July XX, 2018

Dear Governor Phil Scott,

With deep dedication to the future of the State of Vermont, the Vermont Climate Action Commission presents you with our final report; a compilation of our findings and recommendations intended to meet the important charge you put forward to us last July.

Vermont can seize the opportunity to lead the economic innovation that climate change requires over the coming decades. Despite the federal government's retreat on climate leadership, we agree that we can use our fundamental strengths and competitive advantages to tackle this urgent issue, bringing sustainable prosperity to our small but strong state.

We agree with your assessment in the 2018 State of the State address: "We can still control our own destiny." Vermont can be a leader in addressing climate change with economic solutions that support community health and prosperity for the future.

We appreciate your leadership commitment to climate action, and we hope that the recommendations in this report can be implemented to move Vermont forward. Your executive order charged the Commission to "develop a strategy to reduce greenhouse gas emissions and combat climate change that addresses these fundamental principles:

- solutions that reduce greenhouse gas emissions must spur economic activity, inspire and grow Vermont businesses, and put Vermonters on a path to affordability;
- the development of solutions must engage all Vermonters, so no individual or group of Vermonters is unduly burdened; and
- programs developed to reduce greenhouse gas emissions must collectively provide solutions for all Vermonters to reduce their carbon impact and save money."

The Commission report outlines our shared understanding of where we are today and what is needed for Vermont to do our part to meet the Paris Climate Agreement, the Comprehensive Energy Plan targets and the greenhouse gas emission reductions required by Vermont law. These recommendations are intended both mitigate Vermont's contribution to climate change and seize the economic opportunity in a smart, strategic and equitable response.

We offer these recommendations with sincere hope that they serve as a platform to advance the transformation of our energy system to one that is efficient, clean, resilient, affordable and accessible to all Vermonters – in particular the most vulnerable. Vermont's climate economy is a job-creating engine, and we hope our recommendations support further action and leadership to growth this sector.

We believe there is an important role for continued citizen engagement in the State's climate efforts. We would advise the creation of a citizen advisory body to support the implementation of supported recommendations. We provide additional detail on this proposal in the report.

Thank you again for leading to advance a strong and prosperous future for Vermont

Sincerely,

Peter Walke, Commission Chair, Deputy Secretary of the Agency of Natural Resources

Paul Costello, Commission Co-Chair, Vermont Council on Rural Development,

Michael Schirling, Secretary of the Agency of Commerce and Community Development

June Tierney, Commissioner of the Department of Public Service

Michele Boomhower, designee of the Secretary of the Agency of Transportation

Marie Audet, Audet's Blue Spruce Farm

Linda McGinnis, Energy Action Network

Joe Fusco, Casella Waste Systems

Bob Stevens, Stevens and Associates

Kristin Carlson, Green Mountain Power

Mary Sprayregen, Vermont Energy Investment Corporation

Johanna Miller, Vermont Natural Resources Council

Matt Cota, Vermont Fuel Dealers Association

Liz Gamache, Mayor of St. Albans

Adam Knudsen, Dynapower

Bill Laberge, Grassroots Solar

Bethany Fleishman, Vital Communities/Upper Valley Transportation Management Association

Tom Donahue, BROC Community Action in Southwestern Vermont

Stuart Hart, Co-Director, Sustainable Innovation MBA program, UVM Grossman School of Business

Harrison Bushnell, 2018 U-32 High School Graduate

Robert Turner, Consulting Forester

VERMONT CLIMATE ACTION COMMISSION

EXECUTIVE ORDER NO. 12-17

REPORT TO THE GOVERNOR

JULY XX, 2018

DRAFT REPORT

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I. Introduction

The Context: Challenge and Opportunity

Climate change is a fundamental threat to world civilization, to the sustainability of natural systems and species diversity, and to the peace and safety of humanity. Closer to home, it also imperils Vermont's economy and environment. Despite these threats, as Governor Scott noted in his 2018 State of the State Address, "our fate is not predetermined."

Due to the breadth of action required, we must all be part of mitigating and reversing global climate change. The most powerful lever to do this is economic: transforming our economy away from carbon-based energy sources, improving efficiencies, advancing recycling, composting and carbon sequestration, and transforming transportation and heating away from carbon fuels.

Creative Vermont businesses, ranging from utilities to solar and battery storage developers, to contractors, manufacturers, agricultural businesses, and inventors working on electric flight, are already contributing to progress. In the global competition to creatively answer climate change, places that lead will benefit by capturing the attention of entrepreneurs, investors and youth. Being a place that dedicates itself to building economic answers to climate challenges will also respond to some of the economic challenges that Vermont faces and be a path to economic renewal throughout the state.

The Charge to the Vermont Climate Action Commission

In July 2017, Governor Phil Scott convened the Vermont Climate Action Commission. The Governor set the essential framework to focus the Commission's work. "WHEREAS, through the 2016 Comprehensive Energy Plan, Vermont has committed to reducing greenhouse gas emissions by at least forty percent below 1990 levels by 2030 and eighty to ninety five percent below 1990 levels by 2050, and meeting ninety percent of energy needs from renewable sources by 2050."

Governor Scott tasked the Commission to "develop a strategy to reduce greenhouse gas (GHG) emissions and combat climate change that addresses these fundamental principles:

- solutions that reduce greenhouse gas emissions must spur economic activity, inspire and grow Vermont businesses, and put Vermonters on a path to affordability;
- the development of solutions must engage all Vermonters, so no individual or group of Vermonters is unduly burdened; and
- programs developed to reduce greenhouse gas emissions must collectively provide solutions for all Vermonters to reduce their carbon impact and save money."

As the 21 members of the Commission, we offer Governor Phil Scott and the citizens of the State of Vermont this report, which highlights our findings and outlines recommendations intended to meet the charge put forward by the Governor. In December 2017, at the Governor's request, the Commission submitted a list of preliminary recommendations. Those recommendations and the Governor's response can be found at the Commission's website:
http://anr.vermont.gov/about_us/special-topics/vermont-climate-action- commission

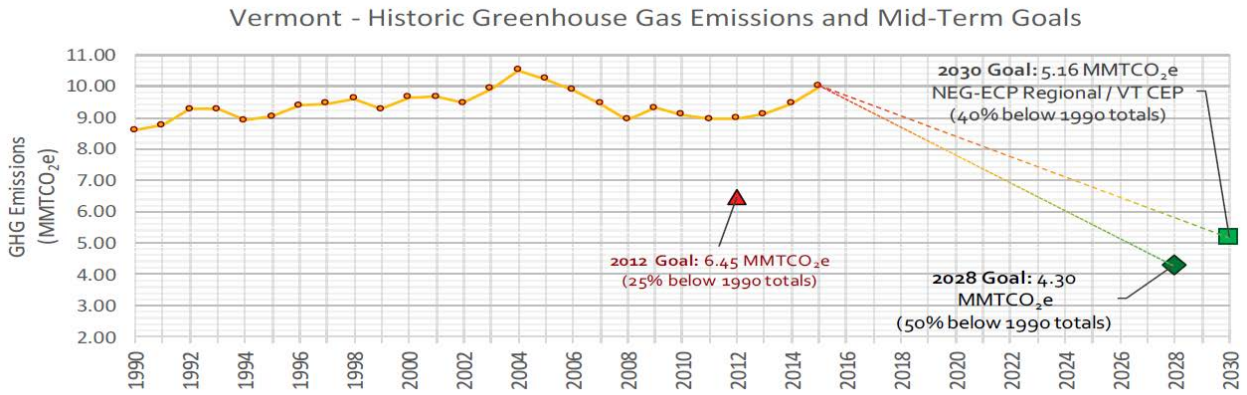
Where We Are Today

Our ability to undertake this work successfully is founded upon meeting the State's climate goals, as contained in its statutory greenhouse gas reduction goals as well as Vermont's 90 by 2050 renewable total energy goal, along with our commitment with other states to follow through in meeting the Paris Climate Agreement. Those goals are:

- **Statutory greenhouse gas reduction goals** – a 50 percent reduction of greenhouse gas emissions by January 1, 2028 and a 75 percent reduction by January 1, 2050.
- **Comprehensive Energy Plan goals** – 25 percent by 2025, 40 percent by 2035 and 90 percent of all energy needs through efficiency and renewable supplies by 2050.
- **U.S. Climate Alliance –** a 26-28 percent reduction of greenhouse gas emissions below 2005 levels by 2025

If Vermont continues its current trajectory – with rising, not declining greenhouse gas emissions – we will not meet these goals. Moreover, we risk missing the economic opportunities that will enable Vermont to thrive in the years ahead. Below is a chart outlining where we stand today and where we need to go to meet our statutory greenhouse gas reduction goals, the Comprehensive Energy Plan greenhouse gas reduction goals, and the Paris Climate Agreement goals. Shifting this trajectory will take concerted effort and investment which will also result in more affordable homes, businesses, and transportation, a stronger economy, and a cleaner environment.

Figure 1: Vermont Greenhouse Gas Emissions and Mid-Term Goals[1]



What Vermont Might Look Like with a Smart, Strong and Strategic Climate Response

If Vermont can seize on this opportunity to lead the climate economy and get ahead of the massive economic disruption that is beginning to take place, Vermont will be well positioned to flourish. According to the World Bank, the Paris Agreement will help open up nearly $23 trillion in new opportunities for climate-smart investments around the world, between now and 2030. The

[1] This information is current as of 2015. The full Greenhouse Gas Emissions inventory can be found on the Department of Environmental Conservation's Air Quality and Climate Division website: http://dec.vermont.gov/air-quality/climate-change

International Energy Agency anticipates investments of $13.5 trillion in clean energy investments alone over the coming fifteen years.

The private sector is responding. More than 700 companies with combined market capitalization greater than $16 trillion have made more than 1200 commitments to reduce greenhouse gas emissions. This includes pledges to adopt science-based emissions reduction targets, to remove commodity-driven deforestation from supply chains, and to set carbon prices. Unilever, the Anglo-Dutch parent of Vermont's Ben & Jerry's, has made pledges across nine different commitment areas, including a promise to reach net-zero greenhouse gas emissions by 2050.

Forward-looking companies are harnessing the benefits of transitioning to 100% renewable power, including cost reduction, increased innovation and reputational gains. Companies are choosing renewable energy for a variety of reasons. Urs Hölzle, Senior Vice President, Technical Infrastructure, Google, cites the desire to manage energy costs as a motivating factor: "*Electricity costs are one of the largest components of our operating expenses at our data centers, and having a long-term stable cost of renewable power provides protection against price swings in energy.*" For Walmart, the largest private sector employer in the world, the focus is on innovation. Laura Phillips, Senior Vice President for Sustainability, Wal-Mart claims "*integrating sustainable practices into our operations improves business performance, spurs technological innovation, inspires brand loyalty, and boosts employee engagement*."

These companies choose supply chains and locations based on the availability of renewable energy and the strength of policies that support a transition to a low-carbon economy. Many of the world's leading technology companies are reconciling the growth in consumer demand with their climate commitments by relocating energy-intensive data centers to locations that offer renewable energy options. The government of Quebec is pioneering provincial and state leadership to respond to corporate demand with an aggressive marketing campaign, promoting Quebec as a low-carbon home and attempting to lure companies with the promise of hydropower. Ireland's Industrial Development Authority is considering a similar approach. Reaching our goals will mean a thriving Vermont economy, more affordable and healthier lives for Vermonters, and a significant competitive advantage over those states and nations that fail to grasp this opportunity. Developing the technology to integrate distributed, renewable energy resources into the electric grid, improving the efficiency and energy use of our homes and business, and advancing additional climate economy opportunities will continue to be a major factor in Vermont's economic growth. Encouraging that sector to grow in Vermont will lead to good jobs – tech jobs, manufacturing jobs, and skilled technician jobs.

Vermont's energy burden – the proportion of income individuals spend on fuel for their cars, homes, and businesses – is high. By making it easier to use non-motorized and alternatively-fueled transportation, Vermonters will pay significantly less to move around without losing the convenience and freedom enabled by our current transportation model. By weatherizing our existing building stock, and increasingly using locally-sourced, sustainably harvested biomass and high efficiency electric heat, Vermonters will be able to more affordably keep their homes comfortable in the winter. These major changes to our two primary greenhouse gas emission sectors – transportation and buildings – are beginning already, but they need to be brought rapidly to scale to achieve the financial and greenhouse gas savings envisioned.

Vermont's transition to a more efficient, lower-emission economy will lead to significant savings in the health care system and increasing the quality of life for Vermonters. Local air quality will improve, and Vermonters will have improved access to healthy options for commuting and running errands. While Vermont's air quality is generally very good, local sources of pollutants and other environmental triggers give Vermont the fourth highest asthma rate in the country.[2]

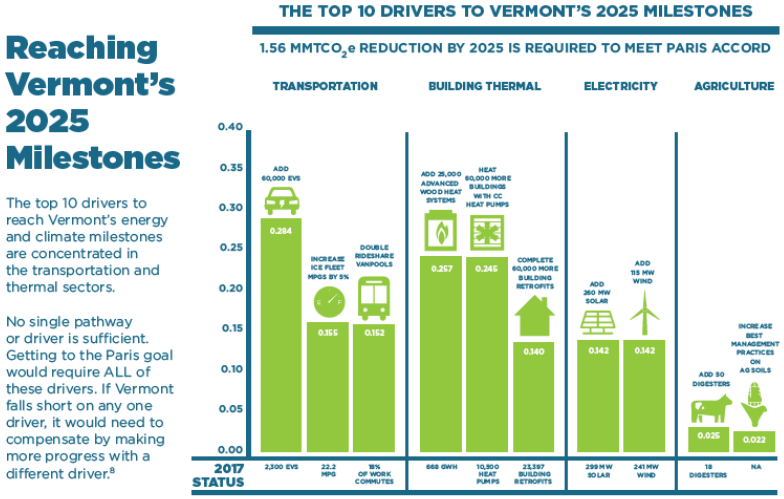
Vermont is already feeling the effects of a changing climate, primarily through more intense and frequent storms that have led to devastating and costly floods as well as a dramatic increase in tick-borne diseases, among other challenges. The changes we make now will help to reduce greenhouse gas emissions and extract carbon from the atmosphere, but we will still be faced with significant climate-related events. While this report does not specifically address adapting to a changing climate, we know that resilience efforts are needed in parallel with our recommendations for climate mitigation and economic adaptation. Some recommendations have the side benefit of reinforcing those efforts to adapt to our new climate and improve Vermont's resiliency.

Getting There Will Take Time – But We Won't Get There if We Don't Act Now

Transforming our state will take a generation or more. To get there we must increase momentum and take meaningful steps forward immediately. There is no silver bullet – no single policy or pathway – that will ensure this necessary transition occurs, so we must begin taking action on multiple fronts to reach our goals.

The Energy Action Network (EAN) has completed a recent review of the available data to arrive at what they believe to be the top ten drivers for reducing Vermont's greenhouse gas emissions. While the Commission does not explicitly endorse that EAN's selected pathway is correct or most likely, but the analysis is useful to understand the magnitude of changes necessary to meet Vermont's goals. In its report, the Commission highlights areas where additional data is needed to create drivers in other areas.

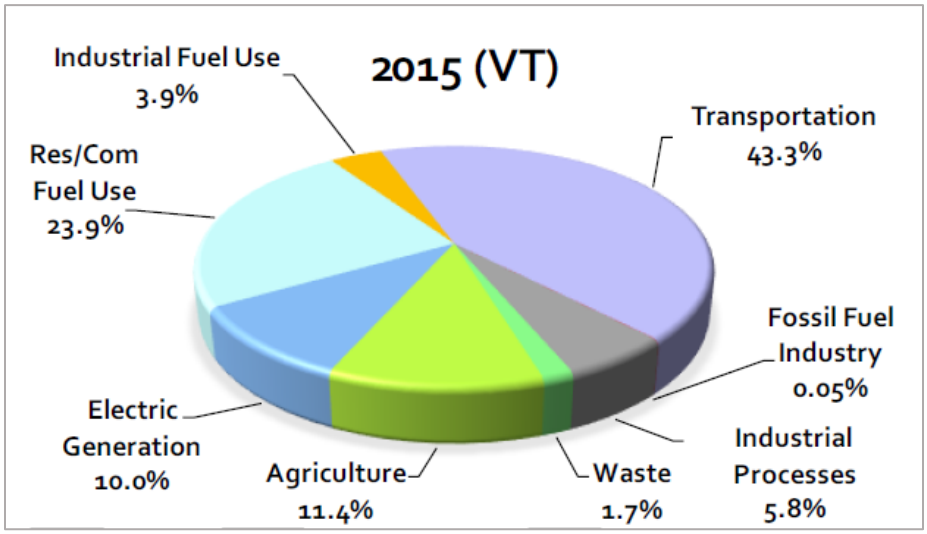
Figure 2: Energy Action Network's Top 10 Drivers[3]



[2] Data collected by the CDC available at https://www.cdc.gov/asthma/most_recent_data_states.htm

[3] Energy Action Network, Annual Report 2017, available at http://eanvt.org/wp-content/uploads/2018/06/EnergyActionNetwork_AR_2017_AA_final.pdf

Figure 3: Greenhouse Gas Emissions by Sector[4]



Many sectors of the economy are responding quickly to climate change. In others, the opportunities are just beginning to emerge. We must take intentional actions to encourage slow-moving economic sectors to flourish and drive the change for the long-term. The recommendations below highlight prioritized actions, not a complete list of actions, necessary to achieve our climate goals. The Commission made the decision to prioritize opportunities where Vermont could have a significant impact, create momentum across the economy, and capture our competitive advantage. More information on the process the Commission undertook to arrive at this prioritization scheme can be found in Appendix B.

The recommendation prioritize five areas. The first three are based on needed greenhouse gas emissions reductions: transportation, building energy, and land use. The fourth set of recommendations identifies ways to harness Vermont's natural and working lands to store carbon. The fifth focus of recommendations is Vermont's growing climate economy and the potential to capture Vermont's competitive advantage. These five sets of recommendations represent areas of focus but not the complete suite of solutions that will likely be necessary to meet Vermont's GHG reduction and climate change goals.

Investment and Return

The actions we recommend will reap long-term savings for Vermonters. To maximize those savings, upfront investments will be required. Many Vermonters may not have the information or financial means to make the necessary changes. In many cases, our recommendations include opportunities to increase all Vermonters' ability to access long-term savings.

We believe there is a leadership role for the State of Vermont to play in making these investments, but we do not believe that government needs to be the lead in all instances. The State should certainly ensure supportive policies are in place and that there is a level playing field for all

[4] This information is current as of 2015. The full Greenhouse Gas Emissions inventory can be found on the Department of Environmental Conservation's Air Quality and Climate Division website: http://dec.vermont.gov/air-quality/climate-change

Vermonters. Without playing that leadership role, Vermont risks falling far short of our goals and having the benefits of the clean energy future enjoyed by only economically advantaged Vermonters.

We include four indicators with each recommendation: the relative greenhouse gas impact, the potential savings, the scale of investment needed, and the ease to implement. The scale of investment indicator provides an order of magnitude estimate for what's needed to tip the scales to produce the desired outcome. We anticipate economic benefits and pollution reduction in all of our recommendations or the actions that will follow in the case of recommendations that create necessary conditions for additional action.

With smart investments in climate action, we can advance economic innovation, opportunity, and job creation; become more affordable for all; and protect the most vulnerable of its citizens.

Ongoing Climate Leadership

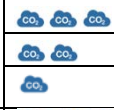
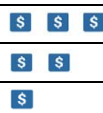
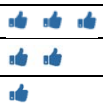
The Commission has worked diligently to respond to the charge provided in Executive Order 12-17. This report represents the culmination the that charge, and yet we believe there should be a continued role for organized citizen support to the implementation of these recommendations and other actions taken by State agencies. We, therefore, detail a recommendation in Chapter IV to create a structure and process that facilitates that ongoing citizen engagement.

II. A Vision for Vermont

In drafting the report, the Commission made the decision to organize its recommendations around the ways it will impact Vermont and the lives of Vermonters. The recommendations are summarized by infographics relevant to each of five topics: homes and workplaces, getting around, communities and landscapes, carbon sequestration, and the climate economy.

Each infographic includes estimates of the impact on greenhouse gas emissions or the amount of carbon sequestered, the cost savings generated, the investment need, and the ease of implementation. The estimates provided for each category reflects the best professional judgment of the members of the Commission and the supporting working groups. Where additional information is necessary to provide greater context for an individual recommendation or explain the assumptions made to arrive at the estimates made, that information is included by recommendation in Appendix C.

The below key, which is included with each infographic, provides the breakdown for what each estimate and associated iconography should convey to the reader.to the reader.

Infographic Key			
GHG Impact	The total amount of reductions in greenhouse gas emissions		High = > 100 MTCO2e Med = 20 – 99 MTCO2e Low = < 20 MTCO2e
Savings Impact	Annual savings achieved if recommendation is implemented		High = > $10 million/yr Med = $2 - $10 million/yr Low = < $2 million/yr
Investment Needed	The investment required to deliver the GHG reductions, financial savings, and social benefits for Vermonters		High = > $5 million Med = $500K - $5 million Low = < $500K
Feasibility	Considering administrative, financial and political feasibility.		High Med Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings		

In instances where a recommendation is intended to create the conditions necessary to make future emission reductions, those are noted by the inclusion of an icon that conveys the unlocking the potential for greenhouse gas and cost savings impacts ().

Appendix B details the process used to arrive at these recommendations.

Appendix D provides a list of common acronyms used.

A. Homes and Workplaces

Thermal energy use, or heat, in buildings accounts for approximately 30% of Vermont's total energy consumption and approximately 24% of Vermont's greenhouse gas emissions, largely from burning fossil fuels: fuel oil, kerosene, natural gas, and propane. The residential sector accounts for 60% of Vermont's thermal fuel consumption, commercial 29% and industrial 11%.

Approximately 68 million gallons of heating oil and 67 million gallons of propane are sold annually in Vermont for residential consumption. Approximately 67 million gallons of propane are sold annually for residential consumption. Wood is widely used for residential heating; an estimated 21% of Vermont homes and businesses rely on wood and wood pellets as a heat source.[5]

Commercial enterprises primarily use heating oil and propane for space heating, but also for air conditioning, refrigeration, cooking, and a wide variety of other purposes. These uses consume 24 million gallons of heating oil and 43 million gallons of propane each year.

Industrial enterprises typically use heating oil and propane for manufacturing, with few instances of its use for space heating. These industrial uses in Vermont annually use 21 million gallons of heating oil and 4 million gallons of propane.

In 2013, Vermonters paid over $500 million to import and burn fossil-based heating fuels. Most of this money left the Vermont economy.

Investing in thermal efficiency improvements, primarily air sealing, insulation and heating system replacements, can dramatically reduce a building's thermal fuel requirements while increasing its affordability.

Thermal energy use is the second largest contributor to Vermont's greenhouse gas emissions: about 24% of greenhouse gas emissions. Curbing emissions will require significantly reducing fuel use in existing buildings.

The 2016 Comprehensive Energy Plan calls for reduction in total energy consumption by 2050 by one third and by 2025 obtaining 30% of the heat used in buildings and 25% in industry from renewable sources.

Vision for Vermont's Buildings:

Four paths will transform our greenhouse building sector:

- Strategic and significant electrification.
- Increased advanced wood heating.
- Investment in deep retrofit and weatherization of existing buildings.
- Limited growth in emissions from new construction.

[5] BERC, Wood Heating in Vermont, 2016 available at http://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/CEDF/Reports/AWH%20Baseline%20Report%20FINAL.pdf

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

- Foster low-cost, local sources of heating;
- Ensure that Vermonters of all incomes maintain affordable heating and energy services;
- Use clean, renewable, and local electricity generation for space and water heating;
- Foster the development of new business opportunities in biomass.
- Reduce building energy burden for Vermonters.

Achieving the Vision for Vermont's Buildings:

In order to achieve the vision outlined above, the Commission has developed the following overarching themes for its recommendations. The specific recommendations follow.

Building Electrification and Advanced Wood Heating:

- Expand incentives for electrification and advanced wood heating;
- Adopt rate design to lower the costs of building electrification
- Increase awareness of advanced wood heating and electrification and benefits to all Vermont.

Building Weatherization and Demand Management

- Foster designs for low-energy consumption and demand management;
- Reduce the energy costs of existing and new buildings;
- Integrate advanced controls and rate design to encourage sound energy management by ultimate consumers, utilities, and third-party providers

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.

Recommendation 1 Double Low-Income Weatherization through the State Weatherization Assistance Program	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Identify and advance viable funding solutions to doubling the Weatherization Assistance Program	Governor, Legislature, and Treasurer
2. Double the rate of Weatherization Assistance Program activities consistent with funding	OEO (Community Action Agency Partners)

Background:

Current resources to meet Vermont's low-income weatherization goals are inadequate. For many low-income residents, this means colder homes, burdensome heating costs, discomfort, and poor health. In 2007, Vermont set a goal of weatherizing 20,000 low income homes by 2020. As of March 2016, there was still a gap of 9,200 homes. Vermont spends approximately $9.5 million annually to weatherize about 900 homes through the Weatherization Assistance Program; that is $11,000 per home, producing approximately 25% in home energy savings and lowering greenhouse gas emissions by 1.8 tons per home annually. This recommendation proposes to weatherize an additional 900-3,600 low-income homes. This could be accomplished either through an aggressive short-term surge over the next four years with an additional 3,600 homes weatherized via a $39M bond or through an increase in funding for the VT Weatherization Assistance Program by $9.5M to double the number of homes completed in 2017 over the next four years (an additional 900 homes).

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 2	GHG Impact	Savings Impact	Investment Needed	Ease
Accelerate the Adoption of Advanced Wood Heat (AWH) to Replace High-GHG Emitting Systems to Reach 30% of VT Thermal Needs by 2025 (Triple Installations)	CO_2 CO_2 CO_2	$ $ $	$ $ $	👍 👍 👍

Action Step(s)	Designated Lead (other stakeholders)
1. Expand incentives through Clean Energy Development Fund	CEDF (Governor, Legislature)
2. Provide low-income rebates on clean AWH through Heating Assistance Fee on new high greenhouse gas heating systems	Legislature and Governor (Energy Efficiency Utilities, CEDF)
3. Reopen school construction aid for biomass projects	Legislature
4. Fund State Wood Energy Program (see below) to provide greater outreach and TA to target sectors	Legislature (FPR)
5. Streamline Act 250 requirements for wood fuel producers	Act 47 Commission
6. Ensure that the State Energy Management Program (SEMP) performance contracting model developed for State buildings (and MUSH sector) incorporates wood heat in feasibility	BGS

Background:

Wood plays a major role in Vermont's energy mix. An estimated 37% of Vermont households heat at least in part with firewood or wood pellets. More than 100 larger buildings use wood chips or pellets for heating, and this number is rapidly growing. Vermont is a leader in heating schools and institutional facilities with wood chips; more than one-third of all Vermont children attend a school heated by wood. Wood chips also fuel two large wood-fired electric power plants, and a number of smaller commercial and public facilities use wood to create heat and/or electricity. To reach Vermont's GHG goals and to improve air quality, the transition to AWH is essential.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 **High**:100 MTCO2e	CO_2 CO_2 **Med**: 20-99 MTCO2e	CO_2 **Low**: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ **High**: >$10 million	$ $ **Med**: $2-$10 million	$ **Low**: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ **High**: >$5 million	$ $ **Med**: $500K-$5 million	$ **Low**: < $500K
Feasibility	Considering administrative, financial & political feasibility	👍 👍 👍 High	👍 👍 Med	👍 Low
🔓	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 3 Encourage Cost-Effective Investment and Customer Use of Building (Install 60,000 space and water heat pumps by 2025)	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Help customers to better understand the value and potential for heat pump technology	Electric distribution utilities (DUs) and PSD
2. Rate Design/and or incentives for load control and enable storage	DUs and PSD
3. Encourage 3rd party entrepreneurship and service delivery beyond electric distribution companies	DUs and PSD
4. Establish and refine incentives for ensuring electric distribution utility development and assistance with electrification pathways	DUs and PSD

Background:

Building Electrification refers to the pathways to help shift largely fossil fuel consumption toward increasingly clean, and ideally less expensive forms of heating enabled through electricity. Promising technologies here include cold climate heat pumps and heat pump water heaters. Heat pumps are three to four times more effective at heating a space than traditional electric resistance heat. The same technology that is used to heat a space can also be used to cool a space. Because the categories of end-uses for which the technology is employed represent flexible loads, these loads can be managed or controlled for additional grid value or benefit. Storage systems, including battery technology, represent complementary enablers of electrification that also serve to enable grid integration of distributed renewable energy technologies.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 4 Adopt and Implement a Roadmap for All New Buildings to be Net Zero by 2030	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Develop a roadmap for the required improvements needed in the triannual building energy code updates to reach the goal of all buildings being designed to be net-zero by 2030.	PSD (builders, architects, EEUs)

Background:

A typical Vermont residence heating with No. 2 heating oil has a heating load requirement of 80 to 100 MMBtu. The average commercial structure ranges from 120 to 150 MMBtu. Approximately 1,000 new homes and 200 commercial buildings are built each year. Net-zero buildings have zero net energy consumption. Energy requirements are met through more efficient systems or integrated renewable energy systems. The most cost-effective way to implement energy efficiency is by ensuring that the technologies are embedded in its construction or manufacturing. Net-zero design ensures that buildings reach the highest levels of energy efficiency and incorporate the enabling technologies for building management and renewable energy generation. Part of the path to affordable housing is to ensure that all cost-effective technologies are integrated into the new building and housing stock to help ensure that the challenges do not continue to grow.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 5 Increase Building Energy Labeling in Vermont to Make Building Energy Use More Visible	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. For existing homes, require State funded programs (Energy Efficiency Utility programs and the Home Weatherization Assistance program) to generate a label when residential buildings are receiving energy assessments and/or being weatherized	PSD (OEO, EEUs)
2. For new residential and commercial buildings, require the generation of a building energy label when they are first being constructed.	PSD (EEUs)
3. For existing commercial buildings require benchmarking and a label utilizing Energy Star Portfolio Manager for the largest buildings (50K+ square feet)	Legislature (EEUs)

Background:

Energy ratings and labeling would provide information on a building's energy use. A building rating takes the building energy usage information and provides a comparison with similar buildings. The energy data and rating can be used to develop a building energy label, which can present a simple visual of the information, much like a fuel economy sticker on a new car. This information can be useful to potential buyers as a means of comparing energy efficiency levels of various buildings and to assess what their future energy costs might be for those buildings. This information may also encourage investment in efficiency on the part of either a prospective buyer or a property seller. For home buyers, this also presents a potential opportunity to include any needed efficiency improvements in an energy-efficient mortgage.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 6 Increase Low-to-Moderate Income Homes Weatherized Through the Energy Efficiency Utility Programs	GHG Impact	Savings Impact	Investment Needed	Ease
	CO_2	$ $	$ $ $	

Action Step(s)	Designated Lead (other stakeholders)
1. Increase low-to-moderate income homes through the state's energy efficiency homes by 25%.	PSD (OEO, EEUs)
2. Expand the Heat Saver Loan and Neighborworks of Western VT loan program by $5 million	Efficiency Vermont / Treasurer

Background:

Current resources to meet Vermont's low-income weatherization goals are inadequate. For many low-income residents, this means colder homes, burdensome heating costs, discomfort, and poor health. Since 2008 the Energy Efficiency Utilities (Efficiency Vermont, Burlington Electric Department, and Vermont Gas Systems) have weatherized over 10,000 homes through their efficiency programs, however there is only a modest emphasis on serving low and moderate-income households. An increase in low and moderate-income weatherization investments made today will reduce fuel needs for the most vulnerable Vermonters, lower their energy costs, make their homes healthier, reduce carbon emissions, thereby providing significant economic returns on investments.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 7	GHG Impact	Savings Impact	Investment Needed	Ease
Expand Vermont's State Energy Management Program to serve Municipalities, Universities, Schools and Hospitals (MUSH)				

Action Step(s)	Designated Lead (other stakeholders)
1. Expand the Department of Buildings & General Services' State Energy Management Program to provide energy efficiency, energy conservation and renewable energy implementation services for municipalities, universities, schools, and hospitals.	BGS (PSD)
2. Establish a pilot with Vermont State Colleges (VSC).	BGS (financial institutions, VSC)

Background:

Expand the State Energy Management Program ("SEMP") to provide energy management services to Vermont's institutional market. The program will build on the success of the Department of Buildings and General Services' SEMP model. The SEMP is now augmented, in accordance with ACT 58 of 2016 Sec. E.112, through a partnership between Efficiency Vermont and BGS to achieve a specific amount of annual savings. The innovative model employed to achieve these savings can be adapted to obtain new energy savings and greenhouse gas reductions in other parts of the broader institutional market in the state. The institutional market includes municipalities, universities, schools and hospitals (i.e., the MUSH sector). Many organizations within this market struggle with high energy costs which in turn are passed to tax payers, students and patients. While there have been previous achievements of energy savings in this sector, barriers still exist that often hinder success in many regions.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

B. Getting Around

Transportation is the largest contributor to Vermont's greenhouse gas emissions of all sectors (43.3%). Electrification of the transportation sector, whether personal vehicles or transit and school buses, will help reduce greenhouse gas 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 2,500—and more recent analysis indicates 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 by joining the U.S. Climate Alliance.

Regardless of the target, EVs powered by renewable energy will provide major reductions in Vermonters' greenhouse gas 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

- a lack of sufficient charging station infrastructure
- a lack of general awareness about the benefits of switching to EVs and how to do it affordably
- the upfront costs of EVs (including used EVs), especially for 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 establish 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 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.

Vermont's 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 create negative impacts on public health and the environment: 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.

Vermont's apportionment of a federal settlement with Volkswagen (VW) are intended to mitigate the impact of VW's cheat devices on Vermont's nitrogen oxide (NOx) emissions, primarily from inefficient diesel engines. The heavy-duty-vehicle portion of these funds could provide a once-in-a-decade opportunity to reduce NOx emissions and leverage longer-term market transformation in the heavy-duty sector that would result in significant NOx and greenhouse gas emissions reductions. 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, over the long run.

While vehicle electrification is essential for reducing transportation energy use and greenhouse gas emissions from the transportation sector, transportation demand management (TDM) is also necessary. As the 2016 CEP points out, "Transportation energy use is fundamentally driven by the locations of homes and businesses, along with the public, private, and commercial infrastructure that includes our roads, sidewalks, transit systems, and vehicles." Broader issues relating to land-use planning are addressed in the Communities and Landscapes section of this Report; this section on How We Get Around includes recommendations to advance the 2016 CEP's strategy of shifting transportation away from single occupancy vehicles to more energy efficient options, like public transit, walking, biking, and car sharing. Together, vehicle electrification and TDM can move Vermont toward its transportation-sector energy goals while benefitting public health, the economy, and Vermont's traditional culture and character.

Vision for Vermont's Transportation System

Two paths 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 VW settlement and other funds.
- 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 economical 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.

Achieving the Vision for Vermont's Transportation System: The Rationale for The Recommended Actions

To achieve the vision outlined above, the Commission has developed the following overarching themes for its recommendations. The specific recommendations follow.

Transportation Electrification:

- 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.

Transportation Demand Management

- 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.

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.

Recommendation 8 Provide a State-funded or State facilitated EV purchase incentive that applies to new and used EVs.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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 purchase prices are one of the main barriers to widespread 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 9 Strengthen the used EV market.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 10	GHG Impact	Savings Impact	Investment Needed	Ease
Make special EV pricing purchase and lease deals more visible and available to the public by consolidating and continually updating information from EV dealerships.	CO2 CO2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 11 Use VW Settlement funds to jumpstart a transition from diesel to electric transit and school buses.	GHG Impact	Savings Impact	Investment Needed	Ease
Action Step(s)			Designated Lead (other stakeholders)	
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: One of the priorities in Vermont's VW mitigation plan is the investigation and investment in electric bus technologies. Outreach and technical assistance are needed to promulgate successful school and transit bus projects.				

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 12	GHG Impact	Savings Impact	Investment Needed	Ease
Investigate and utilize grant funding and finance strategies to help overcome the high upfront costs of electric transit buses.	CO_2 CO_2 CO_2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
1. Investigate and advance financing options such as tariff on bill financing to determine viability and interest 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 **High**:100 MTCO2e	CO_2 CO_2 **Med**: 20-99 MTCO2e	CO_2 **Low**: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ **High**: >$10 million	$ $ **Med**: $2-$10 million	$ **Low**: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ **High**: >$5 million	$ $ **Med**: $500K-$5 million	$ **Low**: < $500K
Feasibility	Considering administrative, financial & political feasibility	**High**	**Med**	**Low**
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 13 Implement recommendations in VTrans' corridor study to provide direct current fast charging within 30 miles of all Vermonters.	GHG Impact	Savings Impact	Investment Needed	Ease
Action Step(s)			Designated Lead (other stakeholders)	
1. 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 direct current 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.				

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 14 Develop and execute strategy for deployment of VW Settlement funds for EV charging	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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 the overall State plan for EVSE deployment.	PSD (VTrans, utilities, Tier III stakeholders)
3. 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)
4. Identify and engage private hosts to raise awareness about VW funds and how to install EVSE.	DUs and PSD
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 rare opportunity to rapidly expand charging infrastructure where it is needed the most. In addition, to building out fast chargers (see recommendation 13), ACCD and ANR should engage all partners to identify priority sectors for VW investment. Attention and priority should also be given to building 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 15	GHG Impact	Savings Impact	Investment Needed	Ease
Conduct research/analysis needed to support the PUC workshop on issues relating to the charging of plug-in EVs required by Vermont Act 158 of 2018.	CO_2 CO_2 CO_2	$ $ $	$	

Action Step(s)	Designated Lead (other stakeholders)
1. Research and propose alternative rate designs and/or mitigation strategies, 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.	PSD
2. Approach the utilities to examine the feasibility of mapping areas of the grid with the capacity to accept charging station loads.	PSD (DUs)
3. Examine the feasibility of identifying these areas on a distribution level. Target areas that need additional load for EV pilot projects.	PSD
4. Incorporate the Sheffield-Highgate Export Interface as a consideration into VW Settlement programs.	Interagency VW Task Force
5. 5. Removal or mitigation, as approp., of barriers to EV charging.	PUC
6. Encourage participation into the PUC workshop.	VCAC
7. Foster collaboration between the auto dealerships and utilities that offer TOU or EV rates.	PSD (auto dealers, DUs)

Background:

Vermont Act 158 of 2018 (the "transportation bill") includes language requiring the Public Utility Commission to open an EV docket. This is an essential next step to lay the groundwork 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 **High**:100 MTCO2e	CO_2 CO_2 **Med**: 20-99 MTCO2e	CO_2 **Low**: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ **High**: >$10 million	$ $ **Med**: $2-$10 million	$ **Low**: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ **High**: >$5 million	$ $ **Med**: $500K-$5 million	$ **Low**: < $500K
Feasibility	Considering administrative, financial & political feasibility	**High**	**Med**	**Low**
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 16	GHG Impact	Savings Impact	Investment Needed	Ease
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.	CO_2 CO_2 CO_2	$ $ $	$	

Action Step(s)	Designated Lead (other stakeholders)
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 (PSD, 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 (PSD, ANR, ACCD, VCAC, VECAN)
3. Develop resource materials for town energy committees and municipalities on how to 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 paid 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 **High**:100 MTCO2e	CO_2 CO_2 **Med**: 20-99 MTCO2e	CO_2 **Low**: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ **High**: >$10 million	$ $ **Med**: $2-$10 million	$ **Low**: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ **High**: >$5 million	$ $ **Med**: $500K-$5 million	$ **Low**: < $500K
Feasibility	Considering administrative, financial & political feasibility	**High**	**Med**	**Low**
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 17 Implement “ride and drive” events to give Vermonters a chance to test drive or experience EVs in person and support purchase consideration for EVs.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 18	GHG Impact	Savings Impact	Investment Needed	Ease
Work collaboratively with auto dealers on developing and deploying strategies to effectively engage customers who are interested in purchasing an EV and to make the sale.	CO_2 CO_2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
1. Implement a dealer engagement program based on previous DEV dealer outreach programs. Incorporate lessons learned and effective dealer engagement tactics from other 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 dissuade 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 engage and potentially incentivize dealers as partners in growing the EV market in Vermont.

Infographic Key				
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Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 19	GHG Impact	Savings Impact	Investment Needed	Ease
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.				

Action Step(s)	Designated Lead (other stakeholders)
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 EV 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 an EV program or fleet transition to EVs.	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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 20	GHG Impact	Savings Impact	Investment Needed	Ease
Increase use of public transit in Vermont with more public transit infrastructure, trip planning tools, and enhanced service with more efficient vehicles and routes.	CO_2 CO_2 CO_2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
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 (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, 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. The 2016 CEP includes the goal to "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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 High:100 MTCO2e	CO_2 CO_2 Med: 20-99 MTCO2e	CO_2 Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ High: >$10 million	$ $ Med: $2-$10 million	$ Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ High: >$5 million	$ $ Med: $500K-$5 million	$ Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 21 Increase efficiency of school transportation and promote active transportation to school.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 22 Increase programs and public infrastructure to support walking and biking in Vermont.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
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 min. activity levels.	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, VAPDA, 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.	VTrans (RPCs)

Background:

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

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 23 Explore the viability of commuter rail service in Vermont.	GHG Impact	Savings Impact	Investment Needed	Ease
Action Step(s)			Designated Lead (other stakeholders)	
1. 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."				

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 24 Implement programs and policies to increase multi-modal transportation.	GHG Impact	Savings Impact	Investment Needed	Ease
	CO_2 CO_2 CO_2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
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.	VTrans (VLCT, RPCs)
4. Adopt State policy to lead by example and encourage or require virtual meetings, car/vanpooling for meetings, and other strategies	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 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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 High:100 MTCO2e	CO_2 CO_2 Med: 20-99 MTCO2e	CO_2 Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ High: >$10 million	$ $ Med: $2-$10 million	$ Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ High: >$5 million	$ $ Med: $500K-$5 million	$ Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 25 Improve infrastructure to support safe and efficient multi-modal travel.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Expand and improve park & rides, including use of existing large parking lots. Study the merits of auto-capture lots 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).	VTrans (RPCs)
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.	Health in All Policies Taskforce

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.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

C. Communities and Landscapes

The Vermont brand evokes strong images of working lands and thriving centers. For decades, Vermont has attracted tourists with beautiful natural and working landscapes surrounding quaint downtowns and village centers. These iconic images, however, represent more than marketing iconography. They represent Vermont's competitive advantage in creating economic opportunity and resilience in the face of a changing climate.

We are blessed with carbon sequestering forests and agricultural lands increasingly being adding carbon storage value while increasing crop yield. We have traditional settlement patterns that enable efficient and cost-saving energy reductions now and in the future.

To answer the greenhouse gas reduction component of our charge, Vermont must use its finite lands, natural systems, and built environment more efficiently. Land is the base resource from which community prosperity is built and sustained. Vital to the success of the recommendations discussed in those sections above is how we intentionally use land resources. We must strengthen compact development patterns, known as "smart growth," to enable efficient use of transportation and building energy while fostering strong and thriving communities. Central to smart growth is that the transportation system is a means of creating prosperity in a community, not an end unto itself.

Vermont also has a tremendous opportunity to sequester additional carbon in our forests and soils. This has the potential to fundamentally alter our net greenhouse gas emission and provide economic benefit to our farmers and forest landowners. We should seize this opportunity in Vermont, which, despite its size, has a distinct advantage over more developed states.

Achieving Smart Growth

Smart growth represents an approach to land use that incorporates vital and compact city, town, and village centers surrounded by working farms, forests, and open space. This development pattern is more energy-efficient, environmentally sustainable, and economically responsible than the sprawling, auto-oriented patterns that defined the second half of the 20th century. Smart growth also provides a solid foundation to prepare and adapt Vermont's landscape for climate change.

Smart growth is energy efficient because it creates more housing choices close to jobs, stores, services and schools, which encourages more walking and biking and makes public transit work better. Supporting this type of development means fewer vehicle miles traveled. That reduces greenhouse gas emissions, creates cleaner water and air, saves energy and money, and helps us meet the efficiency goals in the state's Comprehensive Energy Plan and Regional Energy Plans. Additionally, compact development is often less intense to heat and cool – and can enable high-efficiency district heating options that simply are too expensive in more dispersed development.

Our scenic and working lands also provide critical environmental functions and provide economic vitality. Focusing growth in city, town, and village centers reduces development that fragments agricultural and arboreal landscapes. Large forest blocks, for example, clean and protect the water supply, minimize erosion, store flood waters, provide wildlife habitat, clean the

air, capture carbon, provide outdoor recreation, and maintain Vermont's landscape. Farms and forests also provide food and cover for wildlife, help control flooding, and protect wetlands. Protecting large blocks of productive agricultural soils and connected forest lands is critical to help Vermonters and wildlife adapt to climate change.

Not only does smart growth reduce our carbon footprint, it also creates economic activity and saves taxpayers money. Smart growth communities are better able to offer amenities that grow healthy kids and empower seniors to age in place, and most importantly, they have a community-oriented form that attracts educated and skilled workers.[6] These workers are strongly associated with economic performance and prosperity. Job creation and economic growth are the results of a healthy local economy, not substitutes for one.

The State, Vermont households, and Vermont municipalities can realize significant capital, operational, and maintenance savings by growing smartly. Smart growth reduces initial and ongoing costs Vermonters pay to provide and maintain public infrastructure, facilities and municipal services through efficient economies of scale. Compact development is a wise investment: it means more subscribers per linear foot of sewer and water line, more children served per mile of bus route, fewer trips that must be taken by vehicle, and more efficient public safety response time. Bottom line: development of compact centers surrounded by working and natural lands generates more public wealth and costs less to service than the sprawl alternative. Financial solvency isn't an afterthought – it is a prerequisite to long-term prosperity. Smart growth accounts for revenues, expenses, assets, and long-term liabilities.

Demographic change, greenhouse gas emissions, severe weather, and financial challenges prompt a fresh look at Vermont's smart growth strategies and land use governance as means to address climate change. Smart growth works when development goals, investments, and regulatory structures align to make Vermont's centers attractive places to live, work, and play, while ensuring the viability of farm and forest landscapes, and natural-systems functions outside of centers.

Vermont has planned for and sought the implementation of smart growth principles for decades, but we have failed to implement the many plans that have been written over the years. The recommendations below propose to focus almost exclusively on leading us to actual smart growth on the ground.

The commission recognizes that one obstacle for prioritizing such strategies for greenhouse gas reduction is that it can be challenging to do the math and measure the causal impacts of smart growth development patterns. This is the case partly due to available information, but also because development moves at a slower pace when compared with technological solutions that evolve more rapidly and demonstrate, on paper, a fast return on investment. Nevertheless, the Commission recognizes that Vermont's underlying land use pattern will ultimately make new technologies and other energy saving strategies far more successful than they would be if developed in isolation.

[6] https://sonoraninstitute.org/files/pdf/economic-and-fiscal-impacts-of-smart-growth-policies-07012008.pdf

The smart growth and land use initiatives included below represent an important, foundational set of strategies to adapt to climate change and start reducing greenhouse gas emissions. Changing land use patterns is a long-term undertaking. Investing in these basic steps now is essential.

This package of actions is the foundation. The Commission recognizes that additional work by State agencies will be needed to develop further innovations in this area and measure and communicate the long-term greenhouse gas reduction benefits of smart growth investments.

Increasing Carbon Storage and Economic Returns for Vermonters

Vermont's agricultural traditions and forest lands are also where plants and living soil regenerate carbon, converting CO2 in the air into stable organic matter in soils. By leveraging and building on our traditional settlement patterns, Vermont can decrease its emissions and store enough carbon to account for the remainder of emissions.

Communities and Landscapes Recommendations to Expand Implementation of Smart Growth Principles:

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.

Recommendation 26 Measure and Report Statewide Development Indicators	GHG Impact	Savings Impact	Investment Needed	Ease
			$ $	

Action Step(s)	Designated Lead (other stakeholders)
1. Develop a central repository and maintain geo-referenced digital data on lots, parcels/values, building footprints, unit numbers, uses, roads (private & public), road access, driveways, walkable centers, zoning districts, sewer service areas, water service areas, wells, septic, and impervious surface, and associated permits.	ACCD/VCGI (VTrans, ANR, AAFM, VEM, Tax Department, municipalities, RPCs, RDCs, E-911 Board)

Background:

Vermont does not systematically compile statewide development activity. Developing and maintaining georeferenced digital data and development indicators would allow the State to understand where, how much, and what kind of development is happening. This will help decision-makers measure the extent to which the state is meeting its smart growth goals; measure the development results of public investments; pinpoint development-ready locations; link development to other economic indicators (such as jobs and tax receipts); and inform how to target future efforts. The primary unknown in terms of needed investment is the cost of electronic submissions of survey during subdivisions or boundary changes.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 27 Develop Smart Growth Impact Metrics	GHG Impact	Savings Impact	Investment Needed	Ease
Action Step(s)			Designated Lead (other stakeholders)	
1. Develop a set of indicators for Vermonters to use to evaluate the impacts of development, whether smart or otherwise			ACCD (ANR, NRB, VTrans, VDH, AAFM, RPCs, RDCs, and land use stakeholders).	

Background:

The application of conventional smart growth principles has proven positive economic and greenhouse gas emission reductions, but Vermont's form of compact development often does not reach the scale of conventional smart growth. Therefore, developing a set of indicators for Vermonters to use to evaluate the impacts of development will be critical to measuring and defining success in this arena. The Commission does not anticipate the creation of metrics to be difficult, but finding reliably sourced data may be a challenge.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 28 Expand Interagency and Intergovernmental Support to Communities to Implement Smart Growth Principles	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Develop an Inter-Agency Smart Growth working group to integrate policies and programs that promote and incent compact, walkable development through coordinated municipal assistance	ACCD/VCGI (VTrans, ANR, AAFM, VEM, Tax Department, municipalities, RPCs, RDCs, E-911 Board)
2. Create a pilot program to provide wrap around State and non-profit support to two communities for all-in approach	ACCD (ANR, VTrans, VDH, AAFM, RPCs, RDCs, and municipalities)
3. Develop funding model for unique rural wastewater challenges	ANR (ACCD, RPCs, RDCs, and municipalities)
4. Develop outreach materials for municipalities to better understand the value of smart growth	ACCD
5. Conduct smart growth audits	ACCD (RPCs)
6. Encourage local planners to defer to regional plans to more efficiently complete the planning process	ACCD/RPCs

Background:

Many communities in Vermont lack the resources to be able to move from developing a vision and a plan to implementing smart growth principles. This recommendation serves to address some of the access barriers that smaller Vermont towns have trouble overcoming.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 29 Leverage Health Care Partnerships	GHG Impact	Savings Impact	Investment Needed	Ease
	CO2 CO2	$ $ $	$ $	

Action Step(s)	Designated Lead (other stakeholders)
1. Increase funding and technical support for programs that apply smart growth principles to improve community health and wellness, such as RiseVT and 3-4-50.	Green Mountain Care Board (VDH)
2. Build capacity among health professionals and advocates to engage with planning processes and infrastructure decisions.	VDH (ACCD, VTrans)
3. Explore increasing health care funds dedicated towards community investments that promote healthy living	Green Mountain Care Board (VDH))
4. Explore ways to incentivize cities and towns to sign-on as healthy communities through RiseVT or 3-4-50 programs	VDH (ACCD, VTrans)
5. Integrate public health experts into processes and decisions that affect community design and transportation systems.	Health in All Policies Task Force

Background:

Behavioral patterns, social circumstances, and environmental exposures account for 60% of health outcomes, with genetic predisposition accounting for 30%. Even though healthcare only contributes to 10% of health outcomes, over $2 billion was spent in Vermont in 2016 to treat largely preventable chronic diseases. Smart growth increases opportunities for physical activity, reduce risk of transportation-related injuries, increases access to healthy food, and provide equitable access to education, employment, and vital services. Recognizing this, the public health sector has stepped up its efforts to promote healthy, active communities, which often also supports smart growth strategies. One example is the ongoing work of the Healthy Communities and 3-4-50 programs at the Health Department; a newer example is the RiseVT initiative. As the health care system shifts to a more prevention-focused approach, hospitals and other health care providers should be key partners and funders of smart growth strategies that promote better community health.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 30 Align Smart Growth Policies for an Evolving Transportation System	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Continue to focus on integrated multi-modal planning; expand investments in complete-streets infrastructure and amenities to encourage walking and biking.	VTrans
2. Align transportation investments in ways that reduce highway maintenance costs, support smart growth locations, and expand transportation choice.	VTrans (RPCs, RDCs municipalities)
3. Convene a stakeholders group to identify barriers and propose pathways to complete-streets implementation.	VTrans (ANR, VDH, RPCs, RDCs, municipalities, NGOs)
4. Implement the March 2015 Work Plan, Revising the Vermont State Standards (VSS), M2D2: Multimodal Dev. and Delivery.	VTrans
5. Prepare for autonomous vehicle technology by removing statutory barriers to deployment in ways that favor public transit, transit-oriented development, shared use of AVs, and other approaches that reduce overall vehicle miles traveled	VTrans (RPCs, municipalities, Governor, Legislature, advocacy organizations)

Background:

Transportation creates more greenhouse gas emissions than any other sector of the economy, both in Vermont and across the nation. Although vehicle electrification represents a critical strategy to reduce these emissions, technology alone will not be enough to meet Vermont's emission-reduction targets while growing the economy, accommodating an increasing population, preserving Vermont's scenic landscape, protecting the natural environment, and addressing the transportation needs of the variety of users of the transportation network. A multimodal transportation system organized around smart-growth principals can serve these purposes. and other health care providers should be key partners and funders of smart growth strategies that promote better community health.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 31 Targeted Land Conservation	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Make strategic, science-based land acquisitions and provide technical assistance to willing private landowners	ANR (conservation partners)
2. Increase investment in land conservation and acquisition through funding mechanisms such as VHCB, LWCF, and general funds to the Fish & Wildlife Department and Forest, Parks, and Recreation.	Governor and Legislature

Background:

Targeted land conservation efforts to achieve important climate adaptation goals can yield significant results for both sequestering carbon and making Vermont more resilient. For example, focus investments in areas that will provide the most functional flood resilience value by looking at local regulations, land conditions, conservation easements, particularly in areas upstream of floodplain development. Additionally, provide technical assistance to willing private landowners to create healthy, functioning ecosystems that help sequester carbon and other greenhouse gases, improve flood resiliency, and maintain Vermont's working landscape. Investments in such parcels such as key habitat connectors or areas necessary to maintain important forest blocks will dissuade development in sensitive natural areas and can support the working landscape and recreational opportunities (Economics of Conservation in Vermont, Roman and Erikson, 2015).

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 32 Maintain Large Forest Blocks by Implementing Act 171 Intergenerational Transfer Report Recommendations	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Centralize technical assistance programs and funding.	VF&FVP (UVM Ext., VT Woodlands Assoc.)
2. Expand existing agricultural sector succession planning services/capacity to forestland owners.	VF&FVP
3. Develop a VT Succession Planning Curriculum	VF&FVP (UVM Ext., VT Woodlands Assoc., VT Coverts, VNRC)
4. Increase Awareness of Succession Planning through UVA	VF&FVP (FPR, VT Woodlands Association)
5. Provide grants to landowners to help cover costs of legal, accounting and other necessary services.	VF&FVP
6. Explore/Develop succession tax incentives, options and tools	VF&FVP (ACCD, ANR, Tax)

Background:

Maintenance of large blocks of economically viable, working forestland discourages forest parcellation and fragmentation, and is a key smart growth and carbon sequestration strategy. Much of the state's forestland is privately owned and will change hands in the coming decade; supporting programs that facilitate land transfer without parcellation is critical. Implementation of the Act 171 intergenerational transfer report is a primary strategy to achieve this goal. Forest blocks are at the greatest risk of subdivision and fragmentation when the land changes hands, so outreach to current owners interested in keeping land intact is critical and can be cost effective.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 33 Expand Natural Resource Planning and Bylaws That Address Forest Blocks, Habitat Connectivity and River Corridors	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Provide direct assistance to RPC's and municipalities though outreach and webinars.	DFW (VNRC, RDCs and RPCs)
2. Boost local and regional planning related to forest blocks and habitat connectors, per Act 171 and River Corridors (authorized by 24 V.S.A. § 4424).	ACCD (ANR, VNRC, RDCs, RPCs, and watershed groups)
3. Distribute existing guidance materials and promote trainings that were developed to implement Act 171	ACCD, ANR, VNRC, RDCs, and RPCs
4. Invest in increased staffing capacity at DFW, DEC and within RPC's to apply the best available science	Legislature and Governor

Background:

Act 171 requires local and regional planning to identify important forest block and habitat connectivity areas, and to plan for development in these areas to minimize forest fragmentation. ANR, ACCD and VRNC have already developed model bylaws, written guidance and a webinar on ways to implement Act 171 to maintain a resilient landscape. In addition, Vermont's land use statutes strive to ensure that the design and construction of development in floodplains, river corridors, and other hazard areas are accomplished in a manner that minimizes or eliminates the potential for flood and loss or damage to life and property in a flood hazard area fluvial erosion in in a river corridor protection area. Together, these natural resource planning requirements support smart growth and provide a framework to promote climate change resilient communities, but action is needed to improve staff resources and the implementation of strategies to accomplish the planning goals. Providing increased technical assistance to local planners and land use regulators is cost-effective and feasible; however, passing and implementing new bylaws involves increased complexity.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	..ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 34 Align Regulation with Location-based Impacts	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Support the Act 47 Commission by providing input, data, and policy recommendations.	NRB (ACCD, ANR, VTrans, AAFM, Act 47 advisors and stakeholders)
2. Pass legislation making improvements to Act 250 and/or other land use statutes	Legislature
3. Implement necessary guidance and rules	NRB (ACCD, ANR, VTrans, AAFM)

Background:

The Vermont Climate Action Commission recommends supporting the Act 47 Commission (Act 250 at 50) in exploring, and subsequently addressing through legislation, jurisdictional and criteria questions that address changes needed to support development in compact centers and farm and forest integrity in the rural countryside. The economic challenges of compact development are often exacerbated by the regulatory structure. In addition, the maintenance of rural working lands and important natural resources are often hindered by gaps in the regulatory structure. The Commission supports the evaluation of challenges associated with redeveloping downtowns as well as protecting important natural resources and working lands that are critical to adapting to a changing climate with the goal of achieving comparable protections in a manner that flips the current paradigm where greenfield development is easier and cheaper than in areas that are targeted for concentrated growth.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

D. Sequestering Carbon on Vermont's Farms and in its Forests

Vermont's working lands can be managed to "reverse" greenhouse gas emissions, and it's already occurring in places. With Vermont's traditional land uses of farming and forestry, Vermonters who manage those lands can reap a variety of benefits while accumulating carbon in the soil.

Primarily composed of carbon, the organic matter in soils plays a role in four important ecosystem services: resistance to soil erosion, soil water-holding capacity, soil fertility for plants, and soil biodiversity. Around the world, efforts are being targeted at decreasing soil disturbance, reducing erosion, increasing organic matter inputs to soil through crop residues and organic nutrient sources, and maintaining continuous living plant cover as much as possible throughout the year.

Over the last decade, adoption by Vermont farmers of these practices has resulted in the rebuilding of soil health. As importantly, these soil health improvements have the co-benefits of improving water quality and enhancing flood resiliency while increasing sequestered carbon in the soil and decreasing greenhouse gas emissions from agricultural lands. New regulations (Vermont Clean Water Act) have promoted these practices for their water quality value and increased funding for implementation and education. Vermont farmers also lead in trying innovative practices like a roller crimper that increases the return of organic matter in cover crop residues to a field, with lower chemical inputs.

These practices also provide longer term benefits to farmers by enhancing productivity, decreasing fertilizer costs, and reducing volatility of weather-related yield swings--essentially creating cropping systems that are more resilient to the impacts of climate change. Many farmers have adopted these practices voluntarily, but there is still a financial cost to farm businesses. It is critical that these practices continue, once implemented, as research shows reverting to previous conditions can quickly reverse nearly all the prior gains. Since the potential for capturing annual CO_2 emissions, both locally and globally, through agriculture is high, and so clearly connected to other co-benefits, it is critical to recognize the value of enhancing these practices through future policies. Education and demonstration of such conservation practices that allow for farmer-to-farmer communication are also critical for increased adoption and have been shown to one of the most effective means of changing management. Recent studies (Galik, et al., 2018) have suggested that policies that promote early action can promote innovation and reduce the lags in benefits associated with inaction.

Opportunity: Carbon in Our Forests

Forests cover roughly 78% of the land area of state. They are also a major carbon store or "sink"—both above and below ground. Estimates suggest more than half our state's annual CO2 emissions are being absorbed by the annual growth of these forests, and over 200 years of emissions are stored there. Recent data suggest our net annual sequestration is declining slightly, and—for the first time in over 100 years--our forested land base is declining (Morin, et al. 2017). While these data demonstrate changes in the state of our forests, the reasons for it are complex. One aspect of the future is relatively certain: climate change will increase management costs for forest landowners from a host of expected impacts including invasive plants and insect control, increased drainage and road infrastructure costs, storm damage, and potential reductions in

health and productivity. To climate impacts add increasing property taxes, parcelization, weakening markets, and the shifting demographics of ownership and the stability of our future forest land base becomes tenuous.

Already risky and marginal, the profitability of forest ownership is likely to decline, jeopardizing many of the benefits we have come to expect from our forests—benefits that include clean air, clean water, flood resilience, and carbon storage, along with more conventional forest products. Vermont has been proactive in informing both landowners and policy makers about this growing list of threats. Forest managers have access to regular reporting on forest health and markets. Planners have new legislative mandates requiring they consider the benefits of forest in regional and municipal plans. Workshops encouraging planning for ownership succession are ongoing. The Department of Forest, Parks, and Recreation has developed a suite of tools supporting the adaptation of management in the face of a changing climate. However, none of these laudable actions generate additional revenues to landowners.

One alternative revenue stream is gaining ground in much of the country: programs that allow for forest landowners to monetize forest growth as carbon offsets—generating payments for some of the ecosystem services forests provide. Carbon offset programs not only promote additional sequestration, but by providing a new annual income stream to landowners may well play a role in keeping the major forest carbon sink intact. As with agriculture, co-benefits from habitat protection and sustainable management are additional dividends to the public. Yet, turning carbon in trees into a fungible "security" is far from simple. Program rules are complicated, and the expertise required to develop forest carbon projects is expensive. Larger tracts (more carbon revenue) cover more of these fixed costs, which partially explains why most projects have occurred where parcel size is larger or growth is faster, compared to Vermont. Only one forest carbon project has been initiated in Vermont to date.

Managing forests for carbon sequestration is compatible with all other forms of responsible forest management. The potential for income from trading forest carbon offsets is likely to continue to generate interest, both from policy makers and landowners. Nationally, forest carbon offsets from across the country supply the bulk of traded offsets for the California Cap and Trade mechanism. Whether these programs will continue to grow is hotly debated, but of all the types of offsets available, forest-based offsets display substantial demand and some of the highest prices.

The potential loss of carbon from the loss of forestland is real and substantial. Every acre of forest lost to development has the potential to release a hundred metric tons of carbon dioxide equivalent into the atmosphere – like adding twenty-five cars for a year.

The carbon in our forest soils is relatively stable, presuming soil disturbance is minimized and the forest growing above remains reasonably intact. For decades, the "live" carbon in Vermont forests have seen a positive net change. Growth consistently exceeds loss from mortality and harvesting, consistently extracting carbon dioxide from the atmosphere and converting it into solid carbon. Research is ongoing regarding optimal management strategies that balance both the preservation of the sink and sequestration from growth. In all likelihood, the introduction of offset trading will not have major effects on either the level of currently sequestered carbon or

the accretion of additional carbon through growth. It would reward landowners who protect the existing carbon and for new sequestration.

Vision: Increased Carbon Sequestration in Agriculture and Forestry

Land owners of agricultural and forest land embrace the role their management plays in the mitigation of climate change impacts. Information about the scale and extent of their impact is evident and informs their actions to preserve stored carbon in trees and soil and adopt practices that increase carbon sequestration. They are motivated by ethical, practical, and financial incentives. In addition, they understand that Vermonters value their contribution to efforts that meet State greenhouse gas emission goals while providing co-benefits, including conservation of Vermont's surface and ground water and flood resilience.

Achieving the Vision of Increased Carbon Sequestration in Agriculture and Forestry

I. Agriculture

Our recommendations identify key leverage points and policy actions needed to systematically recognize and advance the existing and potential contributions of agriculture to achieve the State's climate goals. The goals stated in the CEP include reducing greenhouse gas within the state and from outside the state's boundaries caused by using of energy within the state by 50% by 2028 and 75% by 2050. Thus, sequestration, or "reverse emissions," are overlooked. The CEP mentions carbon sequestration mainly in the context of forests. Agricultural practices that can increase carbon sequestration in soils can be significant, as can the contribution of both forestry and agriculture to our climate goals, especially given the many co-benefits.

Extrapolating under reasonable assumptions[7], practices that promote carbon storage in agricultural soils have the potential to offset 2% of our annual state emissions.

II. Forestry

The CEP recognizes the importance of intact forests and discusses the role of wood fuel for heat and energy. The CEP does not acknowledge the role of or the potential for sequestration in Vermont forests, though it does acknowledge the forests as a carbon sink. The Commission will identify actions the legislature and administration can undertake to support and promote additional sequestration in forests by landowners and communities. It will also consider recommendations that promote maintaining and enhancing the value of the large carbon sink represented by our current forests.

The recommendations below are listed in approximate order of importance. A simple version of the priorities:

- Get a baseline of carbon sequestration and set goals in State planning documents
- Look to market-based mechanisms for the sale of carbon credits from sequestration

[7] Our analysis assumes a 1% annual increase in organic matter per year across a distribution of soil types and practices. We also assumed these practices would be achieved on roughly one-third of agricultural acres and be sustained for a period of 20 years. Across all soils, this resulted in average carbon per acre changing from 25 to 30 tons over the 20-year period.

- Track rates of carbon sequestration occurring through water-quality initiatives and payments
- No backsliding:
    - maintain water-quality initiatives and emphasize the benefits of sequestration for soil health and flood resilience
    - Keep forested land – avoid cutting down forests for development

In the action steps for the recommendations, we suggest leaders and stakeholders. Commitments to these steps would have to be formalized and the list is by no means comprehensive. It will take many different partners and the support of Vermonters more broadly to undertake this work.

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.

Recommendation 35	GHG Impact	Savings Impact	Investment Needed	Ease
Document goals and mitigation contributions from agricultural sequestration and create a best practice guide for farmers.	CO2	$	$	👍 👍 👍

Action Step(s)	Designated Lead (other stakeholders)
1. Add a sequestration component to the triennial Vermont Comprehensive Energy Plan	PSD (ANR, AAFM, land use partners)
2. Incorporate sequestration as a type of mitigation within the goals set forth in the Climate Change Adaptation Framework.	ANR
3. Revise and expand the AAFM publication Potential Impacts of Climate Change on Agriculture in Vermont (2010) to reflect new science and new recommendations for farmer planning for the impacts of climate change. This becomes best-practices guide for farmers demonstrating the sequestration potential and potential for reducing N2O emissions from soils using carbon-friendly practices. Explore opportunities to incorporate sequestration potential into ongoing outreach efforts	UVM Ext. and AAFM (NRCS, ANR)

Background:

By documenting contributions, the State will have provided legitimacy to these practices. Farmers will be motivated knowing that the State acknowledges importance of practices. The best practice guide provides the technical assistance necessary for farmers to make appropriate decisions to enhance carbon sequestration in their soils. Documenting the value of agricultural contributions to climate change mitigation is necessary to ensure the continued support for implementation. Vermont is one of the few states that targets agriculture with its Potential Impacts of Climate Change on Agriculture in Vermont (2010), yet neither the Comprehensive Energy Plan nor Vermont's Climate Change Adaptation Framework (2013) include substantial recommendations for agriculture. These guiding documents need to be expanded and brought up-to-date to include the substantial contributions of agriculture, including the multiple benefits, to help ensure the continuation of critical funding and support to the farming community and support State, regional and municipal planners.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 36 Investigate opportunities for the sale of carbon offsets and other mechanisms that leverage private finance.	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Characterize carbon offset opportunities for forestry in Vermont, voluntary and compliance, existing and emerging. Identify active and likely private finance organizations.	UVM (FPR, ACCD, Coalition for Green Capital)
2. Characterize carbon offset opportunities for agriculture in Vermont, voluntary and compliance, existing and emerging. Identify active and likely private finance organizations.	UVM (DEC, AAFM, ACCD, Coalition for Green Capital)
3. Consolidate and summarize above characterization and recommend type of State of Vermont participation and/or next steps and person(s) responsible for those actions.	UVM (DEC, AAFM, ACCD, Coalition for Green Capital)

Background:

Carbon offsets are emerging as a potential mechanism to reward landowners for activities that sequester carbon. There are options for both agricultural and forest lands, but the market for forest offsets is more mature and robust. An initiative led by the Vermont Land Trust and UVM's Rubenstein School is working to develop a "pilot" project to demonstrate the feasibility of carbon offsets trading for smaller private forest landowners in Vermont. There is considerable interest on the part of landowners, yet these carbon projects are complex. This pilot will inform the potential for the sale of offsets to increase landowner income, and its potential as a new conservation finance tool. This effort represents an opportunity for state land managers to participate and answer questions that affect the feasibility of similar projects, either on other private lands (for example, compatibility with the Current Use rules) or on State lands. As the trading of forest carbon offsets becomes more common, county foresters and state land managers will need to have the information and experience to interpret current rules and mandates for landowners. AAFM and DFPR along with the ACCD should evaluate the potential for a fund that would mitigate the risk of investments in these programs, in the hopes of attracting capital to support private efforts. The results of this review can become the basis for recommendations to the State legislature for targeted funding.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 37 Develop an accurate baseline of carbon sequestration in agricultural soils	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Convene relevant stakeholders	ANR (AAFM, UVM)
2. Gather and make easily available existing data on soil carbon content in Vermont and the potential for soil carbon stocks to be increased through common agricultural practices.	NRCS (UVM and AAFM)
3. Evaluate tradeoffs and co-benefits of Vermont-specific agricultural practices that sequester carbon.	ANR (NRCS, UVM, and AAFM)

Background:

Developing a baseline will allow us to understand how much carbon sequestration is to be gained with supporting management practices. This knowledge will help determine the value of this work and subsequently appropriate allotment of resources. In addition, a baseline will assist with tracking, see next recommendation. The phosphorus reduction value of various agricultural practices has been quantified, however, no baseline has been set for the sequestration value of these same practices. Until this is done, quantifying the value of future implementation opportunities is challenging. Based on the modeling estimates of the Lake Champlain TMDL and estimates by USDA/Natural Resources Conservation Service sub-watershed planning, it is reasonable to assume the potential for a minimum 40-50% increase in water-quality and carbon friendly practices over the next ten years. Various UVM departments are involved in research related to the current stocks and stability of those stocks in both agricultural and forest soils, yet this research has yet to provide estimates of where the greatest potential to add carbon can be found, and what land use practices are most likely to return the greatest benefits. We envision this research coming together in a tool that integrates soil science and economics (that is, costs to implement) to support better farmer decision making. For that to happen we need a consistent and expanded accounting system to identify and track benefits. The State of Vermont should lead in the development and funding of an evaluation of the tradeoffs and co-benefits associated with different adaptation and mitigation actions and agricultural practices, specific to Vermont soils, crops, and weather to ensure that decision makers, from policy leaders to farmers, have a comprehensive perspective on their options for responding to climate change.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 38	GHG Impact	Savings Impact	Investment Needed	Ease
Design and implement a way to track the sequestration benefits of water-quality practices that are being tracked through ANR's reporting to EPA. Determine levels of adoption and the additional, voluntary practices				

Action Step(s)	Designated Lead (other stakeholders)
1. Convene stakeholders to identify reporting methodology and ways sequestration could be added to existing program tracking.	NRCS (AAFM, ANR, EPA)
2. Propose an effective way to account for sequestration associated with water quality improvements that are being reported to EPA. Estimate additional cost and propose funding mechanisms.	NRCS (AAFM, ANR)
3. Propose an effective way to account for sequestration associated with water quality improvements that are NOT being reported to EPA. Estimate additional cost, if any.	NRCS (AAFM, ANR, watershed groups)

Background:

Tracking carbon sequestration will provide a measure of progress that in turn secures support for this effort as well as facilitating increased rates of adoption. The measure of progress can be used to identify successful land management strategies for broader adoption. In addition, financial incentives can easily be calculated to reflect carbon sequestration, creating opportunities for additional financial resources, e.g. offset program. VT DEC is required to provide regular documentation to the EPA regarding progress in meeting the State's water quality goals through the Lake Champlain TMDL and the Act 64, Vermont's Clean Water Act. Many of the practices tracked in this effort are the same as those proposed as carbon-friendly, and the State must provide the resources to additionally include the sequestration benefits of these practices or develop a method to efficiently use the water quality data already summarized. This includes not only practices implemented with the assistance of State or federal dollars, but also those done voluntarily by farmers around the state. An alignment of practice adoption levels for water quality goals with those for climate change mitigation goals will demonstrate additional value of investments in related programs.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 39	GHG Impact	Savings Impact	Investment Needed	Ease
Develop and use consistent messaging to farmers about the carbon-capturing co-benefits of the water quality improvements, including the cost-benefit to the farmer	CO_2	$	$	👍 👍 👍

Action Step(s)	Designated Lead (other stakeholders)
1. Develop messaging to incorporate into ongoing partner outreach/education/implementation efforts	NRCS (AAFM, ANR, UVM)
2. Summarize and determine applicability of existing work on costs and returns of carbon-friendly practices.	UVM
3. Create outreach materials and a distribution plan of the costs and benefits of carbon-friendly practices that also improve water quality.	AAFM (ANR, UVM)
4. Identify gaps in knowledge and propose research to fill the gaps.	UVM

Background:

Farmers will be motivated to adopt carbon sequestration practices where economic benefits exist. In addition, farmers will also be motivated where community approval exists, and surveys show that currently, the co-benefit of improving water quality is a community concern for Vermonters. The University of Vermont Extension System has done extensive work to quantify the financial costs and returns to farmers for implementation of these carbon-friendly practices, but the sequestration benefits have not been as widely shared with the agricultural community as the water quality benefits. A priority should be on systematically sharing with farmers a comprehensive package of costs and benefits to each practice to help influence implementation and quantify the cost-benefit to the State. In addition, further and research is needed to confirm how advocated management changes impact soil carbon storage and GHG emissions. Farmers who value mitigation benefits are willing to invest financial capital towards adaptive and mitigating practices when their farm is economically successful. However, when finances are tight, investments are not made toward mitigation. Economic and livelihood analysis of how financial and other livelihood assets drive and limit investment into resilience and mitigation on farms will be crucial to policy makers who wish to encourage mitigation.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 High:100 MTCO2e	CO_2 CO_2 Med: 20-99 MTCO2e	CO_2 Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ High: >$10 million	$ $ Med: $2-$10 million	$ Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ High: >$5 million	$ $ Med: $500K-$5 million	$ Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	👍 👍 👍 High	👍 👍 Med	👍 ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 40	GHG Impact	Savings Impact	Investment Needed	Ease
Use the new "BMP Challenge" program as an opportunity to evaluate incorporating sequestration into water quality project prioritization and tracking.	CO_2	$ $	$	

Action Step(s)	Designated Lead (other stakeholders)
1. Estimate marginal cost of fewer than five BMPs. Rank according to potential to improve water quality and sequester carbon.	UVM
2. Propose pilot program and funding level for "hold-harmless" payment for trying a BMP.	ANR (UVM, AAFM)
3. Publicize program launch, have field days, make payments, and get reporting. Evaluate after two years.	UVM (ANR, AAFM)

Background:

The program provides a safety net for farmers during a transition to new practices, increasing the likelihood of immediate implementation and long-term acceptance of a practice. Changing certain agricultural practices can permanently sequester carbon and improve water quality. Carbon promotion and protection is not currently a component of this program, and cannot be due to funding sources, but the program evaluation provides an opportunity to evaluate concurrent implementation and tracking.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 41 The State of Vermont should expand urban forestry initiatives	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Explore potential funding sources to support the State's Energy Saving Trees Program and other urban forestry initiatives, including RGGI and Energy Efficiency Charge revenues.	FPR (ANR, PSD)
2. Explore mechanisms to incentivize utilities to invest in Energy Saving Trees and other urban forestry initiatives, including through Tier III of Vermont's Renewable Energy Standard.	FPR (PSD)
3. Explore mechanisms to support implementing local strategies to increase and maintain urban tree canopy cover for energy saving and carbon sequestration and other co-benefits including improved water quality as in the Implementation Plan for Lake Champlain TMDL.	FPR (DEC)

Background:

Trees in urban and suburban environments provide well documented energy-saving and health benefits, in addition to removing atmospheric carbon. New urban tree planting on public and private land will be especially critical in the coming years, as Emerald Ash Borer is expected to eventually result in the loss of most ash trees in Vermont, and ash is a popular urban tree. By supporting tree planting in specific environments, this program can provide the greatest net benefits for the most affected communities. These projects are visible and engaging, offering many opportunities for participants to learn about the benefits of trees and tree care. The Vermont Urban & Community Forestry and Climate & Health Programs partnered with the Arbor Day Foundation in 2017 and 2018 to pilot an Energy-Saving Trees Program with residents of urban communities in Vermont. In 2018, a $10,000 investment provided 300 trees to predominantly low-to-moderate income residents in Barre and Rutland. The estimated 20-year benefit (based on i-Tree analysis) is over $90,000, attributable to reduced building energy usage, carbon sequestration and avoided GHG emissions, storm-water filtration, and air pollution reduction. The estimated average energy cost savings over 20 years is $335 per program participant, and the estimated 20-year reduction in atmospheric carbon is 162 metric tons.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 42	GHG Impact	Savings Impact	Investment Needed	Ease
Continue funding the Vermont Housing and Conservation Board for conservation easement purchases on forestland; prioritize projects that emphasize aggregation to maximize conservation and set the stage for carbon offset projects.				

Action Step(s)	Designated Lead (other stakeholders)
1. Review criteria (in any form) used to choose forestry conservation projects.	FPR (AAFM, VHCB, Legislature)
2. Draft recommended changes that would be incorporated as VHCB policy.	FPR (AAFM, VHCB)

Background:

Developing a swath of forest or farmland eliminates much of the stored carbon. Conservation easements are a valuable tool for keeping agricultural and forest land undeveloped. Funding for the Vermont Housing Conservation Board should be continued, with priority given to projects that emphasize the aggregation of like-minded and neighboring landowners to maximize the conservation values and set the stage for future aggregated forest carbon offset projects

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 43	GHG Impact	Savings Impact	Investment Needed	Ease
Re-assess funding needed to continue agricultural practices, especially after 2019, for continued water-quality improvements that also sequester carbon and lessen or avoid flood damage.	CO_2 CO_2 CO_2	$ $	$ $ $	👍 👍

Action Step(s)	Designated Lead (other stakeholders)
1. Tabulate existing sources of funding.	ANR (AAFM, NRCS, Treasurer)
2. Rank funding for effectiveness in improving water quality, sequestering carbon, and lessening or avoiding flood damage.	ANR (AAFM, NRCS, EPA)
3. Recommend one or two secure ways to continue funding.	ANR (AAFM, NRCS, Treasurer)

Background:

When farm income is below the cost of production, voluntary practices often cease, resulting in the loss of the benefits gained. Securing consistent and long-term funding for these multi-purpose practices is a priority. Agricultural practices that improve water quality and store carbon have multiple benefits. Cover crops and reduced tillage decrease soil erosion, improve soil health and crop management, and increase flood resiliency by improving soil infiltration. The continued implementation may reduce some costs (for example, equipment fuel), but implementation likely comes at a net cost to the farmer--cover crop seeding, cover crop termination in the spring, and purchase of new equipment for changes in tillage practices are among the required investments. Funding for implementation of these practices is relatively robust through 2020, however, a precipitous drop is expected that will reduce not only the implementation of new practices, but also threaten the continuation of ones already in place. Dairy milk prices are volatile and at a dramatic low in 2018, with little improvement expected in 2019. Long-term funding pays for more acreage of water-quality improvement and also for ongoing implementation of current practices. There are extensive opportunities to leverage funds that are available for water quality improvement efforts and use these to also support the additional sequestration benefits.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	CO_2 CO_2 CO_2 High:100 MTCO2e	CO_2 CO_2 Med: 20-99 MTCO2e	CO_2 Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	$ $ $ High: >$10 million	$ $ Med: $2-$10 million	$ Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	$ $ $ High: >$5 million	$ $ Med: $500K-$5 million	$ Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	👍 👍 👍 High	👍 👍 Med	👍 ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 44 Incorporate land transfer and changes in parcel sizes and boundaries into ANR's environmental mapping tool.	GHG Impact	Savings Impact	Investment Needed	Ease
Action Step(s)			Designated Lead (other stakeholders)	
1. Convene stakeholders and agree on overall objective. Begin visualizing or sketching an end-user interface.			ANR and ACCD	
2. Identify available data and data gaps. Identify resource needs			ANR, ACCD, and VCGI	

Background:

Forest land subdivision and conversion threatens the economics of forest conservation and sequestration. Better tracking and reporting of land use and development is essential. Forested land provides significant long-term sequestration today with important potential for the future. This reporting should be integrated into current, online tools designed to promote better land use decisions by local and regional planners and private landowners. The Department of Fish and Wildlife currently maintains the BioFinder website for this purpose. We suggest that better land transfer and parcelization reporting be incorporated into this tool.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

E. Jobs and the Economy

Vermont continues to lead the nation in modeling best practices in responding to growing greenhouse gas emissions and reducing human-caused carbon emissions. The Climate Action Commission believes the state is primed to marry these efforts with private, entrepreneurial efforts to create and grow a new *climate economy*.

The *climate economy* is largely defined by the economic responses aimed at reducing carbon emissions and accommodating to the realities of a climate-changed world. It is a large, growing portion of the economy. However, the Climate Action Commission chose to focus primarily on *the economic activities that are related to carbon emissions* when considering how best to grow jobs related to the climate economy. While there are legitimate arguments that expand the climate economy definition to topics such as waste reduction, localized agriculture and advanced manufacturing, the Commission focused on what it believed to be the largest and most immediate opportunity to grow jobs in Vermont.

The Climate Economy Baseline

Vermonters spend more than $2 billion dollars on energy services that include the purchase of:

- 310 million gallons of gasoline
- 70 million gallons of diesel fuel for transportation
- 130 million gallons of heating oil for residential, commercial and industrial purposes
- 100 million gallons of propane for residential, commercial and industrial purposes
- 12.2 trillion BTU of natural gas for residential, commercial and industrial purposes
- 4.5 billion kWh of electricity – some generated locally, some imported from other states and Quebec.
- 7.5 trillion BTU of wood for process and building heat

During the last period of higher fossil fuel prices (2014), Vermonters spent close to $3 billion on energy. The subsequent reduction in the price of oil due to global market conditions has resulted in savings to Vermont businesses and homeowners of several hundred million dollars each year. The possibility of a return to higher petroleum prices is a factor not to be dismissed lightly in that those hundreds of millions of dollars currently available for other purchases could be lost again.

As noted in other portions of this report, there are many areas where Vermonters and Vermont entrepreneurs are participating in the climate economy, including:

Homes and Workplaces

- Weatherization to reduce the need for heating fuels
- Electrification of heating through heat pumps
- Installation of advanced wood heating systems
- The production of renewable fuels from our forestry and wood products industry

Getting Around

- The increased use of energy efficient transit services
- The emphasis on land use decisions to reduce the need for vehicle use

- The shift to electric vehicles
- The construction of electric vehicle charging stations

Our Communities and Landscape

- Utilizing Vermont's millions of acres of forest for carbon storage and sequestration
- Utilizing Vermont's forests for renewable energy fuels
- The choice of home and business location as an important factor in directing the future delivery and use of energy
- The emphasis on land use decisions to reduce the need for vehicle use

The Business of Clean Energy

Many of the recommendations in this report have the potential to spur economic opportunities for entrepreneurs and for Vermonters. However, most of the recommendations focus on consumer-facing, demand creation – with an eye on creating a market with the assumption that jobs and private economic investment will occur. Incentives and policies increase the demand for weatherization, heat pumps, electric vehicles, solar panels and transit. Businesses providing those goods and services receive a benefit by the increase in demand. Perhaps the most recent example of a successful demand-driven incentive has been the expansion of solar in Vermont.

To complement the many demand-side enhancements in this report, the Commission's Climate Economy Business work group focused on the support of bold supply-focused recommendations that will create an ecosystem that supports the creation and growth of climate economy businesses.

Fostering additional job growth requires a focus on matching the familiar challenges of climate economy businesses with the competitive advantages Vermont's energy sector and business ecosystem either already possesses or could possess with deliberate action. The Commission recognizes that while we must do everything we can to create an environment where climate economy entrepreneurs from across the globe would consider Vermont, our highest success will come from helping Vermont-based businesses grow, Vermont ideas turn into Vermont start-ups and Vermont start-ups turn into Vermont scale-ups.

As such, the Climate Economy Work group decided to focus on two parts of the Climate Economy that are well established and primed for expansion:

1) Clean Grid Modernization
2) Expansion of Advanced Wood Heat Production Facilities

Defining Clean Grid Modernization Businesses

Clean grid modernization businesses can be defined as businesses that relate to the creation and utilization of a smart grid – a more communicative and responsive grid that allows for more efficient generation, storage, transmission, and use of electricity. Vermont, with its near ubiquitous installation of smart meters and distributed energy generation assets, offers clean grid modernization businesses an ideal place to do research, apply their technology and grow their business. The state currently has nationally recognized leaders in clean grid modernization,

including our utilities, newly-established energy storage companies, start-up smart-grid utilization companies, and dozens of renewable energy companies.

Distributed renewable generation production businesses benefit from an improved grid infrastructure. Since the early introduction of distributed generation, many economic benefits related to electricity demand peaks and reducing high price spot purchases have been captured, and to meet the State's renewable generation goals, there is the need for expanded renewable generation. Furthermore, distributed generation provides job-creating opportunities and reduces the flow of money out of state to pay for remote generation resources.

Clean grid modernization works in tandem with distributed generation. New generation supplies require a modern grid with demand controls and storage capacity to best utilize the new generation. The use of storage batteries in grid modernization benefits from more distributed generation to provide supply during periods of recharge.

Supply constraints and grid weaknesses in certain regions are an additional feature addressed by clean grid modernization. Strategically siting new distributed generation resources will benefit the grid.

At a time when renewable resource development is slowing, Vermont cannot lose its capacity for these businesses to gain experience and market share. Incentives to these businesses will allow them to continue providing those benefits.

Expanding Advanced Wood Heat Production Facilities

The working group recognized that renewable energy production has created thousands of jobs in Vermont – especially in connection with a national expansion of solar installation, sales and servicing jobs. However, the working group felt that the state should be focusing additional efforts into the expansion of an often-overlooked renewable sector – advanced wood heat. The harvesting, processing and use of Vermont's forests as wood pellets in homes and businesses across the region has the potential to drastically cut our state's greenhouse gas emissions, put forestry workers back to work, and breathe vibrancy into our forest-dependent communities. There is an obvious nexus between Vermont's existing natural assets, this growing sector, and the climate economy.

Supporting Clean Grid Modernization Businesses

The Commission proposes implementing systems that meet the following clean grid modernization goals:

- With flat electricity use, the overall costs of delivery of electricity are reduced 5% (about $35 million per year) compared to a Business as Usual scenario.
- The Clean Grid modernization businesses will have 200 employees (in addition to the jobs associated with the Distributed Generation businesses). Total salaries at $15 million. (Expansion of services into other states will be above and beyond this amount)
- 10% of current electricity sales increase in Distributed Energy Generation in next 5 years (reducing out of state purchases by that same 10% - some portion of that from non-renewable sources)
- Capital investment at $100 million for grid modernization with a significant portion of the costs for battery storage plus additional investment in distributed generation

- Ratepayer savings approximately $10 million per year

The Commission recommends making several structural changes that will incentivize and accelerate clean grid modernization entrepreneurial growth, including:

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.

Recommendation 45 Restructure Regulated Electricity Rate Design	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Summarize research to determine the opportunities available for rate design restructure	PSD
2. Review current law for constraints on rate design	PSD
3. Initiate rate design case before the Public Utility Commission	PSD

Background:

Clean Grid Modernization businesses, especially those using smart grid data to change consumer behavior, need a system in place that provides the appropriate price signals to consumers about when they should or shouldn't use electricity. Smart devices, renewable generation assets and storage companies all need a dynamic electricity pricing system to succeed.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 46 Provide Access to Smart Meter Data for Clean Grid Modernization Companies	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Convene grid modernization companies to define their data needs	PSD and ACCD
2. Work with the utilities to determine what data is available for the grid modernization companies and identify proprietary or sensitive customer data that cannot be shared	PSD
3. Determine policy changes (through PUC) or statutory changes (via legislation to allow for data to be made available	PSD

Background:

The state's success at becoming one of the first nearly ubiquitous smart grids is a unique Vermont asset. The Commission heard from several businesses that participated in the Vermont Sustainable Jobs Fund Accel-VT climate economy accelerator that their access to the utilities and the grid was especially attractive and a potential determining factor to doing business in Vermont. Enabling clean grid modernization businesses access to the entire state's smart grid data could create a new incentive to doing business in Vermont.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 47 Determining Value of Grid Modernization	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Complete literature study of existing studies that have assigned value to grid modernization	PSD, ACCD, and utilities
2. Seek additional expertise, possibly through an RFP to refine the analysis and determine a value for Vermont	PSD.

Background:

Grid modernization is not as attractive for investors as recent investments in renewable energy generation, yet the sector offers great promise to consumers, businesses and utilities. Understanding its economic value will enable the State and our utilities to assign the appropriate public dollar investment to its development.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 48 Establish a $1 Million Innovation Fund	GHG Impact	Savings Impact	Investment Needed	Ease
			$ $	

Action Step(s)	Designated Lead (other stakeholders)
1. Convene experts in finance	Clean Energy Finance Collaborative (CEFC)
2. Seek additional expertise, possibly through an RFP to refine the analysis and determine a value for Vermont	CEFC

Background:

Using the existing structure at the Clean Energy Development Fund, create a new fund that provides equity investments for target climate economy businesses to encourage the growth of the sector. The fund should be modeled on the Working Lands Enterprise Initiative, which provides small grants to private entrepreneurs and non-profit groups to create jobs in the agriculture sector. Eligible expenses should include product development, start-up costs, equipment purchases, and talent acquisition. Many start-up climate economy businesses are attracted to larger cities where equity capital is more available, this grant program would provide a unique Vermont advantage at a Vermont scale. The committee recommends that initial capitalization of this fund equals $1 million.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 49 Create a Small Business Innovation Research Grant Matching Program	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Interview past EPSCOR and SBIR recipients for their experiences	ACCD
2. Design SBIR Matching program (including any legislative actions necessary)	ACCD
3. Draft and promote legislative changes for programs	ACCD

Background:

Incentivize target businesses to do research and technology commercialization in Vermont by providing a State match to the existing federal Small Business Innovation Research grant program. Eleven federal agencies, including the Department of Energy, are required to dedicate 3.2 percent of their research and development budget to small businesses. Companies can apply for as much as $1 million to conduct research in partnership with the federal agency. In the past 35 years, Vermont companies have received approximately $130 million in federal SBIR awards. The State could encourage Vermont businesses to utilize the program by providing a small match to any SBIR award made to conduct clean grid modernization work. In addition, non-Vermont businesses may choose to do their research here in Vermont, resulting in more start-ups being located here in Vermont. The Commission recommends a $100,000 annual investment

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	.ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 50 Enhance the Vermont Employment Growth Incentive for Clean Grid Modernization Businesses	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Draft legislative language to make the two changes in the VEGI statute	ACCD
2. Develop impact analysis to show how the two changes affect future tax expenditures	ACCD
3. Promote legislative changes for program	ACCD

Background:

The current VEGI program provides a cash incentive one to nine years after a specified employment and capital investment target is met. For businesses in this sector, our proposal is to front load the payments at the time of employment and investment (with real-time monitoring to ensure that the positions are maintained). Another aspect of VEGI is that the incentive value is decreased based on an assumption of background growth – growth presumed to take place in the absence of any incentive payment. Start-up businesses and high growth businesses struggle to overcome background growth requirements. If a company of one person hires one person, the 100 percent growth often disqualifies a company from the program. Mid-size, faster growing companies, like those in the tech industry, often need to exceed unattainable growth figures to qualify. To enhance the VEGI program for target climate economy businesses, we propose to assign a zero rate of background growth to calculate incentive payments. The Commission recommends a $200,000 annual investment in this enhancement.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 51 Create a Fully Refundable Research and Development Tax Credit	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Review other state R&D programs	ACCD
2. Draft legislative language for Vermont's R&D tax credit	ACCD, Tax
3. Develop impact analysis to show how the two changes affect future tax expenditures	ACCD, Tax
4. Promote legislative changes for program	ACCD

Background:

The existing Vermont credit provides tax benefit for conducting research in Vermont, but that credit is only available to companies that meet federal requirements and have an existing Vermont income tax liability (corporate or personal for pass-through businesses). Many start-up companies wait years to be profitable. By making the tax credit fully refundable for clean grid modernization businesses, Vermont could become the preferred destination to conduct research and development in the sector. The Commission estimates that this would cost $100,000 annually.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 52 Create a New Student Loan Repayment Program	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Convene representative businesses in the clean grid modernization sector to scope program qualifications	ACCD (DOL and PSD)
2. Design the debt forgiveness package and draft legislative language	ACCD (VSAC)
4. Promote legislative changes for program	ACCD

Background:

Create a student loan forgiveness program for entrepreneurs and workers in the clean grid modernization sector. Graduates of Vermont colleges and universities that work with Vermont businesses in this sector will receive a partial loan forgiveness for each year that they hold the job. In addition, students that pursue an academic field of study that prepares them for work in the clean grid modernization field will also be eligible for debt forgiveness. The Commission estimates that this would cost $100,000 annually

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 53 Support for Free Legal Services to New Climate Economy Entrepreneurs	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Convene representative businesses in the clean grid modernization sector to scope program qualifications	ACCD (DOL and PSD)
2. Design the debt forgiveness package and draft legislative language	ACCD (VSAC)
3. Promote legislative changes for program	ACCD

Background:

One critical area of support for new and emerging clean energy businesses, including clean tech and grid modernization businesses, is intellectual property and corporate legal services. Legal services for new businesses to support formation of the appropriate legal entities, structure outside investment, and even file for an Employee Identification Number can range from $6,000 to $20,000, placing a significant burden on new and emerging businesses at the time when they can least afford such capital outlays. Further, for clean technology companies or others developing new products, intellectual property legal services such as applying for a patent can be as high as $20,000.

Infographic Key				
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Feasibility	Considering administrative, financial & political feasibility	High	Med	Low
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Expanding Advanced Wood Heat Production Facilities

The Climate Economy work group supports the efforts of the Building Work Group to provide incentives to building owners to install modern wood heat infrastructure. This approach will incentivize growth in the sector by generating demand. The following recommendations reduce the barriers to the creation and expansion of advanced wood heating fuel facilities on the supply side.

The Climate Commission proposes to meet the following benchmarks over the next five years:

- 100,000 tons annual production within Vermont – wholesale value $20 million (retail $25-30 million)
- 200,000 tons pulp wood purchase from Vermont loggers – value $5 million
- The wood pellet businesses will have 200 employees (plus 50 jobs associated with logging). Total salaries at $10 million.
- Capital investment at $60 million
- Reduced out of state fuel purchases of $25 - $40 million annually depending on price of fuel oil (if all replacement fuel oil – reduced fuel oil use of 12 million gallons)

Current wood pellet production faces significant competitive pressures from parts of the US and Canada that have lower costs for production. To reduce costs for Vermont producers, this work group recommends a series of strategies:

Recommendation 54 Reduce Electric Costs for Wood Pellet Manufacturers	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Review the current incentive rates to determine if there are enhancements that are appropriate for wood pellet mills that would otherwise not be operating in Vermont	PSD (utilities)
2. Provide Access to smart meter data to clean grid modernization companies	PSD

Background:

Vermont's relatively high-cost of electricity is a deterrent to attracting new high-energy using manufacturers. Though the State has a process enabling businesses to apply for a reduced economic-development rate to encourage load expansion and job creation, the program is rarely used. The Commission recommends creating a new, enhanced rate reduction for wood pellet manufacturers recognizing the benefits of reduced greenhouse gas emissions provided by advanced wood heat and the potential to grow the green economy. .

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
Savings Impact	Annual savings achieved if implemented	High: >$10 million	Med: $2-$10 million	Low: < $2 million
Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

Recommendation 55 Streamline the Permitting for Wood Pellet Production Plants	GHG Impact	Savings Impact	Investment Needed	Ease

Action Step(s)	Designated Lead (other stakeholders)
1. Review Act 194 of 2018 to determine additions that will be beneficial for wood pellet mills	ACCD (ANR, NRB, RDCs, land use stakeholders)
2. Make a legislative recommendation for a clean energy industrial park designation program	ACCD (ANR)

Background:

The State's permitting process can be costly and time consuming, often resulting in hundreds of thousands of dollars and many months of delay. The Commission recommends creating a new designation program that would encourage clean energy, climate economy, and wood pellet production facilities to locate in areas the state, municipality, economic development experts, and land use planners agree is the best place for growth. In return for locating in a designated area, permitting costs and hurdles would be reduced, if not eliminated, allowing for a more cost effective citing process and a more predictable process.

Infographic Key				
GHG Impact	Total amount of greenhouse gas emission reductions	High:100 MTCO2e	Med: 20-99 MTCO2e	Low: < 20 MTCO2e
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Investment Needed	Investment required to deliver GHG reductions, financial savings, social benefits	High: >$5 million	Med: $500K-$5 million	Low: < $500K
Feasibility	Considering administrative, financial & political feasibility	High	Med	ow
	This icon conveys that this action is necessary to unlock potential for additional GHG impact and cost savings			

III. Continuing Citizen Climate Participation

The Vermont Climate Action Commission has taken its charge of developing recommended actions seriously. The process has involved and engaged the broader public in a meaningful way. To achieve Vermont's ambitious but necessary climate goals, the entire population must be engaged in the solution. The scale of the challenge and opportunity it presents is that large.

The Commission believe it is vital to take the recommendations in this report and other related climate actions and begin implementing them as soon as possible. Though the implementation will include leadership from the private, municipal, educational, and non-profit sectors, the primary force for implementation will come from State agencies. The Commission has identified lead organizations for implementation in all of its recommendations, but there is an important for consistent interagency collaboration and coordination.

Therefore, the Commission believes that a new citizen group should be formed to enhance, advise, and provide feedback to State agencies as they implement supported recommendations. The Commission proposes that the Governor issue a new Executive Order to create an interagency implementation working group that would be advisory to the Governor and his cabinet and be supported by a climate advisory council. Maintaining a consistent voice for Vermonters in the implementation will ensure that we continue to make progress toward solutions that allow everyone to make the necessary transitions.

From our perspective, the implementation team should consist of agency leads and key staff that carry out Vermont's climate work. We envision a role for the following agencies and departments, but others may need to be included as well:

- Agency of Natural Resources (Chair)
- Agency of Commerce and Community Development
- Agency of Transportation
- Agency of Agriculture
- Department of Public Service
- Department of Health
- Department of Buildings and General Services
- Department of Public Safety

The Vermont Climate Action Commission has consisted of 17 members of the public. The membership has represented a wide range of stakeholders, but 17 is probably not appropriate given the broader participation by State agencies and departments. Moving forward, if this recommendation is accepted, we recommend limiting the citizen advisory body to twelve members.

There will be significant work that will be occurring all the time by the State agencies, and we recommend creating an effective process that balances that work with the time commitment of citizens participants. We recommend monthly meetings of the interagency group with the citizen panel being included quarterly or more regularly as needed.

IV. Conclusion: Leadership and Investment

The members of the Vermont Climate Action Commission appreciate the leadership of the Scott administration in developing the charge of the commission, re-affirming the Vermont Comprehensive Energy Plan and the state's emissions goals and holding to Vermont's share of the global commitment to combat climate change affirmed in the Paris Accord. Gubernatorial leadership will be crucial to realizing the transformational opportunity before us.

Climate action globally and in Vermont will require significant leadership and investment. The magnitude of the climate challenge is unprecedented in human history. Answering climate change, locally and globally, with appropriate, systematic and on-going action will be crucial to the ecology of our state and the planet and the advance of human civilization.

Confronting these daunting challenges also offers virtually unprecedented economic opportunity. Innovation in the economy, and leadership in public policy, can advance solutions to climate change that are the right thing to do, and that will be rewarded economically. Ongoing commitment and meaningful and supportive policies, programs and partnerships will be required. Places that lead in the development of business and policy solutions in the climate economy will benefit by attracting youth, entrepreneurism and opportunities for renewed prosperity. Vermont should be one of those places; a rural model of innovation and economic renewal.

The recommendations in this report have been elaborated as starting points toward long-term State of Vermont goals to reduce carbon and other greenhouse gas emissions, to meet our energy needs with renewable sources, and ultimately, to contribute to an economy that advances opportunities and affordability for all and lifts up and protects the most vulnerable Vermonters.

There will be costs entailed in the transformative nature of the changes needed—both costs to some existing businesses and sectors, and costs in needed investment in policies, incentives, and initiatives going forward.

The Governor's Climate Action Commission considers many of those costs as an investment in the energy system and economy of the future. We worked hard to minimize those costs and recommend solutions that will lead to long-term affordability, economic growth, and savings for all Vermonters. We encourage the Governor to evaluate opportunities to build sector investments in weatherization, efficiency, wood heat, smart growth, sequestration, renewable generation and vehicular electrification, and the other strategies entailed in this report as priorities for your administration. We also encourage you to invest in more robust economic analysis to inform policy decisions. Many of these investments will generate economic returns and additional State taxes that will offset the initial cost.

Transformative change will require significant investment. Unfortunately, the current marketplace does not produce a financial return and/or the upfront costs are unreachable for many Vermonters for many steps necessary to meet the climate change goals. Our progress from current incentives and citizens willing to go beyond the norm are not enough. Much more needs to be done. We must change the economic drivers of climate change and tip the scales towards the choices that will limit the devastating impacts of climate change.

This will require hard choices. We can reform and equalize our tax system to induce behavior change, we can mandate change through statutory or regulatory action, we can let the market efficiently allocate prices through a system like cap and invest or carbon pricing, or we can accept that that we will not meet our goals through voluntary action in the current market where the price of carbon is not properly accounted for in the costs of our goods and services.

We took what the Governor communicated to the Commission in his January 25, 2018 letter to heart. There will be costs borne on Vermonters under any market-based carbon reduction program. There will be new winners and losers. And there will be a need to help Vermonters adjust to and afford energy costs today – and into the future. Our goal is to ensure that all Vermonters have access to the cost savings we envision, are not disadvantaged relative to our neighboring states and, instead, are economically stronger from Vermont's forward-looking commitment to reducing our significant reliance on imported fossil fuels. A national approach to tackling this issue would level the playing field across the country, but under the current federal administration, the prospects are dim. And opportunity exists with strategic approaches at a smaller scale.

In light of those facts, we propose that the State of Vermont take a regional, national and international leadership position on this important issue, building a coalition to create a system of such breadth that Vermonters can benefit most and face the least consequences. One opportunity exists with our primary international trading partner, Quebec, which has recently joined with Ontario and California to create a cap and trade system. Additionally, all Canadian provinces by the end of this year must select a carbon reduction strategy, whether by cap and trade or tax.

There is significant opportunity for Vermont to build momentum in partnership with other states and provinces in a way that benefits us today – and far into the future. To reach a broad spectrum system will take leadership, and we recommend that Vermont advocate for the creation of as broad a program as possible to amplify the positive impacts and mitigate the negative impacts Vermonters will face as we address the true cost of carbon.

In the interim, the Commission recommends that climate action be considered as a fundamental priority of the administration for the use of limited general fund dollars. Tackling climate change justifies raising new revenues over time. Bonding could also be beneficial where there are long term returns, as in the potential case of low income weatherization where health and energy savings impacts, improved affordability, and a rising quality of life for Vermont's most vulnerable families justify this form of structured investment with interest. There may also be settlements from power line or other infrastructure development that could contribute to climate action in an ongoing way.

As members of your commission, we look to Vermont's continued leadership to advance the economy for the future while protecting the most vulnerable. The Governor provides a unifying voice for all Vermonters to champion the direction forward, to speak for needed policies and investments, to educate all Vermonters about climate change and its implications (including the costs we are already paying today), to encourage their household and collective action, and to seize the economic opportunity for a healthy, secure and prosperous future for Vermont. The Governor empowered us to recommend bold actions that will move Vermont forward. We have tried to answer that call, and we look forward to continuing to support your leadership on these issues and to working more broadly with Vermonters to refine and implement these and other strategies that will position Vermont as a leader and innovator on job-creating climate action.

Appendix A: Executive Order 12-17

STATE OF VERMONT

EXECUTIVE DEPARTMENT

EXECUTIVE ORDER NO. 12-

17

[Vermont Climate Action Commission]

WHEREAS, through the 2016 Comprehensive Energy Plan, Vermont has committed to reducing greenhouse gas emissions by at least forty percent below 1990 levels by 2030 and eighty to ninety five percent below 1990 levels by 2050, and meeting ninety percent of energy needs from renewable sources by 2050; and

WHEREAS, while significant progress has been made in reducing greenhouse gas emissions from the electricity sector through the partnership of the nine Northeast states that form the Regional Greenhouse Gas Initiative, comparable emissions reductions from other sectors that contribute to more than ninety percent of greenhouse gas emissions in Vermont have not been achieved; and

WHEREAS, the State must work with a range of perspectives to develop a strategy to reduce greenhouse gas emissions and combat climate change that addresses these fundamental principles:

- solutions that reduce greenhouse gas emissions must spur economic activity, inspire and grow Vermont businesses, and put Vermonters on a path to affordability;
- the development of solutions must engage all Vermonters, so no individual or group of Vermonters is unduly burdened; and
- programs developed to reduce greenhouse gas emissions must collectively provide solutions for all Vermonters to reduce their carbon impact and save money.

NOW THEREFORE, BE IT RESOLVED, that I, Philip B. Scott, by virtue of the authority vested in me as Governor, do hereby re-affirm Vermont's commitment to reduce greenhouse gas emissions from all sectors of the economy and create the Vermont Climate Action Commission to develop effective actions to meet those goals:

I. Commission Charge and Process

The Commission shall have the following duties and responsibilities:

A. By July 31, 2018, draft and recommend, for the Governor's consideration, an action plan aimed at reaching the State's renewable energy and greenhouse gas reduction goals while driving economic growth, setting Vermonters on a

path to affordability, and ensuring effective energy transition options exist for all Vermonters. The plan shall include specific actions recommended by the Commission to:

(i) implement the long-term policy goals of the Vermont Comprehensive Energy Plan;
(ii) reduce greenhouse gas emissions from all sectors, including those sectors not addressed in the Vermont Comprehensive Energy Plan; and
(iii) stimulate or support investment in the development of innovative technologies and strategies that have significant potential to reduce greenhouse emissions in Vermont.

B. Hold public scoping sessions to inform the recommendations of the action plan.

C. On or before December 31, 2017, evaluate existing State Executive Orders which are designed to address climate change issues and recommend, for the Governor's consideration, updates, modifications or sunset provisions.

D. Convene a Technical Advisory Group to provide additional expertise and analysis of technical issues that may be required to fulfill the Commission Charge. The Technical Advisory Group shall consist of persons available to the Commission on an as-needed basis to provide expertise in climate science; emission quantification; public health; transportation; energy generation, transmission, and storage; energy markets; banking; insurance; regional planning; building design and operation; and any other expertise the Commission deems appropriate.

II. Composition

The Committee shall consist of twenty-one members, with representatives from the named sectors listed below to be appointed by the Governor:

A. the Secretary of the Agency of Natural Resources or designee;

B. the Secretary of the Agency of Commerce and Community Development or designee;

C. the Commissioner of the Department of Public Service or designee;

D. the Secretary of the Agency of Transportation or designee;

E. one representative from the Agriculture sector;

F. one representative from the Clean Energy sector;

G. one representative from the Commercial Hauling or Trucking sectors;

H. one representative from the Construction or Development sectors;

I. one representative from an Energy Utility;

J. one representative from the Energy Efficiency sector;

K. one representative from a statewide Environmental Organization;

L. one representative from the Forestry or Forest Products sectors;

M. one representative from the Fuels sector;

N. one representative from Local Government;

O. one representative from the Manufacturing sector;

P. one representative from the Research and Development sector;

Q. one representative from the Rural Development sector;

R. one representative from a Small Business;

S. one representative from the Transportation Demand Management sector;

T. one representative from the Vermont Community Action Partnership; and

U. one Vermont student currently enrolled at a Vermont academic institution.

III. Chair of Commission and Commission Support

The Chair of the Commission shall be the Secretary of the Agency of Natural Resources or designee. The Chair shall name a Co-Chair and may name an Executive Committee to assist him or her with managing the Commission Charge.

The Commission shall have the administrative, technical, and legal assistance of the Agency of Natural Resources. The Commission shall have technical assistance from the Department of Public Service; the Agency of Commerce and Community Development; and the Agency of Transportation.

IV. Authority of Agencies

This Executive Order shall not limit the independent authority of a State agency to promulgate regulations related to greenhouse gas emissions and climate change in Vermont.

V. Effective Date

This Executive Order supersedes and replaces Executive Order No. 15-12 dated December 28, 2012 (codified as Executive Order 10-40). This Executive Order shall take effect upon signing.

WITNESS my name hereunto subscribed and the Great Seal of the State of Vermont hereunto affixed at Montpelier this 20th day of July, 2017.

Philip B. Scott
Governor

By the Governor:

Brittney L. Wilson

Secretary of Civil and Military Affairs

Executive Order No. 12-17

Appendix B: Vermont Climate Action Commission Charge, Membership and Process

To continue Vermont's efforts to combat climate change and meet the State's renewable energy goals, Governor Scott created the Vermont Climate Action Commission, a 21-member body, through Executive Order 12-17 (EO 12-17) to provide tangible and meaningful recommendations to move Vermont forward to meeting the aggressive climate change goals of our State.

In developing solutions to advance Vermont's climate change mitigation efforts, EO 12-17 charges the Commission with the following guiding principles:

1. solutions that reduce greenhouse gas emissions must spur economic activity, inspire and grow Vermont businesses, and put Vermonters on a path to affordability;
2. the development of solutions must engage all Vermonters, so no individual or group of Vermonters is unduly burdened; and
3. programs developed to reduce greenhouse gas emissions must collectively provide solutions for all Vermonters to reduce their carbon impact and save money.

The Commission consists of the following membership:

1. Peter Walke, Chair, Deputy Secretary of the Agency of Natural Resources
2. Paul Costello, Co-Chair, Vermont Council on Rural Development, representing the rural development sector
3. Michael Schirling, Secretary of the Agency of Commerce and Community Development
4. June Tierney, Commissioner of the Department of Public Service
5. Michele Boomhower, designee of the Secretary of the Agency of Transportation
6. Marie Audet, Audet's Blue Spruce Farm, representing the agriculture sector
7. Linda McGinnis, Energy Action Network, representing the clean energy sector
8. Joe Fusco, Casella, representing the commercial hauling or trucking sectors
9. Bob Stevens, Stevens and Associates, representing the construction or development sectors
10. Kristin Carlson, Green Mountain Power, representing energy utilities
11. Mary Sprayregen, Vermont Energy Investment Corporation, representing the energy efficiency sector
12. Johanna Miller, Vermont Natural Resources Council, representing a statewide environmental organization
13. Matt Cota, Vermont Fuel Dealers Association, representing the fuels sector[8]
14. Liz Gamache, Mayor of St. Albans, representing local government
15. Adam Knudsen, Dynapower, representing the manufacturing sector
16. Bill Laberge, Grassroots Solar, representing small businesses
17. Bethany Fleishman, Vital Communities/Upper Valley Transportation Management

[8] Peter Bourne of Bourne's Energy was the original fuels sector representative, but following the issue of the preliminary report in December, Mr. Bourne resigned for personal reasons and was replaced by Mr. Cota.

Association, representing the transportation demand management sector
18. Tom Donahue, BROC Community Action in Southwestern Vermont, representing the Vermont Community Action Partnership
19. Stuart Hart, Co-Director, Sustainable Innovation MBA program, UVM Grossman School of Business, representing the research and development sector
20. Harrison Bushnell, U-32 High School Senior, representing Vermont students
21. Robert Turner, representing the forestry and forest products sectors

EO 12-17 details the charge and outcome of the Commission as follows:

1. By July 31, 2018, draft and recommend, for the Governor's consideration, an action plan aimed at reaching the State's renewable energy and greenhouse gas reduction goals while driving economic growth, setting Vermonters on a path to affordability, and ensuring effective energy transition options exist for all Vermonters. The plan shall include specific actions recommended by the Commission to:
    (i) implement the long-term policy goals of the Vermont Comprehensive Energy Plan;
    (ii) reduce greenhouse gas emissions from all sectors, including those sectors not addressed in the Vermont Comprehensive Energy Plan; and
    (iii) stimulate or support investment in the development of innovative technologies and strategies that have significant potential to reduce greenhouse emissions in Vermont.
2. Hold public scoping sessions to inform the recommendations of the action plan.
3. On or before December 31, 2017, evaluate existing State Executive Orders which are designed to address climate change issues and recommend, for the Governor's consideration, updates, modifications or sunset provisions.
4. Convene a Technical Advisory Group to provide additional expertise and analysis of technical issues that may be required to fulfill the Commission Charge. The Technical Advisory Group shall consist of persons available to the Commission on an as-needed basis to provide expertise in climate science; emission quantification; public health; transportation; energy generation, transmission, and storage; energy markets; banking; insurance; regional planning; building design and operation; and any other expertise the Commission deems appropriate.

The Technical Advisory Group was created and new members added on a rolling basis as needed to meet the Commission's charge. All participation in the TAG was voluntary, and the Commission has and will seek out the TAG's perspective and expertise as needed to fulfill its charge. The TAG membership as of the date of this report is as follows:

1. Annette Smith (Co-Chair)
2. Kevin Jones (Co-Chair)

3. Bob Amelang
4. Henry Bonges
5. Edward Cameron
6. Olivia Campbell-Anderson
7. Karen Horn
8. Sarah Jackson
9. Ellen Kahler
10. Ben Luce
11. James Maroney, Jr.
12. Erik Phillips-Nania
13. Jason Schafer
14. Jim Stiles
15. Rick Wackernagel
16. Richard Watts
17. Steve Wright
18. Ryan Yoder
19. Eric Zencey

In addition to the requirement that the Commission develop an action plan by July 31, 2018, Governor Scott charged the Commission with developing at least three recommendations prior to January 1, 2018. Those recommendations can be found in Appendix D: Preliminary Recommendations of the Vermont Climate Action Commission.

The Commission met for the first time on August 15, 2017. In September and October 2017, the Commission held four public meetings. The Commission held those meetings in geographically diverse locations, providing access to a public scoping session within a reasonable drive for all Vermonters. The meetings were held in the following locations on the following dates:

- St. Johnsbury, September 14, 2017
- Manchester, September 21, 2017
- St. Albans, September 28, 2017
- Brattleboro, October 5, 2017

In addition to providing the public the opportunity to raise recommendations to the Commission through the scoping sessions, the Commission has maintained a website and email address to facilitate additional public input. All of the ideas gathered have been regularly added to a list and posted online. Additionally, a complete archive of the email and web form submissions has been regularly updated and added to the website: http://anr.vermont.gov/about_us/special-topics/vermont-climate-action- commission

Response to the Governor's Request for Three Actional Recommendations

The Commission spent the fall focused on the request of Governor Scott to provide at least three actionable recommendations by January 1, 2018. To accomplish that task, the Commission formed eight subcommittees. The subcommittees consisted of four sector-specific and four

cross-cutting groups. The subcommittees and their members are as follows:

Sector-specific subcommittees:

- Power Production, Distribution, and Use – Bill Laberge, Johanna Miller, Mary Sprayregen, June Tierney, Kristin Carlson, and Adam Knudsen
- Commercial and Residential Buildings – Peter Bourne, Bob Stevens, Liz Gamache, Stu Hart, and Mike Schirling
- Transportation – Joe Fusco, Michele Boomhower, Bethany Fleishman, Linda McGinnis, and Harrison Bushnell
- Agriculture/Forestry/Waste/Industry – Paul Costello, Marie Audet, Robert Turner, Tom Donahue, and Peter Walke

Cross-cutting subcommittees:

- Access to Capital – Bob Stevens, Robert Turner, Kristin Carlson, June Tierney, and Mike Schirling
- Education, Communication, and Outreach – Johanna Miller, Liz Gamache, Harrison Bushnell, Michele Boomhower, Marie Audet, and Tom Donahue
- Rural Solutions – Peter Bourne, Bill Laberge, Mary Sprayregen, Bethany Fleishman, and Peter Walke
- Research and Development / Non-emissions-based climate actions – Joe Fusco, Stu Hart, Linda McGinnis, Paul Costello, and Adam Knudsen

All subcommittee meetings were listed on the Commission's webpage and announced with the Department of Libraries to ensure the public had the opportunity to participate. The subcommittees developed their priority recommendations, and the Commission voted on them for inclusion in the report to the Governor. The Commission's preliminary recommendations and the Governor's response can be found at the Commission's website: http://anr.vermont.gov/about_us/special-topics/vermont-climate-action- commission.

Work to Develop This Report

Following submission of that report, at the January 11, 2018 Commission meeting, the Commissioners undertook a prioritization exercise to determine where to focus its remaining efforts on actions the group believed would create the most leverage for change in reducing greenhouse gas emissions or sequestering greenhouse gas from the atmosphere. These six topics were selected not because they represented all arenas in which climate action will be necessary to meet our goals, but rather those sectors where significant untapped potential exists for systemic change. In addition to this areas of consensus-based focus, the Commission recognizes that other policies and solutions will merit further consideration and pursuit by the Governor, policy makers and all Vermonters to continue to chart the path for the progress we need.

During the January 2018 meeting, the Commission agreed to focus on six priority areas:

- vehicle electrification
- building energy use
- electric grid modernization
- land use as an enabler
- the climate economy
- carbon sequestration

At the February 8, 2018 meeting, the Commission developed a full day of expert panels on those six topics to better understand what the current state and options for progress were for each topic. Following the panel presentations and discussion with the experts, the Commission determined to move forward with all but the grid modernization. The Commission determined that the grid modernization effort undertaken by the Public Utility Commission, the Public Service Department, and the distributions utilities was sufficient and that the Commission would not add significant value to that discussion. That does not reflect that the Commission is not interested in the success of grid modernization, more that we believe it will occur without our intervention. Working groups were developed for those five topics. Each working group has outlined below their efforts to outline a set of recommendations in each of the five focal areas to catalyze progress in these important sectors. It is important to note, however, that there are several important areas where the Commission chose not to focus; not because further action isn't necessary in those areas – like the strategic deployment of distributed generation – but, instead, that the Commission found it important to highlight a smaller set of actionable items to focus and spur state leadership and action in these sectors specifically.

In the intervening months, the Commission decided to expand upon vehicle electrification to include all needed action in the transportation space. Additionally, the Commission determined that smart growth was the more appropriate focus for the land use discussion. The processes undertaken by each working group is outlined below, but all working groups included outside expertise in order to broaden the perspective about action needed to address climate change.

During the spring, the working groups began briefings for the full Commission on the focus of their recommendations. The recommendations evolved during that time in response to feedback. At the May 10, 2018 meeting, the Commission asked two small groups to explore an appropriate format and presentation style for the report and to explore the issue of funding. This report incorporates the recommendations of those two groups in substance and style.

At the July 12, 2018 meeting, the Commission voted to approve the recommendations included herein. Appendix E includes how Commissioners voted.

Transportation Working Group Process

Building Energy Working Group Process

Smart Growth Working Group Process

The Smart Growth Working Group formed following the February 8th Commission meeting. At the working group's recommendation, the working group changed its focus from overall and

use to smart growth.

Smart Growth has a long history in Vermont, and the working group endeavored to reflect the significant efforts that have gone into Vermont's statewide, regional, and local planning efforts to advance the adoption and implementation of smart growth principles. Despite those efforts, the progress toward realizing smart growth has been inconsistent.

Therefore, the working group made the determination early on to focus on recommendations that would lead to the implementation of smart growth principles in Vermont communities. The working group discussed the barriers to achieve the vision that many communities have established for themselves and looked for ways to overcome those obstacles. The recommendations intentionally do not include adding to or altering existing planning requirements as we have received the feedback that communities have planning fatigue.

The Commission members on the working group received significant input and support from State agency staff and other stakeholders. The Commission members would like to thank the following individuals for supporting the work: Kevin Geiger (Two Rivers-Ottauquechee Regional Commission), Charlie Baker (Chittenden County Regional Planning Commission), Jamey Fidel (Vermont Natural Resources Council), Kate McCarthy (Vermont Natural Resources Council), Billy Coster (ANR), Jen Mojo (ANR), Chris Cochran (ACCD), Jacob Hemmerick (ACCD), Gary Holloway (ACCD), Dan Dutcher (VTrans), Tami Wuestenberg (DEC), John Austin (F&W), Tom Rogers (F&W), Jens Hilke (F&W), and Jared Ulmer (VDH).

Climate Economy Working Group Process

From the outset, the work group focused on two questions:

What are the businesses to support?

What are the public policy mechanisms that provide the most support?

The work group identified a wide range of businesses that fell into one or more of the following sectors:

- Energy efficiency goods and services
- Renewable generation
- Energy services delivery (such as electric utilities and wood fuel suppliers)

The choice among businesses identified was based on three factors

- The existence of the business sector in Vermont
- The opportunities for growth
- The impacts those companies make and could make in the future on the State's climate change strategies.

In parallel with discussions about the businesses on which to focus, the group also considered what strategy-types the Commission could recommend that would provide benefits for their

growth. A starting point in this discussion was a list of existing programs that are used as support for all types of businesses in Vermont and are often hosted at the State's Department of Economic Development. More detailed project ideas evolved when considering the individual business types that arose during the identification of businesses as described above.

As the text notes, several other work groups developed incentives and programs that strengthen the consumer contributions to business growth. (While it may not have been an explicit work group decision, the result is that we decided to focus on producer assistance by cost reduction and improved access to human and dollar capital.)

A work group voting process resulted in the identification of Clean Grid Modernization and Wood pellet manufacturing as the targets for business support activities. The work group then refined the resulting list of incentives and strategies to the two businesses.

Sequestration Working Group Process

Appendix C: Additional Information

1. Double Low-Income Weatherization through the State Weatherization Assistance Program

The Vermont Low Income Weatherization Program has the experience and capacity to work with Community Action Agencies and weatherization partners to implement grants to dramatically expand low income weatherization today. The challenge has been and continues to be funding. An increase in low-income weatherization investments made today will reduce fuel needs for the most vulnerable Vermonters, lower their energy costs, make their homes healthier, and reduce carbon emissions, thereby providing significant economic returns on up front investments. Evidence from other jurisdictions, suggest that the health-related benefits alone are several times that of the investments. One recent study valued the average health-related benefits at 3.5 times greater than the average project cost. Weatherization projects often result in improved indoor air quality and mitigation of improperly ventilated appliances, electrical and fire hazards, and other critical health and safety hazards. As resources allow, weatherization providers can also help mitigate trip and fall hazards, mold and moisture issues, lead paint hazards, and pest issues. This recommendation would meet the long waiting lists for low-income home weatherization that exist today even without outreach by the agencies, and dramatically advance affordability and protect the most vulnerable Vermonters, including children in poverty and seniors living in inadequately weatherized homes.

Weatherizing 900 additional homes implies a reduction of approximately 1.62 MtCO2e annually, or roughly 9.9 MtCO2e annually by 2025, and add roughly $10 million annually to the cost of the existing programs. The average savings per household is about $500 annually. Since the proposal represents an expansion of existing programs and activities of existing institutions, the expansion at this level can be accomplished with relative ease. Since the programs address the some of the most vulnerable segments of the market, additional benefits include less stress on other support systems supported by taxpayers, and improvements to the health and well-being of the affective households.

2. Accelerate the Adoption of Advanced Wood Heat (AWH) to Replace High-GHG Emitting Systems to Reach 30% of VT Thermal Needs by 2025 (Triple Installations)

In conjunction with sustainable forestry practice, advanced forest helps to reduce greenhouse gas emissions, reduce heating bills, improve air quality, develop local economy, and create new jobs through the forest products value chain, thereby helping sustain and manage the state's extensive forest resources. Triple AWH installations = greenhouse gas reduction of roughly 0.3 (million tons of CO2 equivalent) MMTCO2e. Calculates assume the following:

- 18,000 more residential pellet stoves (from the current 31,000)
- 5,100 more automated pellet boilers (from the current 377) ($19,000)
- 1,260 more commercial/institutional bulk pellet systems (from the current 162)
- 108 more commercial woodchip systems (from the current 61)

- At least 4 new small pellet mills to ensure the increased demand is met from locally produced pellets

Total investment assumes roughly $223 million of incremental investment ($356 million total), with roughly a third of the investment covered through incentives. Annual fuel savings are potentially substantial, but can vary with assumed oil prices and the price of wood energy. Given the uncertainties in these values it is difficult to attribute large savings, but savings are expected to cover the incremental costs of the investments the period of roughly a decade at current price levels.

The carbon reduction potential is likely in excess of 0.3 MMtCO2e annually by 2025, depending on the composition of fuels displaced and whether the wood is from sustainable sources.

Vermont's forest economy is an integral part of a regional and international market, in which product prices fluctuate with supply and demand beyond our borders. Eighty-nine percent of the sawlog volume harvested annually in Vermont is processed within the state, and this value-added local rural economy is essential for many communities and landowners. But wood moves freely through our larger, regional economy, and northern hardwoods — maple, beech, yellow birch, and more — are prized and sought---after throughout the world. Exports of sawlogs from Vermont exceed imports, but only slightly, by a 1.3 to 1 ratio.

Primary products include solid wood products from sawmills and veneer mills. These primary manufacturers employ 2,327 workers. Payroll in the wood products sector is about $67 million annually. Current annual economic output, in terms of annual sales or value of shipments, stands at $239 million.

Secondary manufacturers transform lumber and other primary solid products into finished consumer products or components for finished products. The making of furniture, moldings, turnings, and similar products employs nearly 1,600 Vermont workers. The annual payroll in this sector is about $49 million.

Annual economic output, in the form of sales or value of shipments for the secondary wood products sector, is about $143 million in Vermont.

3. Encourage Cost-Effective Investment and Customer Use of Building (Install 60,000 space and water heat pumps by 2025)

Recommendations to encouraging the technology include customer education, ratepayer incentives, rate design, and aggregation of shared access. Most of these recommendations are within the ability of the distribution utility to implement. The obligations and the form of regulation should be aligned with customer interests. The life cycle costs of these measures should not drive up overall costs of energy services for customers. The costs of these new loads should be low, even for the electric system, as these could constitute new loads, adding new margin, and offer the potential to add new services that can help integrate growth in distributed generation.

The better your building shell, the more cost-effective and efficient will be the heat pumps used in the technology. Heat pumps technology should be coupled with improvements to the building shell.

The carbon reduction potential by 2025 is roughly 0.183 MMtCO2e The investment required to install an additional 60,000 heat pumps (water and space) is substantial. The installed cost of a heat pump is roughly $2500. The installed costs of a heat pump water heater is approximately $2000 per water heater. Assuming an average cost of $2,250, the total cost of investment would be $135 million over a period of 6 years. Annual fuel savings would be roughly $54 million annually (for all 60,000). The technology is now relatively mature and an installation network is now widespread with trained and certified installers. Additional incentives provided through rate design or up front payments would be relatively easy given the years of experience that utilities, including Efficiency Vermont, have with these programs.

4. Adopt and Implement a Roadmap for All New Buildings to be Net Zero by 2030

This recommendation would take very little investment to implement. The PSD has already budgeted federal funds to develop the road map. Remaining investments would be by the building owner/developer when constructing these buildings, which would largely be offset by lower operational costs for the building. These buildings would also have less exposure to volatile fuel prices. This provides for long-term affordability.

The State has already made progress in this direction having adopted standards to meet high energy efficiency performance in new State-owned buildings and moving away from fossil fuel heating. Several other states have also developed or are developing goals for net-zero designed homes.

For purposes of the calculated emissions, savings and investments, calculations assumed that investment resulted from efficiency improvements of 10% per update over two update cycles and that the investment required could be achieved at a return of 8 years or better, as has been achieved in past updates. Roughly 10 MtCO2e reduction is achieved by 2025 with annual energy savings of roughly $3 million annual. Total investment required to achieve these savings are roughly $24 million.

5. Increase Building Energy Labeling in Vermont to Make Building Energy Use More Visible

A residential building energy label, called the Vermont Home Energy Profile (VHEP), has already been developed. The VHEP includes an asset-based total MMBtu/year projected energy consumption score; projected energy costs by fuel type; and a general description of the home. An asset-based score was chosen to allow for consistent comparisons, regardless of who had previously lived in the house and how they had operated it. Projected energy costs were chosen, as that is a measure that homeowners can easily understand.

Commercial buildings can be benchmarked with EPA's free ENERGY STAR Portfolio Manager (ESPM) tool, which utilizes operational energy consumption data, with energy use intensity (EUI, measured in kBtu/square foot/year) as the primary metric. ESPM can also generate a building energy label.

One purpose of labeling is to allow the comparison of similar buildings and eventually the valuing of energy improvements in appraisals. For this to happen a volume of labels would need to be generated to have enough for comparison. To date approximately 300 Home Energy Profiles have been generated. The data needed to generate a label is also collected during energy assessments performed through the Energy Efficiency Utility weatherization programs and the State's low-income Home Weatherization Assistance Program, but labels aren't typically generated through these programs. Approximately, 2,000 housing units are served through these programs annually. The necessary data is also collected when buildings are being constructed for the Building Energy Standards certificates. Approximately 1,000 homes and 200 commercial buildings are constructed annually.

Tracking energy usage in buildings is an important first step toward reducing energy consumption and associated costs. Benchmarking helps building owners and managers make informed decisions about energy investments, especially in the public and commercial sectors where facilities managers can control large amounts of energy usage.

On average, buildings which are consistently benchmarked reduce their energy consumption by approximately 2.4% each year (Source: EPA). According to a survey of facility managers, those that benchmark their properties are more likely to make energy efficiency improvements than those that don't benchmark. Research suggests that buildings which undergo the benchmarking process and achieve an energy efficient certification—such as ENERGY STAR—are valued accordingly by the market and obtain higher rents, sale values, occupancy rates, productivity rates, and operational savings. Building energy usage disclosure ordinances have unquestionably spurred the creation of building construction and energy service job in municipalities where these ordinances are already in effect. Money invested in energy efficiency stays within the local economy, rather than flowing to foreign regions for harvesting of their fossil fuels. (www.neep.org)

This recommendation would require little to no additional investment as the data required for the labels will be gathered through the normal course of business by the existing efficiency programs or builders/architects (in the case of new construction).

If Vermont were to enact a benchmarking ordinance for commercial buildings, the level of investment would be spread across stakeholders in the form of staff time and commitment. Northeast Energy Efficiency Partnerships (NEEP) has provided a case study on the recent benchmarking ordinance in South Portland, Maine that provides an overview of what this might entail. (www.neep.org)

6. Increase Low-to-Moderate Income Homes Weatherized Through the Energy Efficiency Utility Programs

Although the State Weatherization Assistance Program can serve low-income households up to 80% of median income, households up to 60% of median income are prioritized leaving most households between 60-80% of median income unserved. Additionally, there are not services or incentives targeted to the 80-120% low/moderate income households. This gap of vulnerable Vermonters who need significant assistance to complete weatherization projects need to be served. Tiered incentives can be used to buy down the cost of loans. This recommendation

would target increased resources to this population to help fill the gap of service to this population by reallocation of existing energy efficiency program resources and direct recently approved State Treasurer funds for low-interest loans to serve this population.

The program costs assume that $5 million annually of public funds can be raised at the public cost of capital of about 2.5%. The practical effect of the use of public funds is to double the number of low to moderate income households that gain access to low cost capital, due to the cheaper cost of public versus private capitals. The State funds, however, are fully repaid. Over 5 years $25 million in State funds would leverage an additional $25 million in private capital to double the level of deep retrofits. Approximately 8 MtCO2e could be achieved annually from 2025 (assuming 5 years of investment) reaching an additional 922 homes annually. Total savings per household would be approximately $522 for total annual savings of $2.4 million. Once funds are committed, the program amounts to an expansion of existing programs and can be achieved with relative ease.

Estimated savings by 2025 are about $0.33 million, on a customer investment of $2.5 million with an annual carbon reduction of about 1 MtCO2e annually. The ease of implementation is likely to be easy given that the data needed to collect these assessments is routinely collected today.

7. Expand Vermont's State Energy Management Program to serve Municipalities, Universities, Schools and Hospitals.

Institutions lend themselves to investment by Energy Service Companies ("ESCOs") through energy performance contracting ("EPC"). The characteristics of MUSH institutions include relative stability of their services and energy requirements, long investment horizons, and low cost of capital. The ESCO industry is an estimated $7 billion market in the US that has reliably partnered to provide $55 billion of guaranteed and verified savings since 1990. About 80-85% of the industry is focused on MUSH and federal customers.

8-10, 13-14, 16-19 Additional Information Related to EVs and Charging Infrastructure

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 greenhouse gas in the next 8 years. (See Graph - EAN Top 10 Driver's to Vermont's 2025 Milestones.) 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 s 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.)

35-44 Additional Information Related to Carbon Sequestration

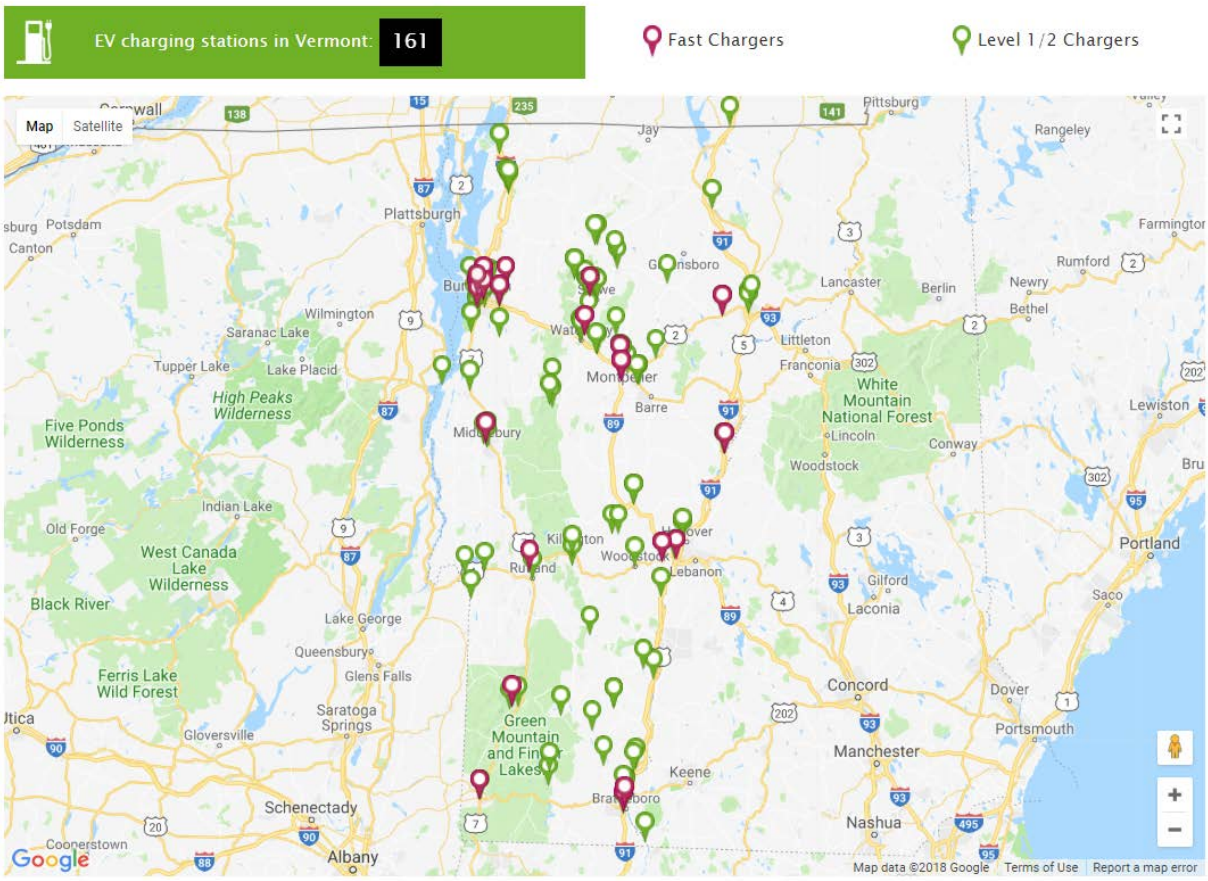
Even small changes in the soil carbon pool have large-scale effects both on agricultural productivity and on the greenhouse gas balance. Maintaining carbon-rich soils, restoring and improving degraded agricultural lands and, more generally, increasing soil carbon, play an important role in addressing the three-fold challenge of food security, adaptation of food systems and people to climate change, and mitigation of anthropogenic emissions. According to the "4 by 1000" initiative—launched by participants during the 2015 COP 21 in Paris-- a**n annual growth rate of 0.4% in the soil carbon stocks, or 4‰ per year, would halt the increase in atmospheric CO2 concentration stemming from human activities.**

Growing plants and trees are the most fundamental way we "capture" CO_2 from our atmosphere. Plants breathe in carbon dioxide and through photosynthesis, convert a portion of the carbon to plant biomass, both above and below ground. << insert graphic of some kind here >> The science around carbon sequestration in soils is complex, yet research points clearly to two important principals. First, reducing soil disturbance keeps existing soil carbon in the soil. Second, while we have lost much of our agricultural soil carbon through 100 years of cropping, that loss can be reversed by adopting a reasonable set of conservation practices. In the temperate regions, estimates suggest such practices can add a ton of sequestered carbon per acre per year, on the average, for 10 to 20 years. Some soils can add more, and some have a lower sequestration potential. Generally, the moist soils of the northeast are better able to sequester carbon than the arid conditions of the west. With an estimated one-third of the arable land in agriculture globally, it is critical that we find ways to increase soil carbon in agricultural systems.

Farmers in Vermont manage 1.25 million acres of land, impacting 20% of the total land in the state. About half of that land is in active crop production including nearly 100,000 acres of corn, soybeans, cereal grains and vegetables; 338,000 acres of hay for livestock feed and biomass crops for bedding and mulch; 139,000 acres of permanent pasture. The rest is over 500,000 acres of farmer woodlots plus farmsteads and undeveloped land (USDA NASS, 2016). In 2016, a total of $776 M of all agriculture products were sold including $505 M from milk sales.
Over the past decade, educators, service providers, and partners in the agricultural community have worked closely with farmers to increase the use of conservation practices largely for their water quality benefits.[9] Cover cropping helps keep soil in place, reduces moisture stress,

[9] Cover crops are grass or grain seeded either during the growing season or after harvesting of an annual crop, usually corn. Cover crops decrease the potential for erosion of bare soil during the non-growing months, while increasing soil health, organic

increases soil organic matter, and adds nitrogen and other nutrients. Pasture management, including rotational grazing and adding compost, increases productivity, soil carbon and plant diversity. Careful nutrient management reduces run-off and fertilizer expense and can curb greenhouse gas emissions from soils in the form of nitrous oxide, while also reducing costs. Beside the water quality benefits, these practices increase soil resilience, maintain or enhance productivity, sequester carbon in soil, and in many cases, reduce the emission of greenhouse gasses.



Charging Stations: There are around 160 public charging stations currently in Vermont (see DEV Map of EV Charging Stations in Vermont), but:

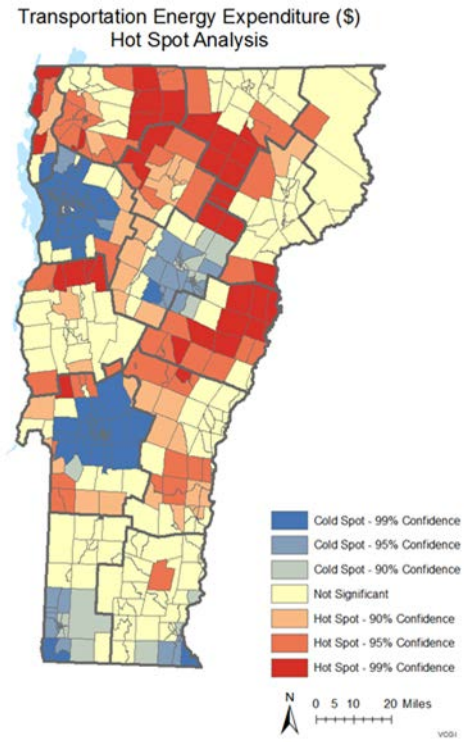
- If we project increasing from 2,500 to 45,000-55,000 EVs by 2025, we need to ensure sufficient charging infrastructure to meet the demand.
- Public charging stations do not reach all parts of Vermont, and many regions are left without any access to public charging stations at all.
- Very few public charging stations are fast-charging; the State lacks an adequate charging network for through travelers.

matter and nutrients. Reduced tillage is a practice that minimizes soil disturbance and allows crop residue or stubble to stay on the soil. The cover residues (often in conjunction with a cover crop) protect the soil from erosion, and the soil structure and health are improved by avoiding annual plowing and heavy machinery. Cover crops are now used on about a third of the corn acres, and are required on some fields as part of the State's Required Agricultural Practices.

- 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 greenhouse gas.

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.

11-12 Additional Information Related to 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 greenhouse gas and overall energy consumed and increasing the portion of renewably powered transportation. Additionally, by providing more public transportation options to rural Vermonters, we can reduce overall Single Occupancy Vehicle (SOV) use, thereby further reducing greenhouse gas 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 transit 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 transit 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 greenhouse gas, 445 metric tons of CO2, nearly 300 lbs of CO, and 628 lbs of NOx. 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.

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 greenhouse gas 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 electric school buses potentially useful as an electricity storage resource as vehicle to grid technology matures.

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 or 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.

29. Leverage Health Care Partnerships

Metric assumptions:

The greenhouse gas Impact of Medium was based on the Energy Action Network (EAN)-estimated 152 MTCO2E reduction associated with reducing single-occupancy commuter trips from 82% to 65% by 2025, which is roughly equivalent to the Comprehensive Energy Plan (CEP) target of reducing single-occupancy commute trips by 20% from 2011 to 2030. This estimate was then rounded down to acknowledge that the health sector is only one of many partners that need to contribute to achieving that goal.

The Savings Impact of High was based on the finding from an ongoing health impact assessment by the Health Department, where it was estimated that participation in an employer transportation benefits program would reduce single occupant vehicle use by 18%, resulting in $240 in annual health benefits per commuter per year associated with increased physical activity, reduced motor vehicle collisions, and improved air quality. If this 18% single-occupant vehicle use reduction was achieved by all 319,484 workers 16 years and older in Vermont (which is similar to the EAN and CEP targets), the aggregate health benefit would be over $75 million per year.

The Investment Needed of Medium was based on the very low/no cost for actions 4 & 5, low cost for action 2, and the potentially high cost for actions 1 & 3 to support the programs and infrastructure necessary to increase active and healthy living. Because the expected savings are related to improved health and reduced health care expenditures, mechanisms should be explored for investing health sector funds towards community smart growth and transportation strategies that provide health benefits.

The Ease of Medium was based on the fact that all of the recommended actions are already occurring to some extent, though the scope and scale of each could be expanded. For the no/low cost actions (2, 4, & 5), there are minimal barriers to completing these actions. For the potentially high cost actions (1 & 3), increasing the financial investment may be challenging, and could require developing innovative new funding or administrative mechanisms.

31. Targeted Land Conservation:

Savings figures are based on impact functioning ecosystems can have on flood protection. Watson et al. evaluated the flood prevention savings of one wetland complex in Middlebury, VT on Otter Creek. They estimate the wetland provided annual flood savings of at least $126,000.

While this cannot be extrapolated across the state, it does provide an indication of the value of functioning, non-impacted ecosystems on flood storage and prevention.[10]

55. Support for Free Legal Services to New Climate Economy Entrepreneurs

In September, 2018, Vermont Law School will launch a new Entrepreneurship and Legal Laboratory (VLSell). This program will eliminate barriers to growth for early-stage companies in Vermont by providing low-cost or pro bono legal services. Legal services will be rendered by students, supervised by experienced legal practitioners. This program meets a need that all new and expanding businesses share, particularly businesses in the new climate economy sector who face complex legal challenges. This Sub-Committee recommends $50,000 in funding support for the VLSell to provide low-cost and pro bono legal services to start-up businesses in the clean technology, energy, and grid modernization sectors. This funding will allow the Program to specifically assist businesses in these sectors, addressing one of the critical barriers to growth that they face.

[10] Keri B. Watson, Taylor Ricketts, Gillian Galford, Stephen Polasky, Jarlath O'Niel-Dunne, Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT, Ecological Economics, Volume 130, 2016, Pages 16-24, https://doi.org/10.1016/j.ecolecon.2016.05.015.

Appendix D: Acronym List

ACCD	Vermont Agency of Commerce and Community Development
ANR	Vermont Agency of Natural Resources
AWH	Advanced Wood Heat
BGS	Department of Buildings and General Services
CATMA	Chittenden Area Transportation Management Association
CCRPC	Chittenden County RPC
CEDF	Clean Energy Development Fund
CEFC	Clean Energy Finance Collaborative
CO_2E	Carbon Dioxide Equivalent
DEC	Vermont Department of Environmental Conservation
DEV	Drive Electric Vermont
DFW	Vermont Department of Fish and Wildlife
DU	Distribution Utility
EEU	Energy Efficiency Utility
EVSE	Electric Vehicle Support Equipment
FPR	Vermont Department of Forests, Parks, and Recreation
GHG	Greenhouse gas
NESCAUM	Northeast States for Coordinated Air Use Management
NGO	Non-governmental organization
NRB	Vermont Natural Resources Board (Act 250)
OEO	Office of Economic Opportunity in the Department of Children and Families
PSD	Vermont Public Service Department
PUC	Vermont Public Utility Commission
RDC	Regional Development Corporations
RGGI	Regional Greenhouse Gas Initiative
RPC	Regional Planning Commission

SEMP	State Energy Management Program
TOD	Transit-Oriented Development
VAPDA	Vermont Association of Planning and Development Agencies
VCAC	Vermont Climate Action Commission
VCGI	Vermont Center for Geographic Information
VDH	Vermont Department of Health
VECAN	Vermont Energy and Climate Action Network
VEGI	Vermont Economic Growth Incentive
VEM	Vermont Emergency Management
VLCT	Vermont League of Cities and Towns
VMT	Vehicle Miles Traveled
VNRC	Vermont Natural Resources Council
VPTA	Vermont Public Transportation Association
VSAC	Vermont Student Assistance Corporation\
VSC	Vermont State Colleges
VTCCC	Vermont Clean Cities Coalition
VTrans	Vermont Agency of Transportation
VW	Volkswagen

Appendix E: Commission Voting Record