

2022 Vermont Comprehensive Energy Plan

Executive Summary

Vermont is at a moment of great opportunity to take control of its energy future. Technology changes over the last decade have set the foundation for a just and equitable transition to a more affordable, cleaner, more efficient, and more reliable energy future for Vermont’s residents and businesses. While significant challenges remain and a transition will take time to implement, advances in technology, strategy, and application have positioned Vermont to make significant strides in the next decade and beyond. Strides that will ensure that we maintain and reestablish the principles of State Energy Policy, as set forth in 30 V.S.A. § 202a:

To ensure to the greatest extent practicable that Vermont can meet its energy service needs in a manner that is adequate, reliable, secure, and sustainable; that ensures affordability and encourages the State’s economic vitality, the efficient use of energy resources, and cost-effective demand-side management; and that is environmentally sound.

To identify and evaluate, on an ongoing basis, resources that will meet Vermont’s energy service needs in accordance with the principles of reducing greenhouse gas emissions and least-cost integrated planning, including efficiency, conservation, and load management alternatives; wise use of renewable resources; and environmentally sound energy supply.

To meet Vermont’s energy service needs in a manner that will achieve the greenhouse gas emissions reductions requirements pursuant to 10 V.S.A § 578 and is consistent with the Vermont Climate Action Plan adopted and updated pursuant to 10 V.S.A. § 592.

This Comprehensive Energy Plan balances the principles articulated in 30 V.S.A. § 202a of energy adequacy, reliability, security, and affordability, which are all essential for a vibrant, resilient, and robust economy, and for the health and well-being of all Vermonters. It also recognizes that the current energy system is marked by systemic inequities that have a disproportionate impact on many of Vermont’s communities in terms of issues such as energy burden and access to renewable energy opportunities. When approached through the lens of equity and justice, the transition required to meet

renewable energy goals and greenhouse gas (GHG) reduction requirements presents opportunities to root out and redress those existing inequities.

This CEP advances these guiding principles through pathways, strategies, and recommendations found throughout the plan, building on and reestablishing the high-level goals set in 2011 and 2016 CEP's: **Meet 25% of energy needs from renewable sources by 2025, 45% by 2035, and 90% by 2050.**

This Comprehensive Energy Plan is structured to meet the greenhouse gas requirements of the Global Warming Solutions Act and to be consistent with the Climate Action Plan required by 10 V.S.A. §592. In addition, and in support of the greenhouse gas reduction requirements, and the top-level goal, this CEP establishes and reestablishes the following set of goals:

The Global Warming Solutions Act requires the following reductions in Greenhouse Gases:

- 26% reduction from 2005 levels by 2025
- 40% reduction from 1990 levels by 2030
- 80% reduction from 1990 levels by 2050

- In the Transportation Sector, meet 10% of energy needs from renewable energy by 2025, and 45% by 2040,
- In the Thermal Sector, meet 30% of energy needs from renewable energy by 2025, and 70% by 2042, and
- In the Electric Sector, meet 100% of energy needs from carbon-free resources by 2032, with at least 75% from renewable energy.

These targets will not be easy to reach, particularly in the transportation and thermal sectors. But they provide a vision, and this CEP articulates the pathways, strategies, and specific recommendations for actions to meet them. At a high level, the 2022 CEP builds on themes from previous plans, with additional insight and knowledge from more recent experience.

- The burdens and benefits of energy policy in Vermont have not been equitably distributed across the state or its citizens. Strategies in this plan will consider both the historical distribution of impacts, as well as those that will occur with energy policy action.
- Transformational changes to the way Vermont generates, delivers, and uses electricity are upon us. The electric grid must be optimized to ensure resilience

and responsiveness, and to benefit all electric consumers. This Plan will provide a structure to guide the course of a highly dynamic, distributed, resilient future electric grid.

- Vermont’s energy policy is interconnected with the health and economic well-being of Vermonters. Energy policy needs to consider non-energy related objectives that can be furthered with action in the energy sphere.
- Efficiency continues to be the most cost-effective first resource, and can and should be structured to equitably distribute the benefits to the Vermonters most in need.
- Innovation in technology and policy will continue to be necessary to achieve the needed energy transition affordably, reliably, and equitably.

To further these goals, Vermont must acknowledge that energy policy goals articulated by the Legislature’s energy policy can at times be in conflict. Those conflicts cannot be a cause for inaction. Rather, they must help improve policy and prioritize the actions that should be supported. All decisions will not please all people all the time, thus the decisions made under ever-changing circumstances cannot happen under cover. To meet required need, some actions will have negative impacts to some stakeholders; transparency in the decision-making process is critical to ensure those negative impacts are mitigated. This plan advocates for a decision-making process that can set benchmarks to understand when a policy is no longer cost-effective—in other words when other options can more affordably achieve the same desired outcome. This plan recognizes uncertainty in Vermonters’ lives and in the future; policy must be nimble in the face of change. Transparently articulating how these principles have been applied when taking action will help ensure necessary conversation and debate on policy priorities. Estimating the implications of a given action (or set of actions) must be made using consistent data and facts.

This CEP also details current programs and articulates the benefits and costs of programs from different perspectives. These perspectives encompass society broadly well as two categories of Vermonters: those who participate early in transitional programs and those who do not. By clearly articulating our assumptions and pursuing policies that seek to balance tradeoffs instead of ignoring them, we can move beyond partisan debate and take the actions that are best for Vermont residents and businesses.

Just and Equitable Energy Transition

Acknowledging that “every one of us benefits when we make society fairer and more just,” as noted by Vermont’s Executive Director of Racial Equity in her 2021 report to the Legislature, the principles of a just transition in building Vermont’s renewable energy future run throughout this 2022 CEP. As Vermont moves towards a cleaner energy future and develops the policies and programs to support those changes, it will be critical to do so through a lens of equity and justice to ensure that no Vermonter is left behind. That has historically not been the case.

The average statewide total energy burden—defined as energy spending as a percent of household income—is about 10%. However, actual energy burden varies widely. With Vermont’s rural character, old buildings, and variable weather, energy burden for some Vermonters can be much higher. The average energy burden across Vermont cities and town ranges from 6% to 20% and can be much higher for individuals. Clean energy technologies, which can reduce costs and energy burden, are generally less common in areas with the highest energy burden.¹

The energy system, at its roots, was built to serve people through enabling the provision of critical services such as warm homes on cold winter evenings and power to support the operations of local businesses. Approaching the clean energy transition through an equity and justice lens will help ensure that the needs of Vermont’s citizens, communities, businesses, and institutions are met, particularly those who have historically been marginalized or underserved and who will be most impacted by the transition. This transition is one that opens the door, not just to meet renewable energy and climate objectives, but to do so in a way that better serves all Vermonters. Building a more inclusive energy system means incorporating Vermonters previously left without full access or ability to participate, as well as addressing and repairing the root causes of existing inequities.

Leveraging the foundational work of the Just Transitions Subcommittee of the Vermont Climate Council, Chapter 3 grounds this CEP in clear understanding of what is meant by energy equity and a just transition for the energy system. It considers what this means for Vermont moving forward and provides recommendations for steps to

¹ Efficiency Vermont, *Vermont Energy Burden Report*, Oct 2019, Sears & Lucci.

broadly advance a just and equitable energy transition while implementing the programmatic and policy actions outlined in the plan.

Adequate, Secure, and Reliable Energy Services

As described in this CEP, many pathways for our energy future include significant electrification of energy resources. A modern electric grid allows for the integration of distributed energy resources (DERs)—such as electric vehicles, heat pumps, smart appliances, storage, and generation—while maintaining and improving safety and reliability. The grid needs to continue to perform by reliably delivering needed energy to customers every hour of the year using exponentially more distributed, diverse, and variable resources, under increasing pressure from severe weather events and cyberattacks, while also reducing fossil resources and staying affordable. Where we don't electrify, ensuring that biofuels (solid or liquid) remain available and affordable is critical.

This CEP sets the goal of having a secure and affordable electric grid that can efficiently integrate, use, and optimize high penetrations of distributed energy resources to enhance the state's resilience and reduce greenhouse gas emissions. It also recognizes the role that broadband services play in delivering transformative technologies—and the capability to manage them to reduce costs—to all Vermonters. This CEP does not create a stepwise plan for a modern grid because such a plan would be immediately outdated. Rather, Chapter 4 illustrates the tradeoffs associated with achieving a modern grid that must be considered.

Adequacy, security, and reliability do not just pertain to our electric grid; they are principles that apply to all of Vermont's energy end uses. Energy demand management through efficiency—providing the same service while using less energy—remains paramount to our future. Whether it is tightening our buildings through comprehensive weatherization retrofits or reducing our vehicle miles traveled, energy efficiency can improve the health, well-being, and prosperity of Vermonters and Vermont businesses while ensuring reliable energy service by lowering overall demand.

For sectors where electrification options are limited, biofuels remain a viable alternative. Even where electrification eventually needs to occur, biofuels can serve as a transition fuel, often with low upfront costs, of which all Vermonters can take advantage.

Progress Since the Last CEP

The 2011 CEP established a goal of meeting 90% of the state’s energy needs through renewable sources by 2050, proposing steps to minimize our dependence on fossil fuels. The 2016 plan maintained that trajectory, and proposed additional actions to get us on the path toward achieving both the 90% by 2050 target and the GHG requirements. The CEP prompted many positive steps toward these targets and requirements, and many successes have been achieved:

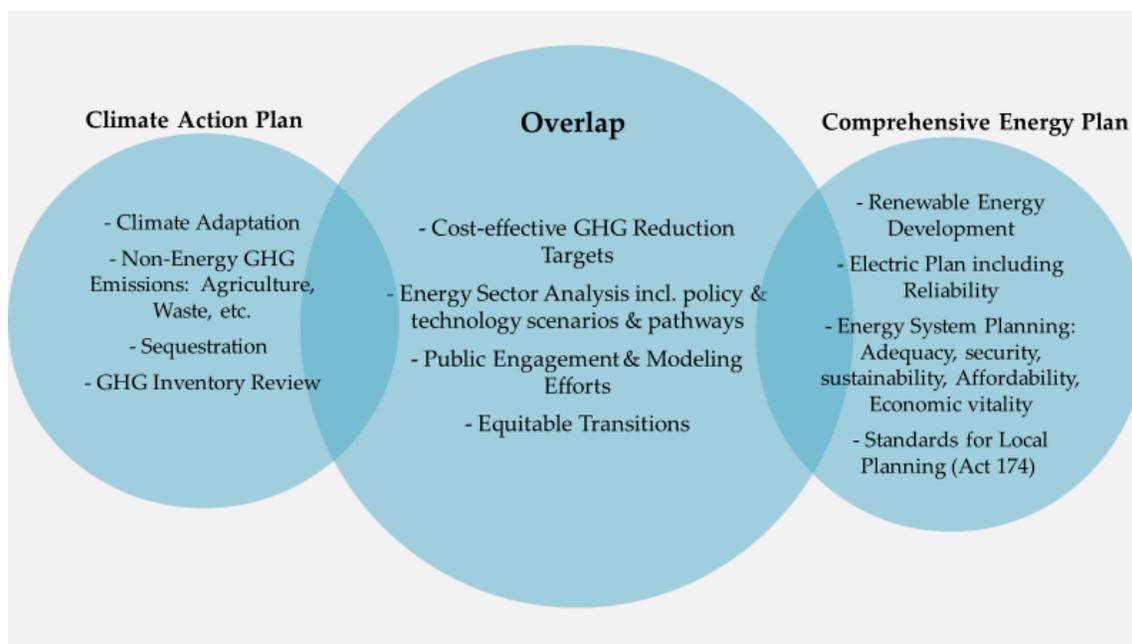
- Implementation of the Renewable Energy Standard, including “Tier III” which requires electric utilities to reduce fossil fuel consumption by its customers;
- Authorization of Innovative Electric Utility Pilots, which allow utilities to take steps toward climate action through modernizing systems and programs that benefit ratepayers in the long term;
- Authorization to double natural gas efficiency program investment, and research and development for renewable natural gas to meet the needs of hard-to-electrify sectors;
- Development of a broad array of electric vehicle customer and dealer incentives and charging rates that reduce both upfront and ongoing costs;
- Development of public charging infrastructure that ensures a fast charging public station is located within 30 miles of nearly all Vermont residences, with continued expansion planned, to ease concern about electric vehicle ranges;
- Installation of over 400 MW of solar and permitting for approximately 50 MW of storage to interconnect to the grid;
- Continued improvement of the Net Metering programs, including review of siting and rates to better reflect development costs and relative contribution toward meeting targets and reducing cost shift to non-participating customers;
- Updated building energy codes to put us on a path to Net Zero Ready for new buildings by 2030;
- Increased access to affordable financing for residential and commercial borrowers through a variety of financial institutions; and
- Development and approval of enhanced energy plans for all 11 regional planning commissions and roughly 30% of Vermont’s municipalities under Act 174.

These, and many other, successes are discussed throughout the remainder of the CEP.

The Vermont Climate Council and Climate Action Plan

The development of the CEP has coincided with development of the Vermont Climate Council’s Climate Action Plan (CAP), as required by the Global Warming Solutions Act (“GWSA”, 10 V.S.A. § 592). As described herein, the CEP is a mechanism to implement statutory energy policy based on a comprehensive analysis of challenges and opportunities in Vermont. The CAP is an action plan specifically for greenhouse gas mitigation, sequestration, and adaptation strategies in the face of climate change. As shown in Exhibit ES-1, while the CEP and the CAP have considerable areas of overlap, they remain distinct planning requirements, with different objectives. While the CEP must be consistent with and fundamentally aligned with meeting the State’s GHG requirements, it is not a climate change plan nor a comprehensive look at Vermont’s non-energy GHG emissions or climate adaptation needs.

Exhibit ES-1: Comprehensive Energy Plan and Climate Action Plan



The CEP reviews energy system planning in ways that are beyond the scope of the Global Warming Solutions Act. For example, it focuses on planning for reliability of the electric system given the pathways necessary to meet our climate goals. In turn, the CAP looks at the impacts of climate change beyond the scope of the CEP, addressing resiliency in the natural and built environment, adaptation, sequestration, and non-energy mitigation.

Of course, energy consumption drives a large majority of Vermont’s greenhouse gas emissions; it was important that the process for the CAP and CEP aligned. Thus, the Public Service Department in its role developing the CEP and the Agency of Natural Resources in its role managing the Climate Council have closely coordinated these two required plans. Notably, public engagement efforts have been aligned, with the Department of Public Service supporting technical workshops with Climate Council participation, and the Climate Council supporting robust public engagement with Public Service participation. The effect was that targeted outreach to both Vermonters and technical experts was not duplicated. In addition, modeling (see the appendix for a detailed summary of these efforts) was initiated for purposes of the CEP but reviewed, modified and adopted for the CAP, ensuring there is one set of energy-related assumptions on which the two plans were based upon. State agency staff have diligently worked on both the CAP and the CEP.

The CEP is required to be consistent with the requirements of the GWSA and the CAP. At the same time, the CAP is required to be informed by the CEP. These requirements to closely coordinate the efforts—even if the resulting actions are not necessarily identical, the basis on which they are formed was efficient and practical—allow for clearer consideration of the issues rather than a debate of the facts.

Public Engagement and Support

Development of the CEP entailed a range of inputs and actions designed to obtain insights and expertise from state agencies and Climate Council members combined with input from community, business, non-profit, and regional planning organizations, as well as academic institutions, municipalities, advocacy groups, and citizens from across the state. As noted above, because of the substantial overlap with the Climate Action Plan, and instead of holding duplicative meetings that had the potential to confuse participants and muddle feedback, significant coordination among agencies on the two plans took place. Core components of the Department’s engagement throughout the course of 2021 included:

- A Request for Information on what should be considered in the plan and what should be modeled;
- Public Regional Forums focused on gathering input from municipalities and regional planning commissions on what they need from the Energy Plan in terms of guidance and standards for Act 174 enhanced energy planning;

- Topical Stakeholder Meetings, led by the Department in coordination with the Climate Council, where industry experts were invited to provide technical feedback related to the electric, thermal, and transportation sectors, with an additional workshop related to electric grid evolution;
- Public Engagement, led by the Climate Council in coordination with the Department of Public Service, through in-person and online workshops; and,
- Following publication of the draft CEP, public hearings around the state to gather more feedback on the draft.

Each of these efforts has resulted in valuable comments that are addressed in the plan. The final CEP will include an appendix of comments and feedback received, and how such feedback was considered.

Vermont can only meet the goals established in this plan with the support and active involvement of individuals, businesses, private organizations, and all levels of government. Individual decisions—about where to live, what car to buy (or whether to buy a car at all), what appliances to buy, whether and how to weatherize your home or invest in renewable energy—will have a significant impact in shaping Vermont’s energy future. The same is true of business decisions. Engagement on the pathways and strategies included in this plan will continue immediately in coordination with the Climate Council engagement on the Climate Action Plan.

Pathways and Strategies to Meet Vermont’s Energy Needs

Addressing Vermont’s energy policy and meeting statutory requirements requires not only a vision as articulated by previous energy plans, but a clear direction to tackle the challenges and seize the opportunities before us. This CEP is organized around two key themes: equitable solutions and grid evolution. Within that context, three major energy sectors are discussed: transportation, thermal, and electricity. Although technology and policy priority evolution has blurred the lines between these three sectors, they remain useful distinctions for discussing the specific challenges and opportunities associated with each end use energy service.

An “All of the Above” approach is necessary to equitably meet Vermont’s energy service needs and reduce greenhouse gas emissions. Within each chapter, the CEP describes pathways, strategies, and recommendations for actions available to Vermont,

where a pathway is a general means of reaching energy goals, strategies are coordinated efforts within a pathway to advance along the pathway, and recommendations are more specific tactics or actions that can be taken to further the strategy. This general structure is meant to be consistent with the structure associated with the Climate Action Plan. Indeed, many of the pathways, strategies, and recommendations are similar (but not exact), a result of the close coordination between plans addressing overlapping but differing scope.

Electric Sector

Vermont's electric sector will play a critical role in decarbonizing the transportation and thermal sectors, increasing the importance of affordable electric rates and an electric system that is reliable and resilient for all Vermonters. Currently, Vermont's electric generation mix is 94% carbon-free, and the statutory Renewable Energy Standard requires that all electric utilities meet at least 66% of electricity deliveries with renewable power. Overall, the electric sector contributed less than 6% of Vermont's GHG emissions in 2017, a number that is forecasted to decline even further.

Pathway – Carbon-free Power Supply

This CEP sets a goal in the electric sector to be fully decarbonized and at least 75% renewable by 2032. Vermont benefits from a strong regional transmission grid that includes ties to neighboring areas; working collaboratively, the region can ensure greater reliability, access to renewable generation, and lower costs than if Vermont was to try and achieve all of these goals individually. This will be increasingly important as load from electric vehicles (EVs) and heat pumps increases, particularly during winter months when heat pumps require the highest load and EVs battery life is less due to cold.

Consider Requirements for Carbon-free Power Supply

While some utilities have internal goals to increase the carbon-free portion of power supplied to customers, there is no binding requirement beyond the 75% Renewable Energy Standard in 2032. Vermont should develop a carbon-free power supply requirement designed to equitably reduce GHG emissions in the electricity sector which in turn will increase the reduction of GHG emissions achieved through electrification measures. Electric bills are essential to customer's economic proposition for electrifying. Power supply choices are long-lived. Thus, it is crucial that any changes to the existing Renewable Energy Standard be made in a deliberative and careful manner to minimize

the economic burden on Vermonters and make as cost-effective as possible electrification of the transport and thermal sectors.

The development of a carbon-free power supply requirement should consider and include transparent information regarding the costs and benefits of different design considerations, including at a minimum: (1) the addition of new generation resources, (2) time and locational considerations, and (3) resource size and diversity.

Transportation and Land Use

Vermont's transportation system is critical to the state's economy and quality of life. It provides access to jobs and mobility for the movement of goods and services that are essential to Vermont businesses, brings tourists and other visitors to the state, provides access for residents' daily activities, and delivers food and other products that Vermonters need for everyday living. Transportation fuels continue to account for the largest portion of Vermont's total energy consumption, and they include more fossil fuels than any other energy source. Transportation makes up 38% of the total energy consumed in Vermont and produces more GHG emissions than any other sector, around 40%.

This CEP set goals in the transportation sector to increase the number of electric vehicles in Vermont and have 100% light duty vehicles sales in Vermont to be Zero Emission Vehicles by 2035. In addition, this CEP aims to increase the share of renewable energy in transportation through both electrification and encouraging use of other renewable and less carbon intensive fuels. **While it does not specify targets for transportation demand-reducing activities, this Comprehensive Energy Plan continues to prioritize Transportation Demand Management (TDM) due to its broad benefits across Vermont's energy policy goals,** recognizing that the choices available to Vermonters about where they live, work, shop, and recreate affects the amount of energy and money spent in moving across the landscape.

Pathway – Vehicle Electrification

Vermont must continue to advance the market share of battery-electric cars and trucks as quickly as possible. A robust policy environment is critical for rapidly increasing the market share of plug-in electric vehicles (EVs) and is supported by ongoing and dramatic advances in electric vehicle technology, especially batteries. Strategies along

this pathway can move the transportation sector toward energy and emissions goals faster than any other single measure.

Accelerate Battery Electric Vehicle Market Share Through Incentives

The principal strategy for advancing the vehicle-electrification pathway is ramping up deployment of battery-electric technology. Battery electric technology can power light- and medium-duty cars and trucks, transit and school buses, short-haul aviation, and short-haul marine in the immediate and near terms, and possibly heavy-duty trucking in coming years. The overall objective of vehicle electrification policies is to establish an economic and regulatory environment where market forces can move forward without the need for government support. These include new and used vehicle incentive programs, targeted programs such as MileageSmart and Replace Your Ride, and enhanced support for medium- and heavy-duty electric vehicles.

Facilitate Increased EV Market Share through Supporting Infrastructure and Policy

Electrifying Vermont's entire fleet will require a vast expansion of the State's charging network. Until EVs reach a critical mass, charging infrastructure will continue to require some public support to help accelerate EV market share. This plan describes support for both Direct Current Fast Charging (DCFC) and Level 2 charging until a sufficient free-market charging network can stand on its own. It also seeks to address the barrier of model availability through continuation of participation in California's Advanced Clean Car program, and calls for the undertaking of a rulemaking process to adopt Advanced Clean Cars II regulations that will require 100% of light duty vehicles available for sale in Vermont to be Zero Emission Vehicles.

The transition to EVs also will require new regulations and oversight to ensure strong consumer protections and transparency associated with charging electric vehicles. This plan calls for the Agency of Agriculture, Food & Markets to adopt appropriate protocols in this area.

Managing Electric Grid Impacts

Increasing loads from vehicle electrification, as well as other forms of electrification, will eventually reverse years of declining loads that have resulted from energy efficiency. To the extent Vermont electric distribution utilities can accommodate

increasing off-peak loads from vehicle electrification without significant system upgrades, the result will be downward rate pressure for all customers as more electricity is sold based on fixed costs or moderately increasing costs associated with local upgrades to substations, transformers, and other supporting infrastructure. The Vermont grid may currently have some “headroom” to accommodate the early stages of electrification, but it will be critical to manage loads associated with electrification of Vermont’s vehicle fleet in order to ensure that objectives of affordability and reliability are achieved. Efficient rate design, including appropriately addressing of demand charges, are supporting strategies needed to manage the grid impacts of electric vehicles while continuing to encourage EV adoption.

Pathway – Cleaner Vehicles and Fuels

Although Vermont and other jurisdictions are working to electrify their transportation systems as quickly as possible, combustion vehicles will be on the road for years to come. More fuel-efficient combustion vehicles and lower carbon-intensity combustion fuels (like biofuels or renewable natural gas) could significantly reduce GHG emissions from combustion vehicles while the transportation sector electrifies. Low-carbon fuels could also potentially provide an alternative to combustion fuels for heavy-duty transportation modes, like long-haul trucking or aviation.

Increase Vehicle Fuel Efficiency

Many factors shape the number, type, and relative efficiency of the vehicles registered in Vermont: federal and state vehicle efficiency standards, the diversity and quantity of vehicles available in new and used markets, the price of gasoline and diesel, consumer preferences, and evolving consumer knowledge about vehicle technologies. While the pace of the transformation of vehicle markets is a complex process driven by many factors, some of which are out of Vermont’s control, state government and partner organizations can play a role in spurring change. Vermont can and should support increasingly stringent federal fuel efficiency standards and continue to explore options to improve the average fuel economy of the state’s vehicle fleet.

Increase Targeted Use of Low-Carbon Fuels and Biofuels

While electrification for Vermont’s light-duty fleet is a viable option, there are many heavy- and medium-duty applications for which electric options are limited. In those applications, alternative fuels—including biodiesel, ethanol, compressed or liquefied

natural gas, and potentially hydrogen—could offer a lower-carbon alternative to gasoline and diesel, with significant GHG savings and fewer emissions. While biodiesel is preferred to natural gas for heavy- and medium-duty applications, both biodiesel and natural gas are preferred over liquid petroleum products, and renewable natural gas is increasingly being used to meet national low-carbon transportation standards. Vermont can and should continue to support targeted use of low-carbon fuels and biofuels, particularly in hard-to-electrify sectors.

Pathway – Support Land Use Patterns that Increase Transportation System Efficiency

Land use patterns—what we build and where we build it—are a foundational building block of our transportation system. The choices we make about what and where we build has significant impact on how the transportation system is designed and operated to facilitate the movement of people and goods to the places they need to get to. The decisions we make today will be long lived and will define many parts of our daily lives in the future, including our energy use. Land use choices that support compact and mixed-use settlement can improve transportation system efficiency overall by reducing the distances between the places to which Vermonters travel regularly.

Enhance Integration of Land Use Planning into Transportation Decision Making Frameworks

Vermont has worked hard to support land use decisions that can meet multiple state goals, including revitalizing communities, increasing affordable housing and transportation options available to Vermonters, reducing energy consumption, and protecting important natural resources. The decisions we make around land use can either enable or impede our energy goals. Land use planning in Vermont includes a diverse set of actors with different expertise, interest, and authority. Better land use outcomes come from a common framework for evaluating and balancing land use goals for public infrastructure, energy supply, housing, transportation, working lands for agriculture and forestry, conservation lands, and other purposes.

Pathway – Increasing Transportation Choices

Transportation infrastructure that increases the quality and types of transportation choices available (often called Transportation Demand Management, or TDM), like public transit, ride share, bicycling and walking, provide alternatives to getting around by single occupancy vehicle. Importantly, these options can make transportation more affordable, encourage economic development in downtown and city centers by

increasing access, provide options for those who may have no alternative means, and promote an active and healthy lifestyle. These transportation choices make the transportation system more accessible and equitable, creates more livable, vibrant communities, and can reduce energy use and emissions from transportation.

Provide Safe, Reliable, and Equitable Public and Active Transportation Options

Transportation demand management options can reduce Vehicle Miles Traveled, which translates in a reduction in energy use and greenhouse gases. This CEP describes the current status of public transit, park & ride availability, rideshare programs, telecommuting, biking and pedestrian programs, and rail. Vermont already invests substantially in TDM options and should continue to do so.

Thermal & Process Energy Use

The heating of Vermont's residential, commercial, and industrial buildings and the fueling of our industrial processes are responsible for nearly 50% of Vermont's total site energy consumption, and 34% of the State's greenhouse gas emissions. Approximately 25% of the energy used to heat buildings and provide process heat in industrial application currently comes from renewable sources, primarily wood.

This Comprehensive Energy Plan expands the target of increasing renewable thermal and process supply to 30% by 2025, increasing to 45% by 2032 and 70% by 2042. With support from current programs, over 10,000 heat pumps were installed in 2020 and even more are expected to be installed in 2021, heating our buildings with more renewable electricity. But more needs to be done; significantly reducing the amount of thermal energy required via weatherization, as well as increasing the use of both bioenergy and continuing progress on heat pumps will also be necessary to reach this goal.

Pathway – Reduce Thermal Energy Demand

The two dominant areas of strategic focus for reducing demand include significantly scaling up weatherization activities to new levels not previously thought possible through new and innovative approaches and making new buildings as efficient as possible to substantially reduce thermal energy demand.

Weatherization-At-Scale

Investing in thermal efficiency improvements can dramatically reduce a building's thermal fuel requirements while increasing its affordability, health, and comfort. Investments in thermal demand reductions through weatherization programs are good for Vermont's economy, and perhaps more importantly, for Vermonters' health. Previous weatherization targets have come and gone without being met, but the efforts to reach them have highlighted key barriers to address, including lack of information, access to capital, tenant/landlord investment priorities, and a qualified workforce currently not sufficiently large to tackle the problem. Low-income Vermonters are particularly sensitive to these challenges, even if they may benefit the most from tighter buildings.

This Comprehensive Energy Plan sets a new target of weatherizing 120,000 households by 2030, relative to a 2008 baseline. Consistent with the expected recommendations of the Climate Action Plan, it is intended to be aggressive but technically feasible given the need to ramp up the workforce necessary to achieve the weatherization goal. Progress will not happen overnight; significant public and private investments will be necessary to ramp programs and services available to Vermonters to help make this transition. Actions include devoting significant federal monies to kick start the pace of weatherization, while building workforce and exploring opportunities for sustainable funding including developing partnerships with entities where weatherization leads to positive outcomes across sectors, including health care and property insurance. In addition, facilitating the weatherization process for customers including energy counseling services will ease the process.

Encourage Efficient New Buildings

Ensuring new buildings are constructed with the best available cost-effective technologies and practices is critical to avoid lost opportunities to reduce Vermont's thermal demand. Around 1,000 single family homes are built in Vermont each year, as well as hundreds of commercial buildings. Once built, they can last 75 to 100 years or more; these buildings must comply with Residential and Commercial Building Energy Standards that are updated every three years. **This Comprehensive Energy Plan maintains the target to achieve net-zero ready construction for all newly constructed buildings by 2030** through building energy standards. Net-zero ready is defined as "A highly efficient and cost-effective building, designed and constructed so that renewable energy could offset all or most of its annual energy consumption."

Pathway – Enhance Low-Carbon Technology and Fuel Choices

Energy consumption serves a variety of end uses in different types of processes and buildings and the choice of energy fuel and enabling technologies should match end-use application and space with the most efficient, renewable, affordable, stably priced option that fully serves the end use. However, Vermont home and business owners are often limited in the types of fuel they can choose from to meet their energy needs, due to factors such as existing capital investments and limitations in delivery infrastructure. It is critical that energy needs for end users be met adequately and equitably with low- or no- carbon fuels, and providing Vermont homes and businesses access to a wide variety of fuel choices will allow them to select the most effective fuel for their application. In this light, strategies to advance access to low-carbon fuels and enabling technologies are necessary. The two main strategies include consideration of a Clean Heat Standard, a “performance-based” obligation to reduce emissions from this sector, and the continued promotion of the use of low-carbon fuels such as electricity, advanced wood heat, biodiesel, and renewable natural gas, among others.

Consider a Clean Heat Standard

While Vermont currently has a variety of programs that seek to promote low carbon fuel choices in various ways, the state does not currently have a unifying mechanism to ensure reduced emissions from this sector such as the Renewable Energy Standard (RES) in the electric sector. The Energy Action Network has over the last year convened a “Network Action Team” to evaluate and design a Clean Heat Standard (CHS) that would create a market for a range of clean fuel choices. Similar to a Renewable Energy Standard for electricity, a Clean Heat Standard would seek to create a technology and fuel-neutral performance-based requirement on obligated heating fuel providers (either wholesale or retail providers) to procure an increasing percentage of their retail sales from low carbon thermal solutions, at a pace set by the Legislature. Obligated entities could comply with the requirement through an array of supply- or demand-side opportunities, such as increasing the supply of renewable fuels (e.g., biodiesel or renewable natural gas) or installing clean heat measures (e.g., weatherization, advanced wood heat, or cold climate heat pumps). **This Comprehensive Energy Plan calls for the formal consideration of a clean heat standard.** This measured step, consistent with the Climate Action Plan, will allow for equity considerations to be fully evaluated, as well as the total costs and benefits to all Vermonters.

Continue to Encourage Cleaner Technologies and Fuels

It is critical to expand low carbon and renewable supply to meet demand, including electrification as well as developing sufficient sustainable biofuels to supply difficult to convert fossil fuel market segments. To respond to this challenge and improve access to fuel choice, the state must encourage use of the most efficient, renewable, cost-effective technology that will meet users' end needs. This is done through the promotion of electrification of thermal loads, development of the advanced wood heat market, and support for district heat, biofuels, and alternatives to natural gas such as renewable natural gas, syngas, and hydrogen.

Affordability and Economic Vitality

Pursuing the goals and strategies in this CEP will support a vibrant economy, promoting an affordable and stable cost of living and doing business. Vermonters spend an average of about \$2.8 billion per year on energy across sectors, 70-75% of it on imported fossil fuels. These purchases have little benefit in terms of local economic activity; on the other hand, investments in energy efficiency, electricity, and wood heat contribute more (per dollar spent) to local economic activity.

Fossil fuels are expensive, and price swings are challenging for customers to budget for. Electricity rates are generally more stable. As Vermont electrifies its transport and thermal use, it is imperative to keep in mind that electric bills will have increasing importance. Cost pressures in the electric sector need to be transparent and carefully considered to ensure equitable energy transformation.

The clean energy transition creates many challenges, but also many opportunities. Vermont has a cutting-edge energy industry and infrastructure that entrepreneurs can engage with—including a near-statewide deployment of advanced metering infrastructure, innovative utilities, leading efficiency and regulatory expertise, and a robust renewable energy development community. The clean energy transition can both ensure an affordable and stable cost of living and doing business, while creating well-paying jobs in industries that support renewable energy and efficiency services. It will be critical, however, to carefully transition to ensure opportunities are equitably distributed, and that costs are not shifted onto Vermonters or Vermont businesses that are not positioned to pay more (See Chapters 2 and 3).

Conclusion

This CEP recognizes that there are many paths that must be pursued to meet our energy policy goals. It identifies many strategies that can, collectively, transform our energy future. Vermont must work via both public and private sector partnerships to advance an energy future that is affordable, reliable, environmentally sound, and equitably distributes the benefits and burdens of the State’s energy service needs.

Chapter 1 introduces this energy plan, including the statutory framework and introduction of key themes of equity and grid evolution that are addressed in Chapters 3 and 4, respectively. Chapter 2 describes the plan development process, including the analytical basis for the CEP.

Chapters 5, 6, and 7 detail historical and current energy use and prices in the transportation, thermal, and electricity sectors, respectively. Chapter 8 describes Clean Energy Financing opportunities to support the strategies outlined in the previous three chapters. Finally, Chapter 9 provides Vermont’s State Agency Energy Plan.

The appendices provide additional resources, including a description and results of the modeling efforts and Act 174 Energy Planning Standards for issuing a determination of energy compliance pursuant to 24 V.S.A. § 4352.