending on the power output of the charger and the vehicle's maximum charge rate. Most EV owners choose to install Level 2 charging equipment at their residence. The installation process varies slightly per site. Some report it takes a two-hour visit from an electrician to install the charger.[22] Given the rural nature of Vermont and the long distances likely to be traveled to customer sites by installers, it is believed that this estimate of installer time is low.

- **DC fast chargers** (also referred to as Level 3 charging) can charge vehicles up to 80% within 30 minutes. They are ideal for vehicles needing a quick charge during longer-distance trips and for charging stations located along interstate highways and major roads. They are less suitable for areas where vehicles are parked for longer periods of time, and don't therefore require the fastest charge possible.

The concept of "dwell time" determines what type of charger is most suitable for a specific location. Dwell time is essentially the question of "how long are vehicles usually parked in this spot?" The answer helps in deciding which level of charger to have on the property.[23]

The Types and Amounts of Labor Needed for EV Charging Infrastructure

The process of calculating the effects on workforce type and size necessary from the EV charging infrastructure required some key assumptions to be made. In order to determine the workforce required, EV charging infrastructure was divided into three categories:

- At-home Level 2 charging;
- Public and workforce Level 2 charging; and
- DC fast charging.

Presented in Table 4 is a list of the job roles and person days required for each level of charging infrastructure. Information on the job roles and person days

[21] Charlton , A. (2022, April 8). *About to buy an EV? Here's everything you need to know about charging your car at home*. Gearbrain. Retrieved September 1, 2022, from https://www.gearbrain.com/home-electric-car-charging-guide-2638678555.html

[22] *Pod Point Home Charger Installation process*. Pod Point. (2022, June 21). Retrieved September 1, 2022, from https://pod-point.com/guides/driver/ev-charger-home-installation-process#:~:text=A%20standard%20install%20typically%20takes,without%20delays%20on%20the%20day

[23] Ruedig, A. (2021, September 16). *Guide to commercial electric vehicle charging stations*. GreenLancer. Retrieved September 1, 2022, from https://www.greenlancer.com/post/guide-commercial-electric-vehicle-charging-stations

required for the planning and design, installation, and administrative support of public and workforce Level 2 charging and DC fast charging was obtained from a national study on EV workforce projections.[24] Information on the job roles and person days required for at-home Level 2 charging was provided by a representative of a nationally-leading EV charging provider.[25]

Table 4: Job Roles and Person Days Required for EV Charging Infrastructure

	At-Home Charging - Level 2 Chargers	Public and Workplace Charging - Level 2 Chargers	DC Fast Charger
Job Roles	**Person Days per Charger**		
Planning and Design		1.08	1.16
General Contracting		2.31	2.98
Utility Linework		0.75	0.75
Electrical Contracting		1.68	1.02
Electrician	0.50	2.31	3.86
Administrative Support		0.91	1.04
Legal		0.17	0.5
Other		0.67	0.92
Total Person Days	**0.50**	**9.88**	**12.23**

Presented in Table 5 is the level of effort by job roles and person days estimated for EV charging installations in Vermont. The person days were calculated by applying data in Table 4 to estimates of the types and amounts of EV charging infrastructure that will be needed for 27,000 EVs in 2025 and 126,000 EVs in 2030 (beyond the charging infrastructure already in place for the 6,585 EVs already in use as of February 2022. Estimates of the mix of additional Level 1, 2, and 3 chargers expected to be needed were developed using the EVI-Pro Lite platform[26] by Dave Roberts, Managing Consultant at VEIC and an EV expert in Vermont. [27]

[24] *Workforce Projections to Support Battery Electric Vehicle Charging Infrastructure Installation, Table 10.* June 8, 2021. https://etcommunity.org/assets/files/Workforce-ProjectionstoSupportBatteryElectricVehicleChargingInfrastructureInstallation-Final202106082.pdf

[25] Personal Communication from Emily Kelly, Manager - Public Policy, Chargepoint, August 5, 2022.

[26] Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite, https://afdc.energy.gov/evi-pro-lite

[27] Personal communication, Dave Roberts, Managing Consultant, VEIC, Burlington, VT. August 5, 2022.

Table 5: Estimated Effort by Job Role in Person Days for EV Charging Installations in Vermont

	At-home Charging - Level 2 Chargers		Public and Workplace Charging - Level 2 Chargers		DC Fast Chargers		All Charging Combined		
	2025 Goal - 4,939 More	2030 Goal - 74,250 More	2025 Goal -1,411 More	2030 Goal - 3,190 More	2025 Goal - 149 More	2030 Goal - 129 More			Number of Full Time Equivalentes (FTE) if completed in one year
Job Roles	2025 Person Days	2030 Persons Days	2025 Person Days	2030 Person Days	2025 Person Days	2030 Person Days	2025 Person Days	2030 Person Days	
Planning and Design			1,524	3,445	173	150	1,697	3,595	**14**
General Contracting			3,259	7,369	444	384	3,703	7,753	**31**
Utility Linework			1,058	2,393	112	97	1,170	2,490	**10**
Electrical Contracting			2,370	5,359	152	132	2,522	5,491	**22**
Electrician	2,470	37,125	3,259	7,369	575	498	6,304	44,992	**180**
Administrative Support			1,284	2,903	155	134	1,439	3,037	**12**
Legal			240	542	75	65	315	607	**2**
Other			945	2,137	137	119	1,082	2,256	**9**
Total Person Days	**2,470**	**37,125**	**13,941**	**31,517**	**1,822**	**1,578**	**18,232**	**70,221**	**281**
Number of Full Time Equivalents (FTE) if completed in one year	**10**	**149**	**56**	**124**	**7**	**6**	**73**	**281**	

As shown in Table 5, a total of 18,232 person days are projected to be needed to install additional EV charging infrastructure by the end of 2025, and an additional 70, 221 person days will be needed between the beginning of 2026 and the end of 2030.

Assuming (for simplification purposes) all charging is installed in one year and that each installer works 250 days per year (50 weeks times 5 days per week), this indicates the level of effort needed to install all EV charging infrastructure in Vermont would be 281 full-time installers working for one year.

While it is certain that all charging infrastructure will not be installed in one year, this indicates that a huge increase in the workforce is not expected be needed. Presumably, the installation work will be done by a mixture of existing electrical contractors or allied trades, and some new contractors. The EV market is too nascent in Vermont at this time, however, to have a credible basis for estimating the portion of future EV charging infrastructure that will be installed by new compared to existing contractors. In general, however, this analysis serves as a reminder that electrical contractors and allied trades will be key to the transition to EVs. It is important that Vermont ensure that sufficient EV charging training is available for both existing and new electrical contractors moving forward.

The EV Auto Repair and Service Infrastructure Anticipated for Vermont

The increased use of EVs will reduce the use of gasoline and diesel vehicles, and is expected to decrease the number of auto-mechanics needed. Because EVs require minimal service and repair, EV owners are expected to spend significantly less time and money on repairs, resulting in less demand for mechanics. Understanding the effects of this transition will aid Vermont's ability to prepare for it.

Throughout the auto repair and service industry, it is well understood that EVs require less maintenance than the conventional gas vehicle. Studies have concluded that EV owners spend significantly less time and money on repairs. As explained by Alex Dilride, a long-time mechanic in San Francisco states, "the electric vehicle repair market is just about nonexistent."[28] Electric cars have fewer fluids, such as engine oil, and fewer moving parts than a conventional car. Brake systems also last longer because of regenerative braking, which converts energy from the brake pads into electricity to recharge the battery, according to the U.S. Department of Energy. EVs also don't have mufflers, radiators, and exhaust systems. The main reasons that bring conventional gasoline vehicles into the mechanic shop do not exist for EVs.[29]

In a study conducted by the California Air Resources Board, findings illustrated that "by 2040, nearly 32,000 auto mechanics jobs will be lost in California, since electric vehicles need far less maintenance and repair than conventional combustion engines." Because California employs 60,910 individuals in this sector, the number of auto mechanics in the state is predicted to decline by 52% by 2040. Therefore, it can be assumed that the auto-repair sector will decrease in size as a result of EV scale-up. Because minimal research has been conducted on this relationship in Vermont, this report uses California's percent of decline in order to determine a rough estimate. The calculations below illustrate this relationship.

Key Assumptions

[28] Lopez, N. (2022, May 24). *Going Electric: California car mandate would hit mechanics hard*.
[29] U.S. Department of Energy. (n.d.). *Maintenance and safety of electric vehicles*. Alternative Fuels Data Center: Maintenance and Safety of Electric Vehicles. Retrieved September 1, 2022, from https://afdc.energy.gov/vehicles/electric_maintenance.html

- There are 1,580 Automotive Service Technicians and Mechanics in Vermont.[30]
- Vermont is adopting ACC II, the same regulatory track as California.
- California is projecting a decline of about 52% of auto mechanic jobs due to the transition to EVs.

Following the California Air Resources Board's calculations, Vermont can be expected to lose 822 mechanic jobs between now and 2040 as a result of pursuing ACC II's goals, indicating that by 2040, there will be 758 mechanics remaining. Because there is no Vermont-specific research on the relationship between EVs and mechanics, these calculations rely on the previous work conducted by the California Air Resources Board. Therefore, they are rough estimates.

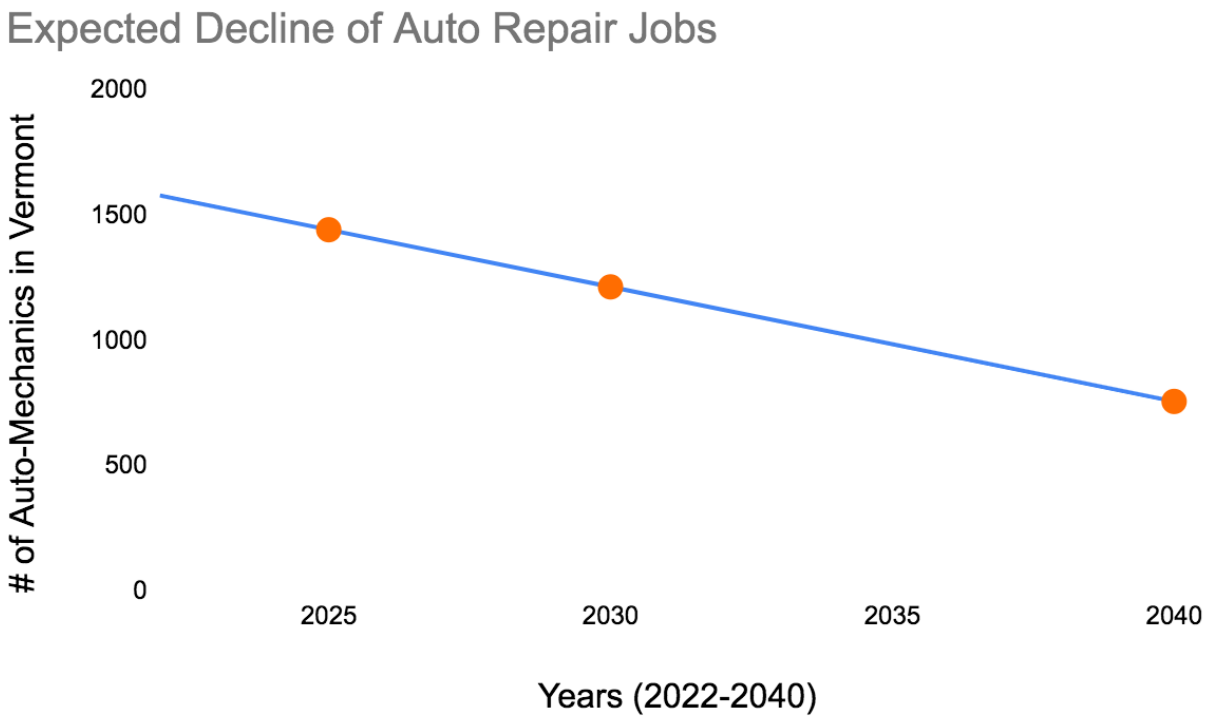

Figure 4: Expected Decline of Auto Repair Jobs from 2022-2040 by Number of Jobs

[30] U.S. Bureau of Labor Statistics. (2021, May). *49-3023 Automotive Service Technicians and Mechanics*. U.S. Bureau of Labor Statistics. Retrieved September 1, 2022, from https://www.bls.gov/oes/current/oes493023.htm

Despite the fact that the size of the auto repair sector is projected to decrease over time, the field may also experience what is known as job expansion or enrichment. Job expansion occurs when:

- A wider range of activities become available to a worker;
- There is a decrease in the number and/or regularity of monotonous tasks;
- New skills are needed and training is available and provided for those skills;
- A worker experiences increases autonomy, accountability, and responsibility; and
- Wages increase.

Job enrichment occurs when:

- Task efficiency and human satisfaction improve;
- There is a greater scope for personal achievement and recognition;
- Worker responsibility is increased and the work is more challenging; and
- The opportunity for individual growth and advancement increases.[31]

The auto mechanic industry may experience both job expansion and job enrichment because even though EVs typically require less maintenance than conventional gas vehicles, with less frequent service touchpoints, servicing EVs requires specialized abilities and the tasks can be more complex. Because of this, each maintenance visit may necessitate more billable service hours and generate increased revenue per hour. Therefore, mechanics might offer new service offerings. For example, an increase in advanced driver-assistance systems (ADAS) means that more vehicles may need to go through a typically lengthy and complex sensor-calibration process.[32] However, making these types of services ready for EVs will also require investment in employee retraining, education, and recruitment techniques (discussed below).

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[31] Paul Jr. , W. J., Robertson, K. B., & Herzberg, F. (2014, August 1). *Job Enrichment Pays Off*. Harvard Business Review. Retrieved September 1, 2022, from https://hbr.org/1969/03/job-enrichment-pays-off

[32] Fischer, M., Kramer, N., Maurer, I., & Mickelson, R. (2021, September 28). *A turning point for US Auto Dealers: The unstoppable electric car*. McKinsey & Company. Retrieved September 1, 2022, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/a-turning-point-for-us-auto-dealers-the-unstoppable-electric-car

In addition, mechanics who work on internal combustion engines in Vermont are likely to continue to be needed in the future, because the use of gasoline and diesel vehicles is expected to continue during the transition to EVs. The CAP does not recommend banning the sales of used cars fueled by gasoline and diesel, and it does not recommend stopping the use of gas- and diesel-powered vehicles that are already on the road. At present, there are a little over 600,000 vehicles registered in Vermont, of which 6,585 were EVs as of February 2022. This indicates internal combustion engine vehicles recently made up 96.6% of Vermont vehicles and EVs made up 3.4%, demonstrating that gas-powered cars continue to make up a significant percentage of the state's vehicle fleet, softening the blow for car mechanics servicing gas- and diesel-fired vehicles. As noted by James Sallee, an economist and research associate at the Energy Institute at University of California, Berkeley's Haas School of Business, "the changes wouldn't occur fast enough to trigger a sharp economic slowdown within the auto repair industry."[33]

In conclusion, Vermont's transition to EVs is expected to result in a gradual decrease in the auto-mechanic workforce, allowing for individuals in the field to adjust their work accordingly. Therefore, the likely reduction in workforce size for auto-mechanics as a result of the transition to EVs is not expected to cause immediate or dramatic economic slowdowns in the sector and could spark processes such as job enrichment. It is also expected that the transition to EVs will create demands for jobs in other sectors, such as vehicle manufacturing, emphasizing the importance of providing the necessary education and training so individuals may transfer to different areas of work in an equitable manner.[34]

The EV Dealer Infrastructure Anticipated for Vermont

The oncoming EV transition will have undeniable effects on the car dealer industry, which will be responsible for ensuring the availability of EVs. The nature of these effects must be understood in order to be prepared for them.

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[33] Lopez, N. (2022, May 24). *Going Electric: California car mandate would hit mechanics hard*.

[34] Economic Policy Institute. (2021, September 22). *The shift to all-electric vehicles could create over 150,000 jobs by 2030-if policymakers make smart investments to secure U.S. leadership in the Auto Sector*. Economic Policy Institute. Retrieved September 1, 2022, from https://www.epi.org/press/the-shift-to-all-electric-vehicles-could-create-over-150000-jobs-by-2030-if-policymakers-make-smart-investments-to-secure-u-s-leadership-in-the-auto-sector/

At present, the State of Vermont has 97 licensed new car dealers.[35] The average car dealership in Vermont employs between 20-55 people.[36] Therefore, Vermont dealers employ between 1,940 and 5,335 individuals.

As discussed in the previous section, electrification will reduce staff levels in service and parts, but this process is likely to be gradual. A report discussing the consequences for car dealers noted that the demand for knowledgeable dealers who provide the delivery points for physical services will still be needed. However, the overall requirement for staff and traditional dealers is likely to fall.[37] In a national study conducted by McKinsey and Company on EV adoption and car dealers, research concluded that if EV adoption continues to accelerate, EVs are likely to account for more than half of national passenger car sales by 2030, a number that is predicted to be higher in Vermont.[38] This is shown in Figure 5 . Therefore, auto dealers are expected to sell a greater number of EVs in coming years, meaning dealers' ability to adapt to the transition to EVs will have significant implications for their businesses.

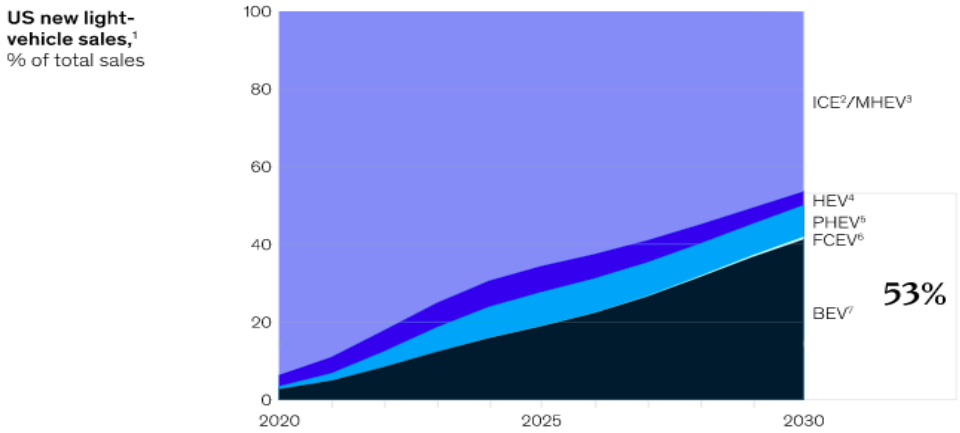

Figure 5: Projected United States EV Sales Rates

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[35] Vermont Department of Motor Vehicles. (n.d.). *Vermont Department of Motor Vehicles Agency of Transportation Report to …* Retrieved September 1, 2022, from https://legislature.vermont.gov/assets/Legislative-Reports/Dealer-Regulation-Review-2016-Bill-No.158.pdf

[36] Interviews conducted with Middlebury Chevrolet and G. Stone Motors in Middlebury, VT.

[37] Les Glassock's & Associates. (n.d.). *Who gives a dime? The impact of Electric Vehicles on Jobs in Auto makers and retailers.* Motor Monitor RSS. Retrieved September 1, 2022, from https://lga-consultants.com/who-gives-a-dime-the-impact-of-electric-vehicles-on-jobs-in-auto-makers-and-retailers/

[38] Fischer, M., Kramer, N., Maurer, I., & Mickelson, R. (2021, September 28). *A turning point for US Auto Dealers: The unstoppable electric car*.

Many dealerships are underprepared to meet the growing number of consumers considering an electric car.[39] A key obstacle dealers will face as they are asked to sell increasing numbers of EVs, will be keeping up with the new sales processes and industry knowledge required to sell them. For example, US sales representatives struggle to properly articulate the cost and benefit differences that "go beyond government or OEM subsidies, such as environmental and technical benefits, and to provide adequate information about lifetime value, maintenance schedules, and depreciation for EVs versus ICE vehicles." Part of the changes within the car dealer workforce will be expanding the knowledge of current employees to include a level of fluency when it comes to EVs. Therefore, McKinsey and Company concluded that as long as dealers can maintain the skills and knowledge surrounding selling EVs, the demand for these roles will remain.

Because dealers are facing the task of selling more EVs than they are accustomed to, there is a demand for more knowledge and skills in this sector. The task of retraining current dealer employees so they are able to sell EVs effectively is a new career space. This could possibly spark an increase in workforce size, in addition to supporting job enrichment, however the exact number is not known. Dealer employees will need to be retrained to sell EVs in the most effective way possible, potentially expanding the scope of dealer job roles.

In addition to the expansion of dealership skills needed to achieve the scale-up of EVs, there is the possibility that new business models may arise, such as MYEV.com.[40] MYEV is essentially the first marketplace for electric vehicles. It is a new EV software platform that allows consumers to learn about, buy, and sell EVs via the internet. Such approaches could have significant implications for traditional dealerships.

SECTION III: SOURCES AND BARRIERS TO HAVING A SUFFICIENT WORKFORCE

Research and workforce estimates completed for this report project some (but not dramatic) fluctuation in workforce size as Vermont transitions

[39] Elliott, H. (2021, October 26). *Drivers are into electric cars. dealers don't know how to sell them.* Bloomberg.com. Retrieved September 1, 2022, from https://www.bloomberg.com/news/articles/2021-10-26/drivers-are-into-electric-cars-dealers-don-t-know-how-to-sell-them

[40] https://www.myev.com/

to EVs. A key area of anticipated change is in the skills and training needed for EV service and repair.

Youth populations may be a key group to sustain the climate workforce and the transition to EVs. The Los Angeles Economic Development Corporation (LAEDC) workforce estimates show more than two-thirds of electric vehicle employment in Southern California is held by workers with no degree (24%) or a high school diploma (43.6%), with a trend toward increasing education. Per LAEDC, 5.6% of jobs in the sector are held by workers holding postsecondary non-degree awards, which include trade certification. Electric vehicle jobs requiring at least a high school diploma are anticipated to grow by 0.7% from 2018 to 2023, and jobs requiring at least a bachelor's degree by 1.2%. In balance, jobs needing no diploma or bachelor's degree are forecasted to diminish by 2% over the same time period.[41] Therefore, the ability to recruit youth populations into the climate workforce is expected to become a significant source to manage workforce fluctuation.

People in other careers who may shift to the climate workforce could also be crucial. One example of this includes individuals who work in the gasoline vehicle industry.

Along with analyzing the potential sources for the future workforce, examining its barriers is also important. Because the transition to electric vehicles in Vermont will require some shifts in the workforce, it is important to understand the central barriers to workforce growth and development. While each sector consists of its own barriers to workforce growth, a few barriers are universal:

- Inadequate social infrastructure such as childcare, transportation to work, or affordable housing.
- Belief that wages and compensation are too low given the cost of social infrastructure, such as childcare or transportation is covered by low wages.
- A lack of inclusivity.
    - There can be a sense that work culture is not supportive of non-dominant identities, such as women and non-binary individuals,

[41] Carr, E., Winebrake, J., & Winebrake, S. (2021, June 8). *Workforce projections to support battery electric vehicle charging infrastructure installation*. Energy and Environmental Research Associates. Retrieved September 1, 2022, from https://etcommunity.org/assets/files/Workforce-ProjectionstoSupportBatteryElectricVehicleChargingInfrastructureInstallation-Final202106082.pdf

Black, Indigenous, and people of color, all ability, LGBTQ+, mature workers, and other marginalized and underrepresented identities, including those related to class and religion.

- Inadequate education or training
  - For individuals who do not have the skills needed to enter the desired workforce.[42]

In addition to the new workers that could become available if these barriers are alleviated correctly, retraining existing workers could play a central role both in providing additions to the climate workforce as well as combatting the barriers to entering it.

SECTION IV: RECRUITMENT TECHNIQUES

Ensuring that the correct number of individuals are available for the new needs of the EV workforce relies on a strong recruitment system. As Robert Triest discusses in his report, "for the most part, it's not a shortage of workers that's the problem, per se. It's a sign that employers just need to offer better packages of wages and working conditions to attract workers."[43]

In order to combat the barriers discussed above, "employers could entice workers by including paying wages above the market rate; allowing longer shifts with fewer work days; and providing flexible parental leave."[44]

In a recent push to combat the labor shortage in Vermont, the state government developed a labor force expansion plan with strategic efforts across agencies, sectors and industries. This plan:

- Provides a federal benefit that gives a dollar-for-dollar reimbursement to employers in order to provide 100% wage replacement for their employees' personal sick leave (up to 80 hours) and 67% wage

[42] Vought, R. (n.d.). *The workforce crisis is complex – bolstering basic needs offers a simple solution*. Vermont Biz. Retrieved September 1, 2022, from https://vermontbiz.com/news/2022/march/11/workforce-crisis-complex-%E2%80%93-bolstering-basic-needs-offers-simple-solution

[43] Barton, A. (2021, September 14). *Vermont's worker shortage is among the greatest in the country, study says*. Burlington Free Press. Retrieved September 1, 2022, from https://www.burlingtonfreepress.com/story/news/2021/09/14/vermont-has-fourth-largest-labor-shortage-according-study/8330277002/

[44] Barton, A. (2021, September 14). *Vermont's worker shortage is among the greatest in the country, study says*.

replacement to care for an individual, quarantine, and/or care for a child in the event of a school or childcare closure.

- Creates a directory of BIPOC owned businesses, offering technical assistance, and networking with fellow business leaders to focus on economic empowerment. The plan includes a $250,000 grant to take that work to new heights via business coaching and other training for BIPOC business owners; networking; and career fairs, workshops, and paid internships.
- Includes millions of dollars in investments designed to grow and strengthen Vermont's workforce including but not limited to:
    - $500,000 for the State Refugee Office to administer grants to refugee or New-American focused programs in an effort to support immigration and/or retention.
    - $250,000 to the Agency of Administration to direct a new Special Oversight Committee on Workforce Expansion and Development.
    - $1.5 million to the Department of Labor to launch a two-year pilot program to establish a coordinated regional system to increase local labor participation rates; decrease the number of vacant positions; bolster worker wages; and collect and distribute information on local career pathways with key workforce development partners.
    - $300,000 to the Department of Corrections to create a pilot, community-based reentry program at Chittenden Correctional Facility for justice-involved individuals.
    - $3 million to the Vermont Student Assistance Corporation to launch the Vermont Trades Scholarship Program for students who demonstrate financial need.
    - $15 million to the Vermont Housing Conservation Board to establish a Construction and Rehabilitation Learning Program and Revolving Loan Fund
    - $1.8 million to the Department of Forests, Parks and Recreation to regrant to groups participating in the Vermont Serve, Learn and Earn Program - celebrated program that offers paid service and

learning opportunities for young Vermonters (more on that below.)[45]

Each of the barriers discussed have feasible recruitment techniques to combat them, but it reveals the close relationship between Vermont's ability to combat climate change and its capacity to strengthen the workforce.

SECTION V: NECESSARY EDUCATION AND TRAINING TECHNIQUES TO BUILD THE WORKFORCE

Vermont's workforce will experience losses and gains across different sectors as a result of scaling up EV adoption. Therefore, it is essential that the state understands the tools to ensure a just transition between these consequences. Retraining individuals who may experience job loss will aid them in finding new work, illustrating the importance of providing education and training for the increasing sectors.

In addition to the high-level recruitment techniques discussed above, the use of different education and training techniques could assist the transportation sector in making the transition towards EVs more smooth. Whether there is an increase in workforce size or not, there will be a need for retraining across the vehicle industry to create a level of fluency and familiarity with EVs, which will allow for career enrichment within multiple career spaces. Job enrichment allows for an increase in scope of a job by extending the range of its duties and responsibilities generally within the same level and periphery. This applies to the transition to EVs because providing training and education to those hoping to participate in the process allows their roles to expand in skills, knowledge, and responsibility.

A concrete example of the importance of job training and education exists in the EV charging industry. Charging infrastructure draws a significant amount of energy from the grid. Therefore, "safety measures are of paramount importance for installers, maintenance staff, operators, and customers of electric vehicle charging stations. While local building, fire, and municipal codes may vary, charger safety measures are standardized under the National Fire Protection Association and National Electric Code standards, among others. The set of standards applicable to charger installation requires

[45] *2022 legislative recap*. Vermont Business for Social Responsibility. (2022, May 19). Retrieved September 1, 2022, from https://vbsr.org/public-policy-post/2022-legislative-recap/

detailed understanding by installation professionals to ensure the safe install and function of charging devices."[46] The task of ensuring safety in charging infrastructure is just one example of the importance of education within respective fields.

CONCLUSION:

As shown in this report, the transition to EVs sparks interesting opportunities and challenges for Vermont's workforce. On a national scale, the growing EV industry is expected to foster a significant net increase in jobs. This increase is predicted to create 2 million new green jobs across the country. However, this growth fluctuates by state, and as discussed, Vermont does not possess some of the sectors predicted to expand, such as vehicle manufacturers.

Rather, in electrifying transportation over the coming decades, Vermont will experience fluctuation in its transportation sector, allowing for shifts within job opportunities, job enrichment, and the balancing of job losses. The transition to EVs in Vermont is not expected to spark any major economic downturns for the state, and how Vermont chooses to interact with its workforce affects its chances of slowing climate change, revealing the close relationship between the two. In conclusion, Vermont's workforce is expected to experience losses and gains across different sectors as a result of scaling up EV use. Whether there is an increase in workforce size or not, retraining across the vehicle industry will play a central role in achieving a level of fluency with EVs. There is the possibility that this training for the future EV workforce may result in processes such as job expansion or enrichment. Therefore, the transition to EVs has the potential to bring positive change to the many sectors that it reaches.

[46] Carr, E., Winebrake, J., & Winebrake, S. (2021, June 8). *Workforce projections to support battery electric vehicle charging infrastructure installation*. https://etcommunity.org/assets/files/Workforce-ProjectionstoSupportBatteryElectricVehicleChargingInfrastructureInstallation-Final202106082.pdf

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