

Vermont Climate Action Commission
Transportation Electrification/Comprehensive Transformation of Mobility

June 13, 2018

EXISTING CONDITION, TRAJECTORY, CHALLENGES AND OPPORTUNITIES:

ANR's 2017 greenhouse gas (GHG) emissions report identifies transportation as the largest contributor to Vermont's GHG emissions of all sectors (42%). Electrification of the transportation sector, whether personal vehicles or transit and school buses, will help reduce GHG emissions, increase the percentage of renewably powered transportation options, and keep more of the dollars spent on transportation fuels within the state.

Recent studies on climate and energy in Vermont have identified plug-in electric vehicles (EVs) as a key pathway to meeting long-term goals, given how many Vermonters still travel long distances to get to jobs and services. Meeting the Vermont 2016 Comprehensive Energy Plan (CEP) illustrative goal of 10% renewably powered transportation would require about 45,000 EVs in Vermont by 2025—a major increase from the current 2,000—and more recent analysis indicates that we need closer to 55,000 EVs to meet the emissions reduction goals of the Paris Accord, as committed to by Governor Scott in June of 2017. Regardless of the target, EVs powered by renewable energy will provide major reductions in Vermonters' GHG emissions while also lowering annual household transportation expenses. However, existing market forces will not increase the market share of EVs fast enough to meet Vermont's climate and energy targets for the transportation sector. Three principal barriers to accelerated adoption are i) a lack of sufficient charging station infrastructure, ii) a lack of general awareness about the benefits of switching to EVs and how to do it affordably, and iii) the upfront costs of EVs (including used EVs), especially to low and middle-income Vermonters and rural Vermonters (who depend the most on personal vehicles to get to work and school and for other essential travel).

A fourth concern that is cross-cutting in character and relevant to the above three barriers is the price of electric service in relation to the costs. The pricing barrier is a matter of rate design. Rate design is used by regulators and utilities to configure prices in ways that allow the utility to recover costs and send sound economic signals to consumers to manage their consumption patterns. Increasingly, technology is enabling rate design to help either encourage or discourage effective management of customer loads. Rate design can either help or hinder the business case for commercial investment in charging infrastructure. And rate design can either help or hinder customer economics—specifically the ability of consumers to cover the costs of charging in relation to the economic benefits of EVs (to both the customer and the utility). More broadly, rates can either exacerbate or overcome the barriers generally associated with the higher upfront costs of EVs.

The large buses that travel our streets—both transit buses and school buses—show how our rural state has worked to provide transit and other transportation choices that help people get where they need to go. At the same time, the inefficient diesel buses that make up most fleets come with real issues: they emit diesel exhaust that is dangerous to children, drivers, and passersby, especially those with chronic

disease; they are subject to fluctuations in fuel prices; and they are inefficient—the average diesel transit bus gets just 4.5 miles per gallon.

The VW settlement funds are intended to help Vermont reduce its diesel emissions. The heavy-duty vehicle portion of these funds could provide a once-in-a-decade opportunity to not only reduce diesel emissions, but also leverage longer-term market transformation in the heavy-duty sector that would result in permanent diesel and GHG emissions elimination. Dedicating VW settlement funds to heavy-vehicle electrification, along with important grid management solutions, would lead to an increased use of renewable energy in the transportation sector and health benefits that far exceed other proposed options, such as moving to newer, more efficient diesel vehicles.

RECOMMENDATIONS:

Two pivotal paths forward will transform our greenhouse gas-intensive transportation sector and maximize mobility options for all. Specific recommendations focus on:

- Strategic and significant vehicle electrification, maximizing the use of the Volkswagen (VW) settlement funds and more.
- Expanding multi-modal transportation choices and transportation efficiency.

Together, these strategies are intended to meet the following objectives:

- Create an environment in which it is convenient, safe and affordable to travel by electric vehicles, bus, rail, bike, or foot and to share rides.
- Make it more convenient and easy for Vermonters of all incomes to purchase and travel by electric vehicles.
- Reduce vehicle miles traveled and single occupancy vehicle trips by Vermonters.
- Increase accessibility to jobs, services, and community activities.
- Reduce transportation energy burden for Vermonters.
- Reduce transportation-related impacts on communities and Vermont's natural resources.

Disclaimer: Below, in each section, we have identified several stakeholders who will either likely lead the effort or be a pivotal partner in it. There are likely several other pivotal players that have not been noted, however, and the list is by no means comprehensive. To undertake this work, it will take many different partners and the support of Vermonters more broadly.

Part 1: Transportation Electrification

Goals:

- Reduce the upfront cost of electric vehicles
- Rapidly expand availability of EV charging infrastructure for all Vermonters
- Adopt rate design to lower EV charging costs while not driving up costs for utility customers
- Increase awareness of EVs and their benefits among Vermont consumers

Recommendation	Impact	Feasibility	Cost
Provide a state-funded or state facilitated EV purchase incentive that applies to new and used EVs	High	Medium	\$\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Investigate, recommend and advance possible sources of revenue to provide point of sale or other incentives for EVs or identify specific ways – partnerships with utilities, manufacturers, retailers or others – vehicle uptake will move at the progress needed to dramatically increase customer uptake.		VTrans	
2. Recommend program designs to target incentives to rural and low/moderate income Vermonters.		VTrans, DEV, low income advocates	

Background: High upfront purchase prices are one of the main barriers to widescale EV adoption in Vermont. Point of sale incentives are a proven mechanism to overcome this barrier, based on experience in Vermont and other states; however, with the current lack of reliable funding sources, incentives become a challenging issue. This recommendation focuses on the next steps needed to investigate all possible sources of funding for a point-of-sale rebate and to identify program designs that will target incentives to Vermonters who need it the most.

Recommendation	Impact	Feasibility	Cost
Strengthen the used EV market	High	Medium	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Investigate used market opportunities and barriers to having used EVs available to Vermonters. identify strategies to keep used EVs for resale in Vermont		VTrans, automobile associations, dealers, lenders, and auto manufacturers	
2. Conduct consumer research to determine key factors in purchase consideration for used EVs and price point necessary to sell these vehicles		DEV	
3. Develop and publicize information on battery warranties and other concerns that consumers may have about EVs		DEV	

Background: Research shows that Vermonters tend to purchase used rather than new vehicles. As more EVs are coming off lease, there is the potential to grow a used EV market in Vermont. However, there are barriers to keeping used vehicles in state, primarily due to the cost to dealers to purchase and resell used EVs. We recommend working with auto dealers and other stakeholders to better understand barriers to keeping used EVs in Vermont and identify strategies to address these barriers. In addition, educational resources can be made available to consumers through Drive Electric Vermont.

Recommendation	Impact	Feasibility	Cost
Make special EV pricing purchase and lease deals more visible and available to the public by consolidating and continually updating information from EV dealerships.	Medium	High	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Work with auto dealers to collect and regularly publicize deals on EVs		DEV, auto dealers, OEMs	
2. Use DEV website to generate sales leads for auto dealers		DEV, auto dealers	

Background: Auto makers and dealers regularly provide purchase and lease incentives that can significantly reduce the cost of an EV. However, these opportunities are not always transparent to consumers. DEV will partner with auto dealers to regularly collect information on discounts, rebates or incentives planned for EVs. This information will be published on the DEV website. Leads for dealers will also be generated, providing an incentive to dealers to participate. Information will be disseminated through existing DEV channels as well as partnerships with Vermont utilities.

Recommendation	Impact	Feasibility	Cost
Use VW Settlement funds to jumpstart a transition from diesel to electric transit and school buses.	High	High	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Develop resources for school districts and transit agencies on electric vehicle technology and how to access VW Settlement funding		ANR	
2. Engage partners to assist with raising awareness about VW Settlement opportunities		ANR, VTrans, Superintendents Association, VLCT, RPCs, Town Energy Committees/VECAN, VPTA	
3. Provide technical assistance to school districts, municipalities and others to develop projects and apply for VW funding		ANR	

Background: Vermont's VW mitigation plan prioritizes investment in bus electrification. Outreach and technical assistance are needed to promulgate successful school and transit bus projects.

Recommendation	Impact	Feasibility	Cost
Investigate and utilize grant funding and finance strategies to help overcome the high upfront costs of electric transit buses	High	High	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Investigate and advance finance options such as tariff on bill financing to determine viability and interest in finance strategies among stakeholders		VTrans, utilities, transit providers	
2. Leverage Tier III or VW Settlement funds		VTrans, utilities, transit providers	
3. Continue to seek federal funding for electric transit buses through FTA Low or No Emission Vehicle program		VTrans, transit providers	

Background: The significantly higher up-front purchase price of electric buses is a barrier to the electrification of the public transit sector. There are finance strategies that leverage fuel and operational savings to pay off loans and there is an opportunity to maximize VW settlement funding to support this focus. More research is needed to identify finance models that will work for Vermont’s transit operators. In addition, the State and transit operators should continue to pursue federal and utility sources to fund the incremental cost of electric transit buses.

Recommendation	Impact	Feasibility	Cost
Implement recommendations in VTrans corridor study to provide DC fast charging within 30 miles of all Vermonters	High	Medium	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
Engage utilities and site hosts and leverage private funds/private industry to the extent possible		VTrans, utilities, private site hosts, EV charging companies	

Background: VTrans has completed a study to identify gaps in DC fast charging and locations that will provide fast charging within 30 miles of all Vermonters. This analysis should help to inform allocation of VW Settlement funds. In addition, work is needed to identify site hosts and other partners to install and operate charging infrastructure at these locations.

Recommendation	Impact	Feasibility	Cost
Develop and execute strategy for deployment of VW Settlement funds for EV charging to include priority investments, selection criteria and goal for number of charging stations to be deployed.	High	High	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Engage utilities and charging companies, including as potential applicants for VW settlement funds, to install and operate DCFCs where there are current identified gaps		ACCD, VTrans, utilities, private site hosts, EV charging companies	
2. Determine opportunities for leveraging Tier III investment as part of overall state plan for EVSE deployment.		PSD, VTrans, utilities, Tier III stakeholders	
3. Identify and engage private hosts, such as gas stations, employers, multi-family housing developers and owners to raise awareness about VW funds and how to install EVSE		ACCD, VTrans, private sector stakeholders	
4. Develop and disseminate guidance for municipalities and VLCT on EVSE siting and how to access VW and/or Tier III funding for projects		ACCD, VLCT, VECAN/Town Energy Committees, utilities	
5. Coordinate with NESCAUM to put forth priority projects for Electrify America investments		ANR	

Background: ACCD is administering Vermont’s VW allocation for EV charging. This is a once in a lifetime opportunity to rapidly expand charging infrastructure where it is needed the most. In addition, to building out fast chargers (see recommendation XXX), ACCD and ANR should engage all partners to identify priority sectors for VW investment. Attention and priority should also be given to building out charging infrastructure on interstate corridors and between Canada and other states. Coordination with utilities, charging companies, private site hosts and Electrify America will ensure VW investments are maximized. In addition, outreach materials should be developed to make it easy for potential applicants to understand how they can apply for VW funds.

Recommendation	Impact	Feasibility	Cost
Conduct research/analysis needed to support the PUC workshop required by the 2018 Transportation Bill (H.917)	High	High	\$
Action Step(s)		Who's Responsible//In Collaboration With:	
1. Research and propose alternative rate designs and/or mitigation strategies, e.g. the use of battery storage with an EV charging station to manage peaks, utility or third-party management of EV charging loads or TOU (time of use) rates all while ensuring it does not drive up costs for other customers		DPS	
2. Approach the utilities to examine the feasibility of mapping areas of the grid with the capacity to accept charging station		DPS, utilities	

loads. This analysis should include the consideration of charging station usage	
3. Examine the feasibility of identifying these areas on a distribution level. Target areas that need additional load for EV pilot projects.	DPS
4. Incorporate SHEI as a consideration into the implementation of the VW Settlement programs.	Interagency VW Task Force
5. Removal or mitigation, as appropriate, of barriers to EV charging	PUC
6. Encourage participation into the PUC workshop	CAC
7. Foster collaboration between the auto dealerships and utilities that offer TOU or EV rates. The utility and dealerships could promote the O&M savings a customer could realize through the purchase of an EV and use of a TOU or EV rate	DPS, auto dealers, utilities

Background: The 2018 Transportation Bill includes language requiring the Public Utility Commission to open an EV docket. This is an essential next step to lay the framework for how utilities will engage with their customers and other market players to support a growing EV market. A range of issues will be covered and research is needed to support this investigation.

Recommendation	Impact	Feasibility	Cost
Leverage and enhance Drive Electric Vermont (DEV) to maximize the impact of education and outreach campaigns and stakeholder engagement to build awareness and encourage purchase consideration for EVs	Medium	High	\$
Action Step(s)		Who's Responsible/In Collaboration With:	
1. Appropriate state agencies work together annually to develop a scope of work and provide funding for DEV to meet annual education, outreach and technical assistance priorities.		VTrans, DPS, ANR, ACCD	
2. Coordinate distribution of EV education and outreach materials and messaging with DEV stakeholders and Vermont Climate Action Commission members to reach more Vermonters, more often		DEV stakeholders, DPS, ANR, ACCD, CAC, VECAN	
3. Develop resource materials for town energy committees and municipalities on how encourage EV adoption and support municipal fleet transitions to electrification. Include information on how to leverage VW Settlement for municipal projects.		ACCD, DEV, VLCT, VECAN/Town Energy Committees, utilities	

Background: For the past five years, the State has invested in Drive Electric Vermont to convene and engage stakeholders on a range of issues to accelerate adoption of EVs. DEV also uses multiple channels

to build awareness about EVs and educate Vermonters about their benefits. This program should continue and be enhanced with greater coordination of messaging and outreach among DEV stakeholders. In addition, the State and DEV should engage NESCAUM and other national partners to ensure coordination of messages and educational campaigns.

Recommendation	Impact	Feasibility	Cost
Implement “ride and drive” events to give Vermonters a chance to test drive or experience EVs in person and support purchase consideration for EVs	Medium	High	\$
Action Step(s)		Who's Responsible/In Collaboration With:	
1. DEV coordinate with local energy committees and other partners to identify locations and participate in existing community events to showcase EVs and provide consumers with an opportunity test drive the vehicles		DEV, auto dealers, Town Energy Committees, VTCCC, RPCs	
2. Target events in regions of the state with high transportation energy burden		DEV	

Background: Drive Electric Vermont and Vermont Clean Cities Coalition have conducted “ride and drive” events for several years, giving Vermonters a chance to test drive EVs. Driving EVs is one of the most effective ways to overcome myths about vehicle performance and increase purchase consideration. DEV and other stakeholders should continue to offer “ride and drive” events, targeting these events in locations with high transportation energy burden.

Recommendation	Impact	Feasibility	Cost
Educate and engage auto dealers to effectively engage customers who are interested in purchasing an EV and make the sale	Medium	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With:	
1. Implement a dealer engagement program based on previous DEV dealer outreach programs. Incorporate lessons learned and effective dealer engagement tactics from others states		VTrans, DEV, auto dealers	
2. Collaborate with Vermont Automotive Distributors Association on outreach to dealers and development of educational materials		VTrans, DEV, auto dealers	

Background: It is essential that auto dealers and their sales staff be educated about EVs. Unfortunately, the sales experience for those interested in EVs is not consistent and can turn off potential buyers. DEV piloted a dealer incentive program that required training and proved effective at engaging auto dealers.

This pilot should inform the reinstatement of programs to engaged and potentially incentive dealers as partners in growing the EV market in Vermont.

Recommendation	Impact	Feasibility	Cost
Make EVs available through traditional car rental, car share, or ride-hailing service to provide drivers ready access to an EV at low cost and with no ownership or lease commitment	Medium	Low	\$
Action Step(s)		Who's Responsible/In Collaboration With:	
1. Develop a deployment plan for existing public car share, traditional car rental, and traditional and non-traditional ride hailing entities		ACCD, Car Share Vermont, car rental companies, Uber, Lyft, taxi companies	
2. Investigate existing ride-hailing/ride-sharing pilot projects in rural areas to explore lessons learned and requirements for startup and implementation		ACCD	
3. Reach out to fleet owners to determine interest and external funding needed to support a program		ACCD	
4. Identify partner to implement a pilot program to determine if program is viable and if so to recruit additional organizations or businesses to participate		ACCD	

Background: Rental cars, car sharing programs, and ride hailing fleets all provide the opportunity for consumers to experience an EV before making a purchase. In addition, electrification of these fleets will reduce emissions. This recommendation focuses on building relationships with a range of fleet operators to explore ways in which EVs can be incorporated into their fleets.

Part 2: Comprehensive Transformation of Mobility (Transportation Demand Management)

Goals:

- Create an environment in which it is convenient, safe, and affordable to travel by bus, rail, bike, or foot and to share rides.
- Reduce vehicle miles traveled by Vermonters.
- Reduce single-occupancy vehicle trips.
- Increase accessibility to jobs, services, and community activities.
- Reduce transportation energy burden for Vermonters.
- Reduce transportation-related impacts on communities and Vermont’s natural resources.

Recommendation	Impact	Feasibility	Cost
Increase use of public transit in Vermont with more public transit infrastructure, trip planning tools, and enhanced service with more efficient vehicles and routes	High	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
1. Deploy and promote VTrans' Open Trip Planner to maximize investment in rides and vehicles		VTrans, transit operators	
2. Work with transit providers, legislature, and regional planning commissions to identify opportunities to increase state and local investment in public transportation		VTrans, State Legislature, RPCs, CCRPC, transit providers	
3. Expand transit subsidies for older adults and under-resourced populations, especially for medical, social service, or other critical needs		VTrans, Governor, State Legislature, RPCs, CCRPC, transit providers	
4. Research what is needed to adopt micro-transit for rides in rural areas, at night, and on weekends		VTrans, transit operators	

Background: In many of Vermont's municipalities, about half or more of the population could be considered "transit dependent," that is, elderly, disabled, student, and/or low income. A goal in the 2016 VT Comprehensive Energy Plan (CEP) is "increase public transit ridership by 110% to 8.7 million trips annually." To achieve this, we must both improve and expand existing transit service as well as do more to promote transit as a smart and easy choice for many Vermonters.

Recommendation	Impact	Feasibility	Cost
Increase efficiency of school transportation and promote active transportation to school	Medium	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
1. Adopt standards for improved routes and safety within one mile of schools and public transportation centers		VTrans	
2. Implement Safe Routes to School with other programs and local initiatives including Way to Go! To School campaigns.		VTrans	

Background: A study shows that 71 percent of American parents surveyed had walked or biked to school when they were kids, but only 18 percent of their children do so. Commonly cited reasons parents give for driving their kids to school are that school buses are unpleasant, unsafe, and take too long and that roads are not safe for kids to bike and walk on. With Vermont's move to consolidate school districts, it's a good time to examine school transportation in the context of what efficiencies can be found that also improve student and community health and wellbeing.

Recommendation	Impact	Feasibility	Cost
Increase programs and public infrastructure to support walking and biking in Vermont	Medium	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
1. Provide bike skills training and bike rider empowerment at schools, communities, workplaces		Local Motion	
2. Partner with employers and/or health insurers to promote active transportation and offer discounts for meeting minimum activity levels, tracked by FitBit (or similar)		VDH	
3. Evaluate Burlington bike share program and identify opportunities to expand the program statewide, including e-bikes, fat tire bikes, e-tricycles for seniors, and e-assist cargo bikes		VTrans, Catma, Local Motion, local bike shops	
4. Provide guidance, sample language, and technical assistance to municipal planners on how to include bike/walk master plans and/or transportation plans as part of municipal development plans and future development processes, ideally tied to transit oriented design and development		VTrans, ACCD, Vt Planners Association, VLCT	
5. Strengthen legislation to enforce and strengthen penalties for motor vehicle violations that put pedestrians and bicyclists at risk.		VTrans, Local Motion	
6. Identify high-risk collision locations and help fund mitigation option		VTrans, RPCs	

Background: The environment, personal and community health, and the family pocketbook are several of the reasons that many more Vermonters would bike or walk for transportation if they could. Lack of safe pleasant sidewalks and bike lanes/paths are one huge barrier to this being a viable mode for more people.

Recommendation	Impact	Feasibility	Cost
Explore viability of commuter rail service in Vermont	Medium	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
Explore a program to focus planning and development in and around Vermont's 90 current or former train stations in the state. At minimum, focus on Vermont's 11 active train stations, and encourage future housing to be located within walking/short transit distance to train stations		ACCD, VTrans	

Background: The 2016 CEP suggests, "continue state efforts to extend the Ethan Allen service from Rutland to Burlington and bring the Vermonter service to Montreal."

Recommendation	Impact	Feasibility	Cost
Implement programs and policies to increase multi-modal transportation options	High	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
1. Expand Capital Commuters program to ALL state workers, then to workplaces statewide (start with large employers first). Use Washington State's Commute Trip Reduction law as a model		VTrans, CATMA	
2. Increase marketing of Go! Vermont's incentives to advance vanpooling via Enterprise and Go! Vermont subsidies		VTrans	
3. Evaluate Complete Streets policy and implementation to identify barriers to implementation and strategies for increasing utilization of policy to plan and implement local and state road projects.		VTrans, VLCT, RPCs	
4. Adopt state policy to lead by example and encourage or require virtual meetings, car/vanpooling for meetings, and other strategies to increase efficiency of state employee travel.		VTrans	
5. Develop and deploy open source ride-hailing software with worker protections for drivers (to avoid issues associated with Uber).		VTrans, Legislature	

Background: The 2016 CEP states, “one successful alternative is to have employees choose cash instead of a free parking space, a practice known as cash-out. The State of California has made parking cash-out required for employers with greater than 50 employees. Studies of employers who have switched to a cash-out system have experienced an average VMT reduction of 12%. As the biggest employer in the Vermont, the state has an opportunity to employ this strategy to help reduce VMTs, and should consider a pilot “parking subsidy cash-out program” in high demand locations. The Capital Commuters program began in July 2013 as a three-year pilot project to reduce transportation and parking demands that face State of Vermont employees based in Montpelier. Overall, the program impressively reduced energy use and parking demands during its first three years. This and other programs can set Vermonters up for success in building new commute habits that not only improve the environment and health outcomes, but also improve mobility access for those without the choice to drive themselves.

Recommendation	Impact	Feasibility	Cost
Improve infrastructure to support safe and efficient multi-modal travel	High	Medium	\$
Action Step(s)		Who's Responsible/In Collaboration With	
1. Expand and improve park & rides, including use of existing large parking lots. Study the merits of auto-capture lots		VTrans, RPCs	

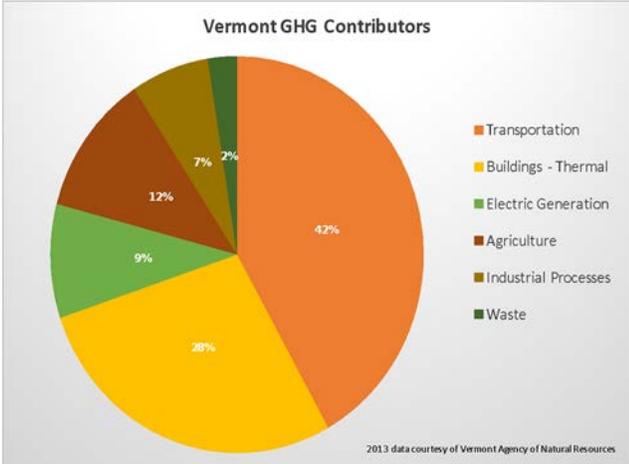
located on the perimeter of downtowns, as alternative to expected all day parking in central business districts (reference Net Zero Vermont’s Team Bridges Sustainable Montpelier 2030 plan)	
2. Improve freight rail infrastructure so heavier loads can be carried by trains. Make way for containerized shipping, expanding the opportunity to shift from truck to train shipping, thus increasing efficiency	VTrans
3. Integrate health staff and health & equity considerations into state agency decisions and processes that affect transportation systems.	VDH

Background: Though much can be achieved through marketing and awareness of non-drive alone travel, change in behavior quickly bumps up against limits to our transportation infrastructure. In addition, there are efficiencies that can be achieved through coordinated efforts between the state and commerce that relies on transportation.

APPENDIX

Transportation Electrification Background

Transportation is the largest contributor to VT GHGs of all sectors, and personal vehicle use makes up the largest share of that. (See the graph of *Vermont GHG Contributors*.) EVs are a critical means of meeting Vermont’s climate *and* energy goals—they use a fraction of the energy required by gasoline vehicles and, when powered from Vermont’s grid, EVs can cut GHG emissions by over 50% today, with even greater reductions possible as renewable energy use grows. Additionally, switching from low-mileage, high-emitting buses to electric ones will help us meet our climate goals by reducing GHGs as well as overall energy consumed. Moreover, by providing more public transportation options to rural Vermonters through efficient use of school buses for public transit during off hours, we can significantly reduce overall Single Occupancy Vehicle (SOV) use, thereby further reducing GHG emissions.

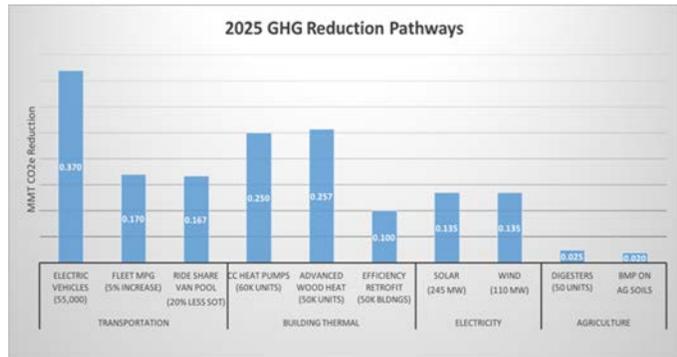


Electric Vehicles: EVs can reduce household transportation costs, particularly for rural residents who must travel long distances for jobs and services. If strategically deployed, EVs can also help utilities manage peak demand and better integrate renewable energy sources, saving money for all ratepayers. To realize these benefits, public programs and policies can help overcome the primary barriers to EV

adoption—the upfront cost of the vehicle, lack of public awareness of EVs, lack of availability of EV models, and lack of availability of public charging—while ensuring equity and affordability for all Vermonters.

Accelerating the adoption of EVs is one of the fastest ways to reduce our GHGs in the next 8 years. (See Graph - EAN GHG Reduction Pathways Analysis.) Additionally, EVs are also one of the fastest ways to reduce annual household energy expenditures.

The average Vermont household spends over half its monthly energy dollars on transportation, with nearly 80% of that money going out of state for fossil fuels. EVs are at least three times more efficient than gas-powered vehicles. They can convert about 70% of the energy supplied from the grid to power the wheels. Typical gas vehicles are only about 20% efficient from the fuel tank to the wheels.



With an expectation that EVs will eventually become more affordable than combustion cars, it is important to focus on expanding outreach to low-middle income and rural Vermonters now, as they may have the most to gain from the change.

By providing the policy framework that accelerates EV adoption for ALL Vermonters, we can dramatically reduce our GHGs to meet our Paris goals while ensuring that low and middle-income Vermonters can benefit from the savings that this shift brings. Most importantly, we have available funding to jumpstart this transition: **the VW settlement funds**. (Note: Up to 15% of the \$18.7M of funds coming to Vermont under Appendix D of the VW settlement can be dedicated to electric vehicle charging infrastructure for passenger vehicles. These funds are not available for consumer incentives.)

Electric Buses: Gasoline and diesel represent more than 35% of all energy consumed in our state. Switching from low-mileage, high-emitting buses to electric ones will help us meet our climate goals by reducing GHGs and overall energy consumed and increasing the portion of renewably powered transportation. Additionally, by providing more public transportation options to rural Vermonters through the efficient use of school buses for public transit during off hours, we can reduce overall Single Occupancy Vehicle (SOV) use, thereby further reducing GHG emissions.

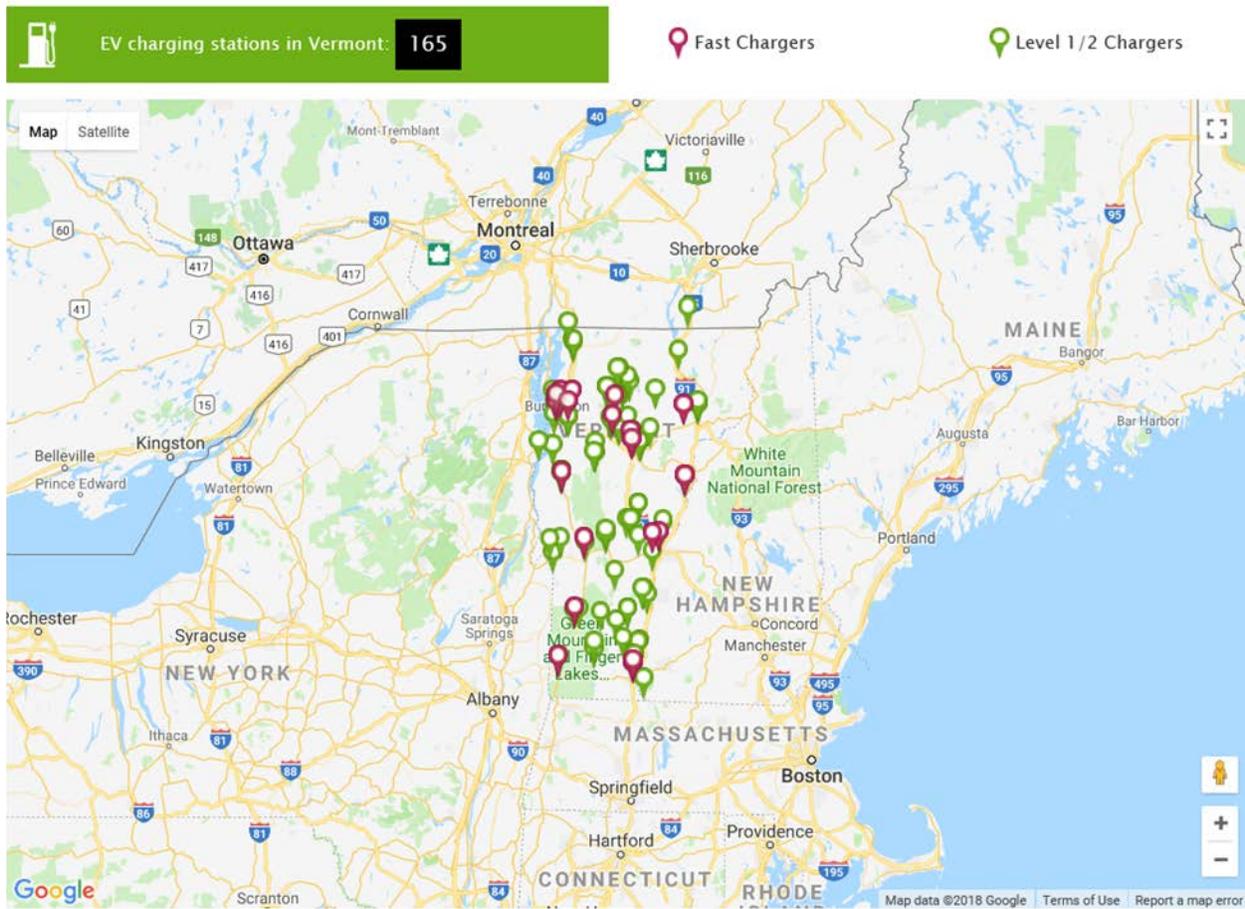
Currently there are over 400 electric buses already in operation in the US. The most recent test in Sept 2017 of public transit buses in California show that the ranges now extend over 1000 miles on a single charge, although most current transit buses on the market average 350 miles. Additionally, there are examples of successful bus electrification projects such as in the City of Greensboro, NC. Greensboro is pairing voter approved funding with a grant from Duke Energy to purchase electric buses and expects to save (from O&M) \$1.7M over the 12-year lifetime of the first 4 buses purchased.

Electric buses cost about \$200,000 more to buy than nearly identical diesel models (\$660,000 for a 35-ft electric bus, compared with \$450,000 for diesel), but those costs are recoverable through the vehicle's lifespan, according to detailed studies by Vermont-based Green Mountain Transit. If diesel costs \$2.40/gallon, an electric bus would save \$44,000 over its 12-year life compared with an equivalent diesel-powered bus, considering all costs and savings, including decreased fuel and maintenance expenses and the increased upfront cost of the electric bus.

Finally, there are many environmental, social, health, and educational benefits associated with switching from diesel buses to electric buses. The emission reductions associated with electric buses vary by model, but to give an example, switching one large diesel transit bus to an electric bus can lead to annual savings of over 50 tons of GHGs, 445 metric tons of CO₂, nearly 300 lbs of CO, and 628 lbs of NO_x. Multiplied over the estimated 12-year lifespan of a bus, and multiple buses across a fleet, Vermont stands to gain real environmental benefits and make progress toward its climate and energy goals from bus electrification. Communities that have electric buses, whether transit or school buses, will also help reduce the very real impacts of diesel on people's health. According to the Clean Air Task Force's study, the cost of health impacts in Vermont from fine diesel particles was \$29M in 2005. The lack of tail pipe emissions also provides significant health benefits, especially to children who ride buses twice a day, five days a week, and they generate far less noise than diesel buses.

Current Condition:

Electric Vehicles:

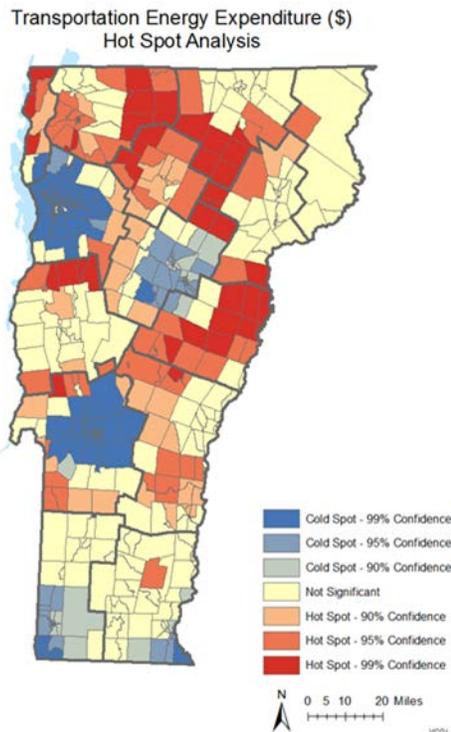


Charging Stations: There are around 165 public charging stations currently in Vermont (see Map of EV Charging Stations in Vermont), but:

- If we project increasing from 2,000 to 45,000-55,000 EVs by 2025, we need to ensure sufficient charging infrastructure to meet the demand.
- Public charging stations do not reach all parts of Vermont, and many regions are left without any access to public charging stations at all.
- Very few public charging stations are fast-charging; the State lacks an adequate charging network for through travelers.
- Very few charging stations are located at places of work (businesses, schools, etc.), where they could assist greater numbers of people who could benefit from all-day charging. (Daytime charging also helps take advantage of solar photovoltaic energy sources.)

Transportation Spending: Vermonters collectively spent over \$1B on transportation energy in 2015. Driving on electricity could cut this cost by 65% to about \$350M, with more of the electricity dollars staying local to Vermont.

Auto Ownership/Geographic Energy Burden: Auto ownership is high in Vermont. While it is essential to invest in public transportation and other options to reduce single occupancy driving, we also need to recognize that these options are challenging to deploy in rural areas. (See map of Transportation Hot Spots.) Most Vermonters will continue to use personal vehicles to meet their mobility and access needs for the foreseeable future.



EV Costs and Savings: New EVs currently cost more upfront than comparable gasoline vehicles, but EVs provide lifecycle savings by cutting energy and maintenance costs in half or more. Over the next 10 years the price difference is expected to shrink as EV technology achieves greater economies of scale. More pre-owned EVs are coming onto the market and provide even greater opportunities for affordable, low-carbon transportation.

Health Benefits: The American Lung Association estimates Vermont experienced \$347M in health and climate related costs in 2015 due to fossil fueled transportation. Shifting to EVs could reduce this by more than 90%. EVs also reduce other harmful and toxic tailpipe emissions, leading directly to added health and environmental benefits beyond GHGs.

Incentives: Several electric utilities are already providing incentives to complement federal tax subsidies for EVs through Tier III of Vermont's Renewable Energy Standard (and some car companies, such as Nissan, are providing their own). However, these are insufficient to meet the needed growth in EV

adoption, they vary widely among utility territories, they frequently do not apply to the used car market, and they are not systematically targeted to low/middle-income Vermonters.

Awareness: Drive Electric Vermont (supported by VTrans, PSD, and ANR) is promoting outreach and education on EVs with the limited funding available. Accelerating the adoption of EVs at the pace necessary to achieve our goals will require additional resources and effort to reach consumers in more rural areas and to engage dealers.

Rate structures: Residential customers in the state typically face a uniform per kWh charge that applies during all periods of the day and is undifferentiated by time of day or conditions on the grid. Thus, homeowners have no incentive to charge their EV's when it is most beneficial to the grid. In some service territories, there is an initial low-cost rate block that applies to the first 100 or 200 kWhs and then increases at a higher tail block that rises to as much as 17 and 23 cents/kWh. More typically, residential consumers in the state pay about 15 cents/kWh. Yet the underlying forward-looking costs of EV charging range from 3 to 8 cents/kWh, depending on the period in which vehicles are charged. Controlled charging off-peak can cost as little as 3 to 4 cents/kWh to the utility system. Rate designs can send a strong conservation signal in an era in which we need to grow demand for well-managed EV loads. Current rate designs provide little incentive to manage customer loads for system benefits and likely undermines customer economics for greater EV adoption and ambitions to move from high-carbon fuel demands to low-carbon electricity. Under present conditions, there is little incentive for commercial and industrial customers to invest in charging stations due to rate designs and demand charges that may represent an economic barrier. The rate designs available through our utilities likely do not reflect the opportunities to help accelerate the construction of public charging stations generally, and the customer and utility economics of well-managed charging.

Funding Sources:

- **Charging Infrastructure:** VW settlement funds (15% for light duty vehicle charging), and possible Tier III or other utility funds.
- **EV Incentives:** there is a need to understand the pros and cons of a range of potential funding sources that would not affect the state general fund or the transportation fund revenue. These include, among others, expanding the Tier III requirements of the State's Renewable Energy Standard.

Electric Buses:

Public Transit Buses: Currently in Vermont, there are a total of 425 public transit vehicles, of which approximately 90 are set to be replaced due to age and condition (value of appx \$12M, in capital budgets). These vehicles range from smaller vans to larger buses, and their lifespans range from 7-15 years, depending on the type and size.

Burlington has already bought four electric buses in partnership with Burlington Electric, VEIC, the Vermont Agency of Transportation, and Green Mountain Transit (and a grant from the U.S. Department.

of Transportation). The result of this is that some of Burlington's most vulnerable people will have cleaner air to breathe through diesel emissions reductions, Green Mountain Transit will enjoy lower operating and maintenance costs associated with all EVs, and Burlington will reduce its GHG emissions to zero for these buses. Most of Green Mountain Transit's buses travel around 30,000 miles each year, consuming 7,000 gallons of diesel and emitting 77 tons of carbon. About 15 of the diesel buses in GMT's fleet have been in service for more than 14 years or 370,000 miles. GMT officials say that these buses are considered near the end of their useful lives and in need of replacement.

School Buses: There are 250 public schools in Vermont, including 28 union high schools, attesting to the full reach of school buses to all regions of Vermont. School buses fall within Type I (more than 15 passengers) and Type II (between 10 and 16 passengers). School buses are generally utilized only during the morning and afternoon hours when children are going to and from school. For the remainder of the day, they are generally not in service, leaving seats vacant that could potentially be used for public transit. Using these buses to provide transit services would, however, diminish these resources' usefulness as an electricity storage resource.

Renewable Energy vs. Efficient Diesel: Achieving this goal assumes that electric buses are powered with renewable energy. Currently, approximately 55% of Vermont's electricity is considered renewable, with utilities required by the Renewable Energy Standard to increase the percent of renewable electricity in their portfolio annually until 75% is achieved in 2032. In some jurisdictions, the percentage of renewable sources is far higher: for example, both the Burlington Electric Department and Washington Electric Co-op have portfolios that are already 100% renewable, while GMP's portfolio has forecast 60% renewable energy by the end of next year.

Funding: The VW Settlement funds are intended to be used to reduce diesel emissions. Rather than utilize this once-in-a-decade source of funding to transition heavy-duty vehicles to more efficient diesel engines, this could be the moment to catalyze a permanent shift away from NOx tailpipe emissions and to zero emissions for the lifetime of the vehicle. It is essential that any decisions around spend these funds consider the lifespan costs of the vehicle, including operations and maintenance costs, as well as pollutants and carbon costs. Whereas "efficient diesel" vehicles are less expensive to purchase, they are much more expensive to maintain with regular diesel, oil, transmission fluid, emissions systems repairs, etc., and they will continue to emit pollutants and carbon (albeit at a reduced level) for their lifetimes. Given the long lifespan of most heavy-duty vehicles (average 12 years), it is critical to utilize VW funds in a way that generates years of the lowest possible emissions. Any economic analysis must compare the net present values of the costs of these vehicles over time, including the externalities (positive and negative) generated by continued fossil fuel use over the life of the vehicles.

Grid Constraints: Because of the growing amount of renewable generation on Vermont's electric grid, there are times and places where we produce more than we use (during high wind/sun periods), and other times when we use more than we produce. In particular, the grid faces increasing constraints in the Sheffield-Highgate region in Northern Vermont. Generation resources inside this area are limited in real time to ensure that the system capacity is not exceeded in the event of a potential future transmission outage. The practical effect of this is that, from time to time, generation resources in this area are required to curtail their output due to the lack of capacity to export power, and many

Vermonters in those areas who wish to install solar on their homes or businesses are unable to do so at this time. Utilities, regulators, clean energy advocates and other stakeholders are trying to find ways to address this and maximize the use of our renewable energy resources.

Electric buses could serve to both increase load in grid constrained areas and provide storage capacity for Vermont's renewable generation for use during times of low generation by using renewably generated electricity during the day (when there is high solar generation at lower prices), and storing energy in their batteries when they are not in use that can be used to supplement our grid when renewable generation is lower, and demand is high (in the evening, when people are using lights and heating homes). It is important to note, however, that using these same buses for transit services would reduce the hours they could serve as grid resources.

School Buses as Public Transport: School buses are located in every part of the state and operate on predictable routes and schedules, as well as predictable downtimes, providing ample opportunities for charging. These buses could be used to combine public transit and school bus routes.

Goals:

Policy Context for the Workgroup's goals:

1. The Comprehensive Energy Plan (CEP), prepared by the Department of Public Service pursuant to 30 V.S.A. § 202b.
2. The Vermont Transportation Energy Profile, prepared by the University of Vermont's Transportation Research Center prepares under contract with VTrans every two years.

Summary of the Workgroup's Goals:

Accelerate the electrification of the transportation sector by promoting the adoption of EVs through improving charging infrastructure, boosting consumer awareness, and decreasing purchasing costs with a particular emphasis on low/middle-income and rural Vermonters as well as catalyzing the shift from diesel to electric in our state's buses while increasing the availability of public transportation in rural areas.

Other Entities Exploring Topic:

Jurisdictions across the nation and across the globe are working to accelerate vehicle electrification. Vermont executive branch agencies are engaged in a variety of activities intended to accelerate the electrification of the transportation sector. For example:

1. Through its consultants, Dubois & King and Drive Electric Vermont, the Vermont Agency of Transportation (VTrans) completed a report in November 2017 entitled, *Electric Vehicle DC Fast Charging on Vermont Highway Corridors*. The study identifies six priority site locations where filling gaps in DCFC coverage along interstate and arterial highway corridors would provide

publicly available dual-plug fast charging within 30 miles of nearly every address in Vermont. At the same time, DCFC at these sites would establish a network of fast chargers for long-distance through travel. Five of the six sites are on private property, and the sixth is at a state park and ride facility.

VTrans worked with an intrastate Agency team, including the Agency of Natural Resources, Public Service Department, Department of Buildings and General Services, and Agency of Commerce and Community Development, to provide guidance on the final report. The full study is available at the following link:

[http://vtrans.vermont.gov/sites/aot/files/planning/documents/DC%20Highway%20Corridor%20Report 112217 Final FULLVERSION-web.pdf](http://vtrans.vermont.gov/sites/aot/files/planning/documents/DC%20Highway%20Corridor%20Report%20112217%20Final%20FULLVERSION-web.pdf).

The consultants screened all six priority site locations for proximate 3-phase power and the cost to provide it, landowner willingness to host a charging station, amenities and site conditions suitable for charging stations, accessibility, adequate parking, and potential for expansion. The priority sites are located outside interstate rights of way, so the operators of the new charging stations will be able to assess a fee for their use without contravening the federal rules against commercial activity on interstate property. Funding options and potential business models to support ongoing DCFC at these sites was also explored in the report. However, funding is not immediately viable due to state budgeting constraints and the current early-market phase of vehicle electrification.

2. VTrans, through its consultants at the UVM Transportation Research Center, produces a Transportation Energy Profile biannually. The latest Profile is available at [http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/The%20Vermont%20Transportation%20Energy%20Profile 2017.pdf](http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/The%20Vermont%20Transportation%20Energy%20Profile%202017.pdf). The profile evaluates the State's progress toward achieving the goals and objectives that the CEP establishes for the transportation sector.
3. Several state agencies are working together on administering the State's actions with respect to Appendix C and Appendix D of the nationwide settlement of Volkswagen's fraudulent use of diesel emission defeat devices. Vermont is expected to receive \$18.7M under Appendix D of the settlement. Up to fifteen percent (\$2.8M) of these funds may be used for electric passenger vehicle charging infrastructure. Appendix D funding may also be used to support additional electric vehicle infrastructure as necessary to support electric buses purchased with Appendix D funds. In addition, Vermont agencies are working together to encourage Volkswagen to direct Appendix C settlement funding toward Vermont through Volkswagen's Electrify America program, which will invest \$2B over the next ten years in zero emission vehicle infrastructure and awareness. The VW funds will help stimulate market transformation and the electrification of the transportation sector.
4. VTrans and other agencies provide legislative testimony regarding electric vehicles. VTrans has testified in opposition to increased registration fees for electric vehicles as a means of addressing declining transportation revenues.

5. VTrans and ANR participate in the Transportation and Climate Initiative (TCI), facilitated by the Georgetown Climate Center. This group of Northeast and Mid-Atlantic states works collaboratively to support the deployment of electric vehicles and to maximize the economic opportunities these vehicles can bring to the region.
6. VTrans, the Public Service Department, and the Agency of Natural Resources fund Drive Electric Vermont (DEV), which is facilitated by the Vermont Energy Investment Corporation (VEIC). DEV works to increase awareness of electric vehicles, encourage investment in charging infrastructure, and coordinate with other New England and Mid-Atlantic states to plan for greater regional infrastructure buildout. DEV offers incentives for purchasing zero emission vehicles (ZEVs), raises consumer awareness, keeps data, and works on legislation and policy relating to ZEVs.
7. VTrans has been an active participant in the New England Governors & Eastern Canadian Premiers Tactical Air Quality Committee and worked with Governor Scott's Office on the revised regional Climate Change Action Plan that the Governors and Premiers accepted last summer.
8. The Federal Transit Administration (FTA) recently awarded VTrans \$480,000 through its Low or No Emission Vehicle Deployment competitive grant program (Low-No) to offset the costs of purchasing four electric transit buses. VTrans' Public Transit Section worked with the Green Mountain Transit Authority (GMT) and the Burlington Electric Department (BED) on leveraging these funds.
9. Vermont has adopted the California emissions standards under section 177 of the federal Clean Air Act. ANR is principally responsible for administering Vermont's Zero Emission Vehicle Action Plan, under which Vermont implements its responsibilities under a Multi-State ZEV Action Plan adopted by the ten section 177 states.
10. The Agency of Natural Resources, the Public Service Department, and VTrans have been working together to advance a section in this year's Transportation Bill (H.917) that would accelerate vehicle electrification. This legislation is essential to support a profitable EV charging business model as EVs continue to take hold and for pricing transparency. The bill would require the Public Utility Commission (PUC) to investigate numerous issues relating to EVs and to provide recommendations to the Legislature. A key task for the PUC is to combine a reasonable highway user fee on EVs with rate design to ensure that recharging EVs is less expensive than refueling with gasoline or diesel while moving policy discussion around EVs away from the free-rider issue.
11. Vermont agencies working on climate and energy issues meet monthly to coordinate their efforts through an Interagency Climate and Energy Workgroup.

Transportation Electrification Metrics:

1. **Desired outcome: Increased number of fast-charging stations.**

Barriers: limited VW settlement funds; rate structure does not currently incentivize private investment.

Metric: public and private charging stations available throughout Vermont to keep pace with demand.

2. Desired outcome: Outreach/education to publicize incentives for and benefits of EV adoption.

Barriers: high EV purchase prices, lack of standardization of incentives; lack of dealer involvement/incentive in marketing EVs; lack of all-wheel drive EVs; difficulty in reaching rural populations or those who cannot afford to change vehicles; difficulty in providing local leaders with the information and skills necessary to explain the benefits.

Metric: rapid acceleration of EV adoption (45,000-55,000 by 2025), and decrease in energy burden related to transportation.

3. Desired outcome: Increased dollars available for incentives, increased number of dealers participating, and increased number of low, middle income, and rural EV owners.

Barriers: new revenues or pricing systems are not consistent with the Administration's priorities.

Metric: sufficient funding to provide incentives for low/middle-income Vermonters, on a declining basis as adoption increases, purchase prices decrease, and more used EVs become available.

4. Desired outcome: increased electric public transit and school buses.

Barriers:

- **Funding:** To maintain momentum (beyond the initial pilot projects), it will be necessary to identify additional sources of funding for subsequent phases. This will ensure that investments in charging infrastructure and driver and mechanic training are maximized. Subsequent funding could include gradual reallocation of VTrans dollars (with careful consideration of tradeoffs relative to state goals) and federal funding such as the Low or No Emission vehicle funding program. **Opportunity:** Capitalize on the experience and success of the Clean Energy Development Fund (CEDF) as a potential catalyst for electrification of this sector.
- **Regulatory Framework:** There is currently a lack of a regulatory framework for electric vehicle charging that reflects state goals. **Opportunity:** Policies could include time-of-use charging, incentives for charging at times that help stabilize the grid, and revenue reinvestment from EV charging to support further deployment.
- **Uncertainty about technology, impact on service, and the bottom line:** Investing funds to learn, help prove the technology, and catalyze the market (so that it could be off and running on its own!) is an appropriate role of government. **Opportunity:** this proposal offers a way to reduce this uncertainty.
- **Up front cost of technology:** while the purchase cost of the technology is higher, the

lifetime savings on O&M bring the costs down considerably and drive a permanent NO-TAILPIPE emissions change in the public transit sector. **Opportunity:** The opportunity to combine VW Settlement funds and Tier III requirements to help drive the change and generate savings that can be put in escrow for continued electrification is considerable.

- **Lack of awareness:** Most Vermonters are unaware of the available technology, range and substantial GHG and O&M savings offered by electric public transit and school buses. **Opportunity:** This provides a unique marketing and education opportunity for every Vermonter to see a living example of how renewably powered electric vehicles work, as well as peer-to-peer learning between transit agencies, municipalities, and school bus operators.

Metric: percentage of electric public transit and percentage of school buses out of entire fleet.

5. **Desired outcome:** increased number of miles of shared public transit bus/school bus routes in rural areas/developed areas.

Barriers: state (and federal?) regulations that may impede the combining of services.

Opportunity: These have been overcome in other states, and Windham County RPC has already begun studying the implications of this idea in its Regional Plan.

Metric: number of additional available public transit ridership seats (on school buses) and student ridership seats on public transit, number of actual riders.