

Appendix 12

Pathway, Strategy, and Action Matrices

Appendix 12 contains the pathways, strategies, and actions discussed in the Cross-Sector Mitigation subcommittee during the development of the Initial Climate Action Plan (CAP). Actions were prioritized using the framework outlined in Appendix 5. Appendix 12 includes all the recommendations subcommittees discussed, regardless of whether they were included in the narrative of the Climate Action Plan.

All actions listed in the matrices not included in the final CAP narrative were discussed and important to be listed by the subcommittees but may not have full consent of all members of the Subcommittee. Specifically, actions that were not prioritized for inclusion in the CAP may or not enjoy consensus approval but were not advanced at this time due to the parameters imposed by the prioritization framework. See Appendix 5 for more details on the prioritization framework.

Transportation Emissions Mitigation Pathways, Strategies and Actions					Guiding Principles										
#	Sector	Pathway	Strategies	Actions	Equity Considerations	Impact	Impact Notes	Cost Effectiveness	Cost Effectiveness Notes	Co-Benefits	Co-Benefits Notes	Technical Feasibility	Overall Priority Ranking		
1	Transportation	Electrification (Light-duty fleet)	EV Purchase Incentives	Fund incentives for and further administration of the Incentive Program for New Plug-in Electric Vehicles (PEVs), MileageSmart, Replace Your Ride Incentive Program and Electric Bike Incentive Program. New PEV is currently being administered by DEV and utilities, and VTrans is planning to procure an administrator for three of the aforementioned programs, except Mileage Smart which is being administered by Capstone Community Action. Amend program parameters (incentive amounts, income threshold requirements, etc.) based on analysis of current program, consumer data and the anticipated scale of need correlated to this and corresponding recommendations. Specifically, expand EV incentives; fund used EV vehicle incentives, determine the dollar amounts and makeup of purchase incentive needed to achieve EV deployment and equity goals, such as, if incentives are tiered, create income tiers instead of vehicle price tiers. Include eligibility for business and municipal fleet EV purchases. Maximize existing revenue streams, maximize American Rescue Plan Act and other potential federal funding streams to expand these programs and determine long term funding source(s) as needed.	The program will prioritize low and moderate-income families, as it does now. This goal and implementing program elements will be examined, adjusted and potentially increased as needed in the future to ensure broad, equitable access and participation.										
2					Design and implement a vehicle efficiency price adjustment linked to new vehicle purchase and use tax within vehicle classes to incentivize purchase of more efficient vehicles (electric vehicles in particular) and disincentivize purchase of less efficient vehicles. Factor income and business use into the rate for potential fee relief. Determine how to best integrate this program with the purchase incentives implemented in complimentary actions.	The program is limited to new car purchases and can be designed to exempt certain income levels and purchasers who require a certain class of vehicle for business and commercial use for which there may be no cost-effective, comparable, available alternative. Also, higher income earning Vermonters are the primary purchasers of new vehicles. This program's singular focus on new vehicle purchases is intended to help address equity considerations. For Vermonters who require new vehicles for business use, it will be important to consider and potentially exempt any purchase for such purposes from the program.									
3				Lead by Example (State Procurement)	Require all state fleet light-duty vehicle purchases to be electric by MY20XX.										
4					Fund further build-out of DCFC (Level 3) and Level 2 EVSE based on the EVSE Deployment Plan developed by Drive Electric Vermont pursuant to VTrans' Multipronged Vehicle Electrification Strategy and continue to coordinate regional efforts. Incorporate prioritization of multi-family and workplace charging availability, such as equity principles and environmental justice mapping tools into implementation of program and funding decisions.	The state will work with local public and private partners to improve EVSE accessibility for multi-family properties, rental property dwellers, and Vermonters living in rural areas.	High	Electrification of the light-duty fleet will have a high GHG reduction impact based on emissions reductions shown in the LEAP mitigation modeling work. The initiatives contained within this pathway are enabling actions to achieve the EV adoption levels necessary to meet the required GHG reduction goals. The technology forcing regulation (ACCI) requires increasing numbers of EVs to be delivered for sale in Vermont. Financial point of sale incentives enable and encourage the purchase of the delivered electric vehicles and should be designed (or redesigned) with a focus on equity and the incorporation of used EVs into the program. The electric vehicle supply equipment action will enable the necessary infrastructure to support this higher level of EV adoption and the beneficial EV specific charging rate will be an additional incentive to spur EV adoption in the form of fuel cost savings, and will have the added benefit of allowing for managed charging by distribution utilities. The TCI-P will be the critical umbrella program that will provide the funding required to implement all of these priority actions necessary to achieve the overall need of light-duty vehicle electrification.	High	Cost effectiveness of electrifying the light-duty fleet was shown to be high in the LEAP modeling results.	High	Light-duty electrification is a strategy that can easily be communicated with broad and varied benefits to Vermonters and Vermont itself. There are significant benefits related to reductions in criteria pollutants that will have health benefits for Vermonters from the electrification of vehicles. Electrification substitutes one technology with another with the same relative convenience as compared to mode switching assuming public charging, price challenges for low and moderate income families, and the need for AWD and light duty trucks models are addressed	Yes	High	
5				Public Investment in Electric Vehicle Supply Equipment	Direct the PUC to work with electric utilities in developing beneficial EV charging electricity rates and alternative demand charge rate designs for low utilization, high power charging locations.	EV specific charging rates would be available to all Vermonters and, if based upon shared savings for load control, lower costs for all customers. Having this additional financial incentive to help reduce overall vehicle costs for the consumer would be another factor to help overcome the currently higher upfront cost of EVs and allow for greater access to the EV market for everyone.									
6				Technology forcing regulatory programs	Adopt California Air Resources Board Advanced Clean Cars II Regulations beginning no later than Model Year 2026, which includes, as proposed, a 100% ZEV sales requirement by 2035, more stringent criteria pollutant emissions standards, robust vehicle durability standard, warranty provisions, battery state of health standardization, battery labeling, and availability of repair information to independent repair shops.	Vehicle manufacturers may have the ability to earn credits towards compliance with ACC II by implementing equity-focused projects. Vermonters will benefit from a more mature market delivering at economies of scale. Increasing the availability and overall number of EVs generally will also help significantly drive down the cost of EVs over time and accelerate and expand the used EV market in Vermont, enabling increased consumer access to EVs.									
7				Educate student drivers on benefits of electrification and other transportation options to reduce VMT	Fund implementation and further enhancement of a unit within Vermont's driver education curriculum to educate student drivers about electric and high efficiency transportation options, as well as how to reduce VMT via use of other transportation options.	Education opportunities will be made available at no cost and will be integrated into existing driver education requirements for ease of access. EV education, information and buyer assistance support – including via Drive Electric Vermont or otherwise – will be translated to ensure non-English speakers can access the information.									
8				Participate in carbon market for transportation fuels	Join the Transportation and Climate Initiative Program, when regional market viability exists; adopt rules to participate in the TCI program starting in 2023. Enact a complementary policy that goes further to ensure equity outcomes (consider a firewalled fund, establish an expanded equity board, direct a minimum/significant investment in LI, rural, overburdened and underserved communities, e.g. 70%) and have funds go to transportation related or efficient transportation enabling investments.	The TCI-P MOU requires a 35 percent minimum investment in low income, overburdened communities and the creation of an Equity Advisory Body. To go further to ensure better process and equity outcomes, there is also a bill being drafted for introduction in the 2022 legislative session that will require a yearly review by a broad stakeholder group and substantially more TCI-P revenues directed to low income, rural, historically disadvantaged communities.									
9					Adopt California Air Resources Board Advanced Clean Trucks Rule (an increasing percent ZEV sales requirement for manufacturers), Low Nox Omnibus Rule (includes a more stringent NOx emission standard and lengthened useful life and warranty), and Phase II GHG Rule for Truck Trailers beginning no later than Model Year 2025. Fund incentives for medium and heavy duty electric fleet purchases.	Reductions in these emissions through electrification would benefit communities that are disproportionately impacted by poor air quality related to transportation emissions.									
10				Electrification (Heavy-duty fleet)	Technology forcing regulatory programs	Adopt California Air Resources Board Advanced Clean Fleets (an increasing percent ZEV purchase requirement for fleets) and Innovative Clean Transit Rules (requiring all public transit agencies to transition to a 100% zero emission bus fleet by 2040) following feasibility analysis by ANR. This would 1) require public fleets to purchase ZEVs when they make new purchases; 2) require high-priority (any entity with \$50 million or more in gross annual revenue, or any broker or other fleet owner that in combination owns, operates, or dispatches vehicles under common ownership and control that totals 50 or more vehicles) and federal fleets to meet ZEV targets as a percentage of the total fleet starting with vehicle types that are most suitable for electrification; and 3) set a 100% new medium- and heavy-duty vehicle ZEV sales requirement starting in 2040. This would also require, depending on the transit agency size, 25% of total new transit bus purchases to be ZEVs by 2025/2026 and 100% by 2029. This must include funding incentives for medium and heavy duty electric fleet purchases.	Electrification of the heavy-duty fleet will have a high GHG reduction impact based on emissions reductions shown in the LEAP mitigation modeling work. The initiatives contained within this pathway are enabling actions to achieve the EV adoption levels necessary to meet the required GHG reduction goals. The technology forcing regulations (ACT and ACF) require increasing numbers of				Cost effectiveness of electrifying the heavy-duty fleet was shown to be high in the LEAP modeling results.		Heavy-duty electrification is a strategy that can more easily communicated with broad		

Transportation

11	Transportation	duty fleet)		Fund programs that incentivize electric auxiliary systems, such as (but not limited to) hybrid-electric bucket trucks and electric transport refrigeration units.	Reductions in these emissions through electrification would benefit communities that are disproportionately impacted by poor air quality related to transportation emissions.	High	medium and heavy-duty EVs to be delivered for sale and purchased in Vermont. Financial point of sale incentives enable and encourage the purchase of the delivered electric vehicles and should be designed (or redesigned) with a focus on equity and the incorporation of used EVs into the program. The TCI-P will be the critical umbrella program that will provide the funding required to implement all of these priority actions necessary to achieve the overall need of heavy-duty vehicle electrification.	Medium	There is additional uncertainty in this vehicle weight class given the generally higher incremental cost, associated EVSE cost and electricity needs, as well as emerging technology issues.	High	and varied benefits to Vermonters and Vermont itself. There are significant benefits related to reductions in criteria pollutants that will have health benefits for Vermonters from the electrification of vehicles and heavy duty vehicles specifically because they burn diesel fuel.	Yes	High					
12			Electrify MHD vehicle auxiliary systems	Fund programs that incentivize installation of electrified parking spaces in truck loading/unloading zones.														
13			Participate in carbon market for transportation fuels	Join the Transportation and Climate Initiative Program, when regional market viability exists; adopt rules to participate in the TCI program starting in 2023. Enact a complementary policy that goes further to ensure equity outcomes (consider a firewalled fund, establish an expanded equity board, direct a minimum/significant investment in LI, rural, overburdened and underserved communities, e.g. 70%) and have funds go to transportation related or efficient transportation enabling investments.														
14		Reduce VMT		Work to achieve the state's land use goals	Direct federal funds to downtowns, village centers and other areas with the density and mix of use suitable for transit, walking and biking and other non car dependent modes. <i>(This and other needed land use and smart growth strategies to be further informed by and coordinated with the work of the RR+A and A+E subcommittees as well as the cross cutting group.)</i>	The TCI-P MOU requires a 35 percent minimum investment in low income, overburdened communities and the creation of an Equity Advisory Body. To go further to ensure better process and equity outcomes, there is also a bill being drafted for introduction in the 2022 legislative session that will require a yearly review by a broad stakeholder group and substantially more TCI-P revenues directed to low income, rural, historically disadvantaged communities.												
15				Increase state, regional and local capacity to implement sustainable transportation strategies	Require VTrans, in coordination with the Climate Council and legislative committees of jurisdiction, to develop a state sustainable transportation implementation plan to include: 1) Identification of VMT benefits of Smart Growth, 2) VMT reduction targets, 3) Determination of the appropriate level of investment across transportation modes to achieve short and long-term goals and funding necessary to achieve those goals, 4) Support of RPCs and municipalities to develop local and regional transportation planning. Plan should incorporate recommendations from UVM Transportation Research Center's and Transportation for America/State Smart Transportation Initiative's analyses, respectively.													
16				Increase walking and biking	As a core component of developing a state sustainable transportation implementation plan, require VTrans to develop a multi-year plan to increase availability and use of transit and micro-transit to achieve a more robust, integrated public transportation system.													
17				Increase the availability and use of public transportation	Extend fare-free transit to all public transit users.													
18					Fund and expand the state's Complete Streets, trails, and other bike/ped funding programs.													
19					Continue and expand the state's commitment to Amtrak and inter-city bus service, including micro-transit													
20					Continue state efforts to expand broadband and better understand and realize the VMT/emissions reductions benefits of remote work/school/tele health.													
21		Lower carbon intensity of fuels/fuel switching		Participate in carbon market for transportation fuels	Join the Transportation and Climate Initiative Program when regional market viability exists; adopt rules to participate in the TCI program starting in 2023. Enact a complementary policy that goes further to ensure equity outcomes (consider a firewalled fund, establish an expanded equity board, direct a minimum/significant investment in LI, rural, overburdened and underserved communities, e.g. 70%) and have funds go to transportation related or efficient transportation enabling investments.	The TCI-P MOU requires a 35 percent minimum investment in low income, overburdened communities and the creation of an Equity Advisory Body. To go further to ensure better process and equity outcomes, there is also a bill being drafted for introduction in the 2022 legislative session that will require a yearly review by a broad stakeholder group and substantially more TCI-P revenues directed to low income, rural, historically disadvantaged communities.	High	TCI-P will be the critical umbrella program that will provide the funding required to implement numerous high priority actions in the Climate Action Plan necessary to achieve the required emissions reductions. Beyond the critical revenues TCI will raise, the "cap" component of the program is anticipated to reduce GHG emissions by approximately 25 percent from 2023 to 2032.	High	The cost-effectiveness of TCI-P will depend upon the actions and initiatives funded by the program, but would likely be high given the prioritization of cost-effective mitigation actions.	High	The co-benefits of TCI-P will be the actions and initiatives funded by the program, but would likely be high given the prioritization of cost-effective mitigation actions.	Yes	High				
22				Lower carbon intensity of fuels sold and used in on and off road vehicles	Determine feasibility, emissions impact and potential economic benefits of adopting a Low Carbon Fuel Standard in Vermont and regionally.										Low	Low	Low	Low
23		Increase vehicle efficiency		Public Investment in high-efficiency vehicle replacement programs	Further fund and implement the Replace Your Ride purchase incentives, which can be accessed in combination with programs like Mileage Smart.	These programs prioritize and/or limit eligibility to low-income individuals and families. These programs also improve access to more fuel-efficient vehicles for low-income families, helping to reduce household energy burdens.	Low	Included in LD electrification Pathway above.	Low		Low		Yes	Low				
24	Reduction in idling of vehicles			Amend idling law to increase stringency and penalties for idling of vehicles (all weight classes) and expand enforcement authority to other agencies. Explore options for incentivizing the reporting of idling violations. Expand anti-idling technology incentive programs to apply to all vehicle weight classes where feasible.	Low										Low	Low	Yes	Low
25				For light- and medium-duty emergency vehicles (police, sheriff, fire, etc.) require the purchase and use of idle reduction technologies to decrease the need to idle when emergency lights and/or computer systems are needed.	Low										Low	Low	Yes	
26				Require automatic start-stop technology for all state and municipal fleet purchases of internal combustion engine light- and medium-duty vehicles.	Low										Low	Low	Yes	
27	Effective administration and coordination of climate change programs and policy	Increase state government and community partner capacity	Create a climate director position in the executive branch that leads an interagency entity charged with collecting and analyzing data, planning and overseeing program implementation to assist the Climate Council planning and achievement of the GWSA's mandated requirements over time. Expand state government capacity to support integrated climate work through the creation of X number of new positions.	Reductions in these emissions through electrification would benefit communities that are disproportionately impacted by poor air quality.	Low	Low	Not applicable to emissions reductions specifically, but an action that will enable the implementation of the actions and programs necessary to achieve the required reductions.	High	Low				Low					

Buildings/Thermal Energy Emissions Mitigation Pathways, Strategies, Actions																							
Sector	Pathway	2025 Goal / Metric	2030 Goal / Metric	Importance to 2050	Strategies	Actions	Ready to Implement Now (Y/N)?	Estimated Timeline to Implement	Other Implementation Considerations	Overall Prioritization	GHG Reductions (or net GHG emissions) 2025	Consistency with Guiding Principles	Equity Considerations*	Non-GHG Benefit/Impact	Technical Feasibility**	Cost & funding needs	GHG Reductions (or net GHG emissions) in 2030	Lead implementer	Key Stakeholders				
Buildings/Thermal Energy	Pathway 1 – Reduce building-related carbon emissions by improving their energy efficiency.	25% reduction in building energy use from 2018 baseline by 2030, consistent with 120,000 additional weatherized buildings beyond current levels (approx. 30,000 "reads" confirmation from Cadmus)	25% reduction in building energy use from 2018 baseline by 2030, consistent with 120,000 additional weatherized buildings beyond current levels (approx. 30,000 "reads" confirmation from Cadmus)	High	1 - Develop and implement multi-year statewide "Weatherization at Scale" initiative	Administrative decisions could speed up the implementation of related programs. For example, one of various organizations delivering counseling services (Action #3) could be designated as the lead organization for providing that service, and could, in turn, support the various other organizations providing the same service. Current Wx funding comes, e.g., from forward capacity rate (FCM) payments and Regional Greenhouse Gas Initiative allowance revenue sales. FCM revenues are expected to decrease; RGGI funds will increase but are still a fraction of the needed support. Increased funding commensurate with the scale of Wx needed, therefore is a key element that needs to be addressed. Potential sources include federal funding (e.g., pending Infrastructure (II) ARPA), USACE Report recommended funding, Clean Heat Standard, general fund, and bonding, recommended by Climate Economy Action Team.	HWG results expected October 2021			High	TBD based on meeting overall Wx goals	Likely to be determined "consistent," due to the focus being on medium and low income Vermonters (i.e., those Vermonters earning less than 120% of annual medium income). Still, TBD once equity consultant reviews.	Focus of Wx at Scale is on making investments to improve the housing of moderate- and low-income Vermonters.	TBD based on GHG reductions provided by overall Wx activities	While VT has extensive experience delivering Wx services, lack of funding is the fundamental barrier to delivering the scale of Wx called for to meet GHG goals. Implementing weatherization at scale is technically feasible; weatherization is currently implemented by Vermont utilities, Efficiency Vermont, Capstone agencies and others.	VT's housing stock is dominated by homes built before 1975, with over a quarter of them built before 1935. These buildings produce over a third of the state's GHG emissions and represent roughly 35 percent of our energy expenditures. Thermal modernization of our buildings is a key to reducing GHG emissions and doing so in a way that recognizes the economic challenges faced by the most vulnerable Vermonters in keeping homes heated and comfortable. With a focus on the most burdened households, Vermont can begin to address its climate challenges and pair up clean fuel options and weatherization programs to deliver comprehensive low-carbon building solutions. While a central goal of the GWSA is to reduce GHG emissions, it will be critical to understand the effects of various GHG reduction policies on all Vermonters, especially those who struggle with the costs associated with housing and energy use. On average, Vermonters spend about 10 percent of their income – roughly \$5,800 annually on energy expenses. However, the actual burden that Vermonters face – their spending relative to their household income – ranges statewide from 6% to as much as 20%. When one considers the cost of housing and energy, Vermonters face an even greater challenge. According to the Vermont Housing Finance Agency, over 35% of all Vermont households (90,000) in the state are "cost-burdened" by their housing costs, meaning that either rent or mortgage, insurance, taxes and utilities consume at least 30% of their income. Furthermore, of these cost-burdened Vermont households, over a third (39,000) spend in excess of 50% of their income for housing. A quarter (30,000) of Vermont's roughly 330,000 homes are used or intended for renters. Chittenden County has the highest rate (34%) of rental housing in the state. While the median construction year for owned homes in Vermont is mid-1970s, Vermont rental housing is significantly older. The median year built for rental homes is 1964. In addition to the number of relatively old rental properties, 80% of the Vermonters that rent are categorized as low-income, according to Efficiency Vermont and the Vermont Housing Finance Agency. One quarter of all renters pay between 30-49% of their income for housing, and another quarter pays 50% or more of their income for housing and energy. Global Warming Solutions Act buildings policies will need to incorporate social equity into recommendations to minimize adverse effects on low-income households and those most burdened by high energy bills.	TBD pending Cadmus/VEF analysis	Vermont utilities, Efficiency Vermont, Capstone agencies and others.	The Department of Public Service, and other consumer advocates				
						3 - Encourage utilities to develop and submit tariff on-bill financing proposals to fund efficiency investments to the Public Utilities Commission for review and approval pursuant to 30 V.S.A. 209	Utility TOBF pilots will be underway by Q1 2022	Need to review results of TOBF pilots after, e.g., 6 or 12 mos.	High	TBD based on meeting overall Wx goals	Policy would enable renters and landlords to make efficiency improvements without taking on financial liability to a lender.	Program design should incorporate sufficient education to ensure that burdens & benefits are clearly understood by participants.	As with other building-related efficiency measures, tenants should expect to experience significant non-GHG reduction benefits. These would include but not be limited to greater comfort, reduced exposure to indoor air pollution associated with the combustion of fossil appliances, and other public health benefits.	TOBF is designed precisely for the purpose of helping participants overcome the initial costs of efficiency investments. TOBF requires an initial source of capital for investments and then relies on a subsequent stream of funding to reimburse the initial capital outlay. Nationally, Coops have been successful at this approach due to their low cost of capital.	The Department of Public Service, and other consumer advocates								
						4 - Administration appoints lead agency to coordinate government workforce development efforts to avoid qualification of effort across state government	Starting in 2022	GWSA targets demand increases in home weatherization from the current rate of 2,000 to 2,500 homes a year in 2020 to 11,000 homes weatherized annually by 2025 and 11,400 weatherized annually by 2030.	Med/High	TBD based on meeting overall Wx goals	Several organizations in Vermont currently offer counseling services. Efficiency Vermont's program may be a larger scale than other counseling services currently being offered by other utilities and organizations. Designating one organization as a lead organization for providing that service could focus the effort while also supporting the various other organizations providing the same service.	Likely to be determined "consistent," due to the focus being on medium and low income Vermonters (i.e., those Vermonters earning less than 120% of area medium income), and intended to provide them with information and education related to their Wx choice. Still, TBD once equity consultant reviews.	Likely to be determined "consistent," due to the focus being on medium and low income Vermonters (i.e., those Vermonters earning less than 120% of area medium income), and intended to provide them with information and education related to their Wx choice. Still, TBD once equity consultant reviews.										
						5 - Develop and implement a plan for coordinating and enhancing counseling services to Vermonters with low and moderate-income who could benefit from the State's energy savings programs (Public Service Department)	Starting in 2022		High	TBD based on meeting overall Wx goals	Articulation of (1) the category of landlords subject to the program, i.e., eligible for program financial and educational support, and required to demonstrate that their properties meet minimum efficiency standards; and precisely what standard of efficiency to adopt; (2) coordination with existing weatherization programs and funding sources; (3) scope exceptions, e.g., buildings that can be verified as meeting/exceeding relevant existing code, and attached accessory dwellings units; (4) compliance exceptions, e.g., buildings achieving equivalent energy efficiency performance; historic buildings; affordable housing units previously weatherized according to relevant standards; buildings where efficiency upgrades are technically impractical.	This policy would be designed specifically to assist low- and moderate-income Vermonters who experience significant energy burdens. Depending on the specifics of program design, it could be developed to more specifically be responsive to additional equity considerations.	As with other building-related efficiency measures, tenants should expect to experience significant non-GHG reduction benefits. These would include but not be limited to greater comfort, reduced exposure to indoor air pollution associated with the combustion of fossil appliances, and other public health benefits.	This action is technically feasible, like other Wx efforts. VT has deep experience in delivering these sorts of services.	This program will rely on the same sources of funding that are being broadly considered for the Wx at Scale work.	Vermont utilities, Efficiency Vermont, Capstone agencies and others.	The Department of Public Service, and other consumer advocates						
						1 - Authorize the adoption of efficiency standards for existing rental properties, allowing for an 8-year implementation plan, the first 5 years of which would be marked by significant education and funding to ease the implementation for property owners. This would be a relatively "modest" standard. For example, the approach adopted for this purpose in Boulder CO, uses a point scale that roughly equates to the 1999 IECC. For reference, in 1998 Vermont enacted a more stringent statewide residential energy code than what is being proposed here: that code was based on the 1995 CIBO/IECC and Vermont amendments to the 2000 IECC.	One year, post legislative authorization		High	TBD based on meeting overall Wx goals	Policy is directed at the improvement of rental units occupied by a significant number of energy burdened Vermonters. Landlord use of public funds to finance efficiency improvements should be conditioned on the agreement to not raise rents for a period of years.	As with other building-related efficiency measures, tenants should expect to experience significant non-GHG reduction benefits. These would include but not be limited to greater comfort, reduced exposure to indoor air pollution associated with the combustion of fossil appliances, and other public health benefits.	This action is technically feasible, like other Wx efforts. VT has deep experience in delivering these sorts of services.										
						2 - Institute a new rental property efficiency standard (RPE3)			High	TBD based on meeting overall Wx goals	Adoption of updated codes will produce the efficiency and related emissions reduction and other benefits that one should expect from improved code compliance	Enforcement of codes will produce the efficiency and related emissions reduction goals that one should expect from improved code compliance											
						3 - Improve the energy performance of all new buildings in Vermont			Medium	TBD based on meeting overall Wx goals	TBD	TBD											
						1 - Regular update of the statewide residential and commercial building and energy codes by the Public Service Department culminating in a net-zero requirement by 2030			Medium	TBD based on meeting overall Wx goals	TBD	TBD											
						2 - Develop and fund a state-level Energy Code Rider initiative that provides code training and enforcement assistance to municipalities throughout the state to ensure awareness of and compliance with existing and future building and energy codes (Public Service Department)			Medium	TBD based on meeting overall Wx goals	TBD	TBD											
						Buildings/Thermal Energy	Pathway 2 – Reduce building-related carbon emissions by reducing the carbon content of their fuel use.	40% reductions by 2030 – relative to 1990	40% reductions by 2030 – relative to 1990	High	1 - Implement a Clean Heat Standard	1 - Adopt legislation authorizing the PUC to administer a Clean Heat Standard	One year, post legislative authorization, i.e., Q1 of 2024			High	A CHS should be thought of as an "umbrella" policy that will animate a market for lower carbon-intensity fuels. As such, this policy does not mandate actions. Instead, it encourages choice for both suppliers and consumers. How fuel suppliers comply with a CHS will depend on what they determine where opportunities lie and what best suits their capabilities. For consumers, the CHS gives them a range of lower carbon-intensity choices of how to heat their homes. Cadmus modeling will quantify the results of various types of adoption – TBD based on Cadmus modeling.	The transition required of Vermont to move to lower carbon intensity fuels requires a long-term and just plan that incorporates the needs of all Vermonters. This certainly includes those communities experiencing higher than average energy burdens, it also includes the Vermont workforce whose lives and livelihoods have been built around our current fuel supply industry. In addition to creating the conditions to reduce combustion-related emissions, improve indoor air quality, and save consumers money, the CHS creates a place for Vermont businesses that currently deliver fossil fuel to become part of Vermont's climate solution. The CHS enables these businesses and their employees to join others in building a less carbon intensive energy future for the state.	Given the quality of buildings, the cost of fuels, and the number and income status of Vermonters that rent, it is critical that Global Warming Solutions Act buildings policies incorporate social equity into recommendations. Buildings-related solutions must minimize adverse effects on low-income households and those most burdened by high energy bills. To ensure that a CHS does not negatively affect energy-burdened Vermonters, it would need to incorporate policies to minimize adverse effects on low-income customers, and potentially on other customer segments for which there may be equity concerns. This could include fuel assistance, heating, or other programs to improve energy affordability for low-income households. Because the CHS provides a path for fuel deliveries to employ and transition into the provision of cleaner energy services, the CHS design is fair to traditional fuel suppliers and their employees.	Managing and reducing utility spending at peak times on a utility system is an available way to lower the cost of providing energy to ratepayers. This is illustrated by an example from the State of Rhode Island. In 2016 their ratepayers paid 9% (23.9M) of their total expenditures that year on the highest cost 1% of their hours of electric energy use. In the same year, 26% (567M) of the total that they paid for electricity went to only 10% of their hours of electricity use. The ability to move demand for electricity away from peaks with controllable water heaters or other flexible load like EVs is of high value to utilities. When those savings are shared with ratepayers this demand response capability can contribute a significant source of savings. The States of Oregon and Washington adopted a standard requiring all new electric water heaters to be grid enabled. This provides utilities or third parties new ways to engage with consumer water heaters for grid management purposes. This also provides consumers with lower cost options to heat their water. Coordinating the adoption of a standard for controllable heat pump water heaters with neighboring states could help drive appliance markets serving Vermont.	Today, there is some ability to control and manage these electrical devices. Electrical vehicles with smart chargers and homes with controllable thermostats can be managed by consumers or utilities to charge in optimal ways to save money and avoid emissions. Electric water heaters, however, despite being far more efficient than their fossil counterparts, are generally not available for a utility to manage remotely. Appliances like heat pump water heaters, among other types of household and commercial equipment, are subject to federal efficiency standards that pre-empt state or local appliance efficiency standard adoption. However, states like Oregon and Washington have adopted non-federally regulated appliance standards that focus on controllability. Coordinating the adoption of a standard for controllable heat pump water heaters with neighboring states could help drive appliance markets serving Vermont.	The states of Washington and Oregon both reference Bonneville Power Authority's CTA 2045 Water Heater Demonstration Report and Scaled Deployment and Demonstration of Demand Response using Water Heaters with CTA 2045 Technology Brief as key resources to clarify the opportunity associated with grid interactive water heaters. The report includes highlights of the business case (in the aggregate of Washington and Oregon):	Legislature
2 - Adopt appliance standards for water heaters based on their ability to be "loadable" on the grid and "controllable" to ensure their optimal deployment on the power grid, and the grid's flexibility	1 - Authorize the Department of Public Service to engage with neighboring states and stakeholders to adopt appliance standards for Vermont and the region that require electric storage water heaters for sale in Vermont to have a modular demand response communications port that complies with the ANSI/CTA-2045-A or an equivalent communication interface standard	Several years post authorization			There are several reasons why Vermont could encourage the adoption of a water heating appliance standard for controllability. First, Vermont utilities that have demand response programs that can take advantage of managed water heating which can be a cost effective tool to reduce customer's electricity demand for brief periods. If this low-cost communication port were required to be on every water heater, Vermont utilities could use water heaters to help the grid absorb extra energy when needed. Using CTA 2045 communication technology, utilities can exploit the energy storage capability of water heaters to smooth out the intermittent nature of renewable generation. Second, at least three New England recently adopted appliance standards on their own, and recognize the value that coordinating with other states on standards to encourage the sale of improved appliances. The following states could be useful partners to Vermont in the adoption of a controllable water heater standard:							Maine (DA0), signed into law in July 2021, gives the Maine Department of Environmental Protection the authority to set minimum efficiency standards for 10 household and commercial products, including computers and monitors, faucets, and water coolers. The new law directs the Department to align the standards using information from other states that regulate these products. The standards would take effect in January 2023.	Each year roughly 25,000 Vermont households replace their water heaters. If that number of water heaters installed in Vermont were "controllable," that could save consumers money and produce significant carbon reduction benefits. It would also provide the state's utilities with a significant demand response and system resilience opportunity to do with thousands of water heaters what one Vermont utility is now doing on a limited scale with a relatively few Tesla Power Walls.	In addition to creating the conditions to reduce combustion-related emissions, improve indoor air quality, and save consumers money, the CHS creates a place for Vermont businesses that currently deliver fossil fuel to become part of Vermont's climate solution. The CHS enables these businesses and their employees to join others in building a less carbon intensive energy future for the state.	Retrfitting" water heaters with CTA 2045 communication technology would make them controllable, but would do so at an unnecessarily high cost. By comparison, incorporating this communications technology as an original component of water heaters lowers the per unit price significantly. In 2018, when considering Oregon and Washington's plan to adopt appliance standards requiring electric storage water heaters to have a similar modular demand response communications port, the Bonneville Power Administration determined that a retrofitting approach would not be cost effective, but that a strategy requiring this capability to be incorporated at the factory would be cost effective and produce significant benefits.	Public Service Department	VEIC, manufacturers, appliance retailers, utilities.						

Electricity Mitigation Pathways, Strategies and Actions													
#	Pathway	2025 Goal / Metric	2030 Goal / Metric	Importance to 2050	Strategies	Actions	Impact	Impact Notes	Equity	Cost Effectiveness	Co-Benefits	Technical Feasibility	Overall Priority Ranking
1	Further decrease GHG emissions from electric sector purchases	63% renewable portfolio standard	71% renewable portfolio standard	High/enabling	Develop 100% carbon free electric portfolio standard for implementation post 2030	<p>Review design parameters of 100% carbon-free electric portfolio standard that equitably promotes electrification - here are the questions reviewed by the CC previously that we would expect to include:</p> <p>Mechanisms to support equitable access to renewable energy</p> <p>Supporting existing versus new resources</p> <p>In-state versus out-of-state generation</p> <p>Supporting generation of all sizes (ex. small scale distributed energy resources (DERs) versus utility-scale/larger DERs)</p> <ul style="list-style-type: none"> Scale of deployment Energy storage (both short and long duration) <p>Time scale on which renewability is measured (ex. annual, quarterly, monthly, hourly)</p> <ul style="list-style-type: none"> Incentivizing resources to deliver when needed (e.g. during peak hours, noting that these are likely to shift over time; seasonal needs such as winter loads; how storage may fit in) <p>Siting, including environmental, community, and transmission system considerations</p> <p>Carbon impact of resources; what source/criteria are utilized</p> <ul style="list-style-type: none"> Informed by GHG inventory recommendations <p>Timeline for reaching 100%</p>	High	Pathway 1: High/enabling because: 100% RPS not needed to meet either 2025 or 2030 GHG reduction goals according to the Pathways analysis so is not a high impact near term item, but is foundational for supporting the eventual GHG goals beyond 2030 and therefore is being elevated by consensus of the committee to a recommended action in the years ahead.	Depends on program design	Depends upon design.	Depends upon design (local jobs if more local renewables; economy/affordability support if rate impact lower, etc.)	Yes	High
2	Enable All Vermonters to Choose Electrification	Track according to Pathways device/equipment adoption data	Same	High/enabling	Provide financial and technical assistance for Vermonters to upgrade electric service and to purchase and install equipment.	Develop programs for implementation regarding 200-amp service and related building upgrades, coordinated with weatherization, efficiency, and equipment incentive programs (EV chargers, HP, storage, etc.) and ensure that any potentially related statewide programs (such as Clean Heat Standard, if adopted, or enhanced weatherization efforts) includes building electrical upgrades in their design and funding models in order to enable decarbonization.	High	Pathway 2: Enabling because the very significant GHG reductions in buildings and transportation sector will not happen without these upgrades.	Target lower income Vermonters, multifamily, and rural areas of Vermont without strong infrastructure. Ensure direct financial support through equitable source for income qualified, plus easy financing access for all utilizing same tools as for weatherization and equipment financing, including possible on-bill payment through electric utility bills after pilot project for weatherization improvements currently underway.	Depending upon tools funded and level of funding - see DPS Cost of Carbon Measures report	High co-benefits - jobs, economic activity, healthier buildings and people, greater equity - upgraded housing stock and access to energy services, lower overall costs (EV maintenance, fossil fuel price volatility, electric bills through shared load management), safety, reliability	Yes	High
3	Load Management and Grid Optimization	Based upon Pathways end use goals for fossil fuel switching	Same	High/enabling	Prioritize continued efficiency, along with load control and generation/load matching.	Support direct utility load control programs, including implementation of management platform	Medium/enabling	Impact is medium/enabling most likely, based upon already existing programs and regulatory authority. Will support GHG reduction in other sectors and grid reliability.	High, if implemented with shared savings in mind so that all customers benefit	Depends upon specific design and cost recovery, but purpose of these programs should be to more cost-effectively manage DERs across the grid than in the absence of such control.	High. • Jobs (individual project deployment and infrastructure) • Enabling individual and community-level resilience • Safety • Lower overall costs than in absence of programs, yielding economic benefits	Yes	High
						Encourage dynamic rate offerings, including those designed to encourage direct load/generation matching, and rate design to support electrification through shared customer savings	Medium/enabling	Impact is medium/enabling most likely, based upon already existing programs and regulatory authority. Will support GHG reduction in other sectors and grid reliability.	While rates must be offered to all similarly situated customers care must be taken to consider who will have the opportunity to benefit, such as Time of Use rates providing variable benefits to shift workers and avoiding "electrification" rates that do not share increased load benefits with all customers.	High, so long as shared savings are the goal. To the extent subsidies between customer groups are utilized, historically marginalized individuals and those who have not accessed energy programs successfully in the past should be prioritized.	Medium • Jobs (individual project deployment and infrastructure) • Enabling individual and community-level resilience • Safety • Lower overall costs than in absence of programs, yielding economic benefits	Yes	High

Non-Energy Emissions Pathways, Strategies and Actions								Prioritization					
#	Sector	Pathway	2025 Goal / Metric	2030 Goal / Metric	Importance to 2050	Strategies	Actions	IMPACT	COST-EFFECTIVENESS	CO-BENEFITS	TECHNICAL FEASIBILITY	OVERALL PRIORITIZATION	Notes (Assumptions made, lumping, etc.)
Explanation	This should match the GHG Emissions Inventory Sector	A sectoral pathway is a high level means of achieving GHG emissions reductions	Quantitative goal if known; narrative description otherwise	Quantitative goal if known; narrative description otherwise	Qualitative Low, Medium, or High measure answering the question: how important will this strategy likely be to meeting 2050 reduction requirements?	Statements of measurable activity, a benchmark, to be reached in pursuit of the pathway. Strategies should be measurable and are a more specific subset of pathways.	The "operational" tasks that the state will undertake to meet the pathways and strategies. Actions may be written around existing, or propose new, policies, programs, projects, initiatives, plans, etc.						
1	Waste	Fugitive Emission Reduction from WWTFs	At least 1/3 Anaerobic Digesters at Municipal and Industrial NPDES facilities have operational flares by 2025. 1/2 of anaerobic digester facilities have completed engineering studies to assess biogas capture potential for beneficial use.	All Anaerobic Digesters with NPDES or Pretreatment permits have operational flares by 2030. All anaerobic digester facilities have completed engineering studies to assess biogas capture potential for beneficial use.	Medium	Require consistently operated flare or systems for reuse of biogas. Evaluate biogas capture potential for flaring excess.	1. Complete a survey of WWTFs with Anaerobic Digesters (ADs) and their operational status. 2. For ADs without current beneficial use, require an engineering evaluation (cost subsidized) to determine cost of capital investment and asset management to install beneficial use system. 3. Work with municipalities to discuss funding options for implementation of beneficial use systems. 4. Provide subsidies to encourage the implementation of beneficial use or flaring of methane where beneficial use systems cannot be implemented. 4. Require all applicable facilities that are not implementing beneficial use to have functional flares installed by January 1, 2030.	LOW	HIGH	HIGH (odor reduction in surrounding communities)	YES	HIGH (emissions reductions do not equal this as high, but flares already required to be present on these facilities so action would just be ensuring they were functioning properly)	Assuming, based on agency knowledge and outreach, that "4% of municipalities have anaerobic digester systems with potentially non-functioning flares. Emissions from WWTFs were calculated on a per capita basis using approximately 4% of Vermont's population and assuming a biogas generation factor and percent methane within the biogas. If the flare is non-functioning we assume that 100% of the methane generated is emitted. These methane emissions, when converted to CO2e, total ~3,000 MTCO2e of reductions annually if the flares were operational.
2			a minimum of 2 facilities Municipal or Industrial NPDES facilities with aerated sludge holding converted to Anaerobic Digesters.	a minimum of 5 facilities Municipal or Industrial NPDES facilities with aerated sludge holding converted to Anaerobic Digesters.	low	Convert aerobic holding tanks to anaerobic digestion of sludge where GHGs can be captured for reuse or neutralization.	1. Survey WWTFs to determine interest in installing anaerobic digesters, conduct engineering evaluations to determine feasibility and costs 2. Prioritize areas where there is a high ratio of population to anaerobic digester capacity. 3. Select facilities to site new anaerobic digesters. 4. Provide design & construction subsidy to municipalities selected for anaerobic digesters, taking into consideration that the new ADs are meant to take septage & sludge from sources in a defined regional area. 5. Implement MOUs through funding mechanism to require the municipality accept sludge and septage from the defined regional area.	LOW	LOW	MEDIUM	YES	LOW	This action would be beneficial for the purpose of using an existing waste stream to potentially create energy (offsetting emissions related to heating buildings or from electricity). From an inventory perspective the CO2 from wastewater treatment is biogenic and so is not counted in the inventory totals, so changing from an aerobic system to an anaerobic system could potentially increase emissions (mainly CH4 produced instead of CO2). Those additional emissions would potentially be offset by the energy generated, but those reductions would not be included in the wastewater sector.
3	Electricity	Reduction of Energy Used in Wastewater Treatment	15% of Municipal WWTFs with energy optimization studies and implemented practices by 2025	30% of Municipal WWTFs with energy optimization studies and implemented recommended practices by 2030	Low	optimization of sizing and operations of pumps and blowers at WWTFs	1. Offer 100% subsidized energy audits to all WWTFs with no existing audits 2. Provide financial support for municipalities to implement the most effective recommended practices from the audit	LOW	MEDIUM	LOW	YES	LOW	Lacking specifics/details to perform this impacts calculation. Based on MA case study there is a large annual return on investments for efficiency upgrades at WWTFs. Because the emissions reductions would be seen in the form of using less electricity, any emissions reductions would show up in the electricity sector, but would be small (despite the fact that WWTFs use a large amount of electricity) due to the low emissions total for the entire sector.
4	Transportation	Reduced Transportation of Wastewater Treatment Residuals.	reduce the number of loads transported from WWTFs by 10% by 2025	reduce the number of loads transported from WWTFs by 20% by 2030	Medium/low	Improved dewatering to reduce the need for residual transportation, additional digesters for sludge processing around the state	1. Survey WWTFs to determine interest in and capacity to implement additional dewatering 2. Subsidized engineering evaluations for all WWTFs interested in implementing new or refurbished dewatering equipment 3. Provide a generous match (50%) to purchase and install dewatering equipment 4. Institute an annual \$5 allocation for a defined time (5-10 years) for these facilities to hire and maintain a larger operational staff where needed to implement dewatering equipment & support for operator training and certification.	LOW	LOW	MEDIUM	Yes	LOW	Assuming \$5 facilities which could benefit from de-watering equipment (94 total minus facilities with anaerobic digesters and facilities currently with de-watering equipment). Assuming an average of 1 truck per facility per week traveling an average of 150 miles per trip and a fuel economy of 6.3 mpg (diesel). Total reductions would need to be modified based on the number of facilities actually installing new de-watering equipment.
5	Industrial Processes (ODS Substitutes)	Reduce the leakage of HFCs from Refrigeration Systems in Vermont			Medium	Reduce fugitive emissions from refrigeration systems by investigating implications and costs associated with requiring annual inspections of systems and requirements to repair leaks through adoption of a refrigerant management program (RMP). Benefit of reducing fugitive emissions of high GWP gases as well as saving businesses money in not needing to buy additional refrigerant. Cost would be associated with equipment fees, leak detection, and reporting.	1) Work with VEIC and additional stakeholders to better understand the number and type of entities that would be potentially subject to a refrigerant management program (RMP) and the associated costs and benefits. 2) Work with VEIC to perform additional outreach and education to help determine the scope and thresholds for such a program. 3) Consider whether to require permanent leak detection systems for entities using over a certain threshold of high GWP refrigerant and if a cost share should be provided, with additional outreach through work with VEIC and other stakeholders to better understand the number of applicable entities and the costs and benefits of such a requirement.	MEDIUM	MEDIUM/HIGH	MEDIUM	YES	CONSENSUS MEDIUM	This combines development of a refrigerant management program (RMP), the installation of leak detection equipment, and an incentive program for entities to switch from high GWP HFCs to lower GWP alternatives. Impact is based on reductions from an RMP program as quantified by the CA created tool used in the GHG inventory. Additional work would need to be performed to determine how emissions reductions from an RMP would potentially overlap (or complement) those from permanent leak detection systems. Quantification of the impact of an incentive program to drive the transition to low GWP refrigerants has not been completed, but would complement an RMP program well as there would be an existing list of facilities to target for incentives. Cost effectiveness is somewhat variable because the cost of equipment repair depends on the issue, and the cost of refrigerant switching is also variable, but cost effectiveness was considered MEDIUM/HIGH because preventing refrigerant leaks through an RMP or permanent leak detection system saves money over time through having to purchase less refrigerant and the transitions to low GWP alternative refrigerants often have other energy efficiency benefits or don't have a significant cost increase.
6	Industrial Processes (ODS Substitutes)	Reduce the end of life emissions of HFCs from Refrigeration Systems in Vermont			Low	End of life program to capture HFCs (additional enforcement of current HVAC industry and strappage facility regulations) to ensure that refrigerants in old equipment being disposed of are either destroyed or recaptured properly to avoid their release to the atmosphere.	1) Consider proposing legislation for extended producer responsibility, requiring equipment manufacturers to cover the cost of refrigerant recovery or disposal at equipment end-of-life. 2) Perform additional education, outreach, and training to disposal facilities and staff regarding existing federal prohibitions (in Section 608 of the Clean Air Act) on venting of ODS and ODS substitutes during equipment disposal. 3) Ensure that disposal facilities have appropriate EPA certified refrigerant recovery equipment (and explore the potential to find funding for this equipment if necessary and appropriate).	LOW	MEDIUM	LOW	YES	LOW	More investigation is needed to be able to quantify emissions impacts from and HFC end of life program. Existing prohibitions against venting HFCs at the end of equipment life, but unclear how strictly that regulation is adhered to. Is potentially a cost-effective strategy, requiring mainly outreach and education, depending on the total emissions currently being released (as opposed to being recycled or destroyed) at equipment end-of-life at Vermont facilities.
7	Industrial Processes (ODS Substitutes)	Reduce Use of HFCs in Refrigerant Systems in Vermont			Medium (Lumped with RMP and permanent leak detection systems above)	Provide incentives (potentially through/related to refrigerant management plan) for consumers of high GWP HFCs in the state to switch to lower GWP alternatives.	1) Provide incentives for businesses to transition from high GWP refrigerants to lower GWP alternatives using data from outreach for RMP development to target appropriate facilities. This would be a voluntary program that would speed the transition to lower GWP refrigerants and supplement/complement reductions achieved through the Act 65 rulemaking.					CONSENSUS MEDIUM (Lumped with RMP and permanent leak detection systems above)	Lumped with RMP and permanent leak detection above.
8	Industrial Processes (semiconductor manufacturing)	Reduce Process Emissions from Semiconductor Manufacturing			Medium/low	Continue to explore efficiencies and alternatives to high GWP fluorinated gases in the semiconductor manufacturing process	1) Global Foundries has been pursuing several actions (use of technologies in the manufacturing process to destroy high GWP gases when emitted and chemical substitutions) already and discussions have been ongoing between Global Foundries, the Public Service Department (PSD), and the Agency of Natural Resources (ANR) through a pending Public Utilities Commission (PUC) proceeding considering Global Foundries' petition to become a Self-Managed Utility (SMU). The PUC proceeding may or may not result in emission reductions for Global Foundries consistent with the GWSA requirements. As of the date of this plan, the PUC proceeding has not been concluded. In the absence of sufficient and/or binding emissions reductions consistent with the GWSA requirements, ANR will promulgate rules in a timely manner necessary to ensure the 2025, 2030, and 2050 emissions reductions requirements are met. In the event that the PUC proceeding has not concluded by December 1, 2022, ANR will commence rulemaking.	LOW	LOW	MEDIUM	YES	CONSENSUS MEDIUM	Emissions reductions would come from the destruction of high GWP fluorinated gases or chemical substitutions in the semiconductor manufacturing process.