11 | Energy

Solar Panels in Woodstock | © TRORC

A. Introduction

The primary purpose of this chapter is to identify a path to implement the state's goals as outlined in the 2022 Comprehensive Energy Plan[1] (CEP) and the greenhouse gas reduction required by the Global Warming Solutions Act (GWSA) at the regional level.

As the CEP goals, federal and state policies, and energy technologies change, this chapter will need to be updated. Regional energy planning has benefited from technical support from the Vermont Department of Public Service (PSD), the Vermont Energy Investment Corporation (VEIC), the Energy Action Network (EAN), Green Mountain Power (GMP), Washington Electric Cooperative (WEC), and other organizations.

B. Background

Vermont's energy planning began in response to the oil crisis of the 1970s. The first comprehensive state energy plan was created in 1991 and required periodic updates. The most recent update was completed in 2022. Vermont's energy policy, as codified in 30 VSA § 202a[2], establishes these state goals:

- "To assure, to the greatest extent practicable, that Vermont can meet its energy service needs in a manner that is adequate, reliable, secure, and sustainable; that assures 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."

The 2022 Comprehensive Energy Plan (CEP) established the following set of goals:

- In the transportation sector, meet 10% of energy needs from renewable energy by 2025 and 45% by 2040.
  - » Zero-emissions vehicles account for 100% of light-duty vehicle sales by 2035.
- In the thermal and industrial process sector, meet 30% of energy needs from renewable energy by 2025 and 70% by 2042.
- In the electric sector, meet 100% of energy needs from carbon-free resources by 2032, with at least 75% from renewable energy.
- Weatherize 120,000 households by 2030, relative to a 2008 baseline.

Vermont statutes related to energy—requiring greenhouse gas reductions, renewable energy generation and building efficiency—are outlined below.

Greenhouse gas reduction goals (10 VSA § 578[3])

- "Greenhouse gas reduction requirements. Vermont shall reduce emissions of greenhouse gases from within the geographical boundaries of the State and those emissions outside the boundaries of the State that are caused by the use of energy in Vermont, as measured and inventoried pursuant to section 582 of this title, by:
  - » "not less than 26 percent from 2005 greenhouse gas emissions by January 1, 2025 pursuant to the State's membership in the United States Climate Alliance and commitment to implement policies to achieve the objectives of the 2016 Paris Agreement;
  - » "not less than 40 percent from 1990 greenhouse gas emissions by January 1, 2030 pursuant to the State's 2016 Comprehensive Energy Plan; and
  - » "not less than 80 percent from 1990 greenhouse gas emissions by January 1, 2050 pursuant to the State's 2016 Comprehensive Energy Plan."

25 by 25 state goal (10 VSA § 580[4])

- "It is a goal of the State, by the year 2025, to produce 25 percent of the energy consumed within the State through the use of renewable energy sources, particularly from Vermont's farms and forests."

Building efficiency goals (10 VSA § 581[5])

- "To improve substantially the energy fitness of at least 120,000 housing units and reduce greenhouse gas emissions by 0.15 MMTCO2e by 2031.
- "To reduce annual fuel needs and fuel bills by an average of 25 percent in the housing units served.
- "To reduce total fossil fuel consumption across all buildings by an additional one-half percent each year, leading to a total reduction of six percent annually by 2017 and 10 percent annually by 2025.
- "To save Vermont families and businesses a total of $1.5 billion on their fuel bills over the lifetimes of the improvements and measures installed between 2008 and 2017.
- "To increase weatherization services to low-income Vermonters by expanding the number of units weatherized or the scope of services provided, or both, as revenue becomes available in the Home Weatherization Assistance Fund."
- Renewable energy goals (30 VSA § 8005[6])
- The Global Warming Solutions Act[7] (Act 153 of 2020) mandated the creation of a Vermont Climate Action Plan (CAP)[8], which was released in 2021.

Weatherization is improving the building thermal envelope to increase energy efficiency of homes, reduce energy costs for residents, and improve health and safety. This includes a range of efficiency improvements from a 25% reduction in energy consumption to a more comprehensive standard.

- Energy Action Network

C. Energy Defined

Energy, as used in the 2022 CEP and this Plan, is not the same as electricity. Energy includes all forms of energy used by people for transportation, thermal (heating), and electricity. Energy can be expressed in British Thermal Units (BTUs). Charts in this Plan will be shown in BTUs, including million BTUs (MMBTUs).

D. Key Energy Issues

Environmental Protection

The consequences of our current pattern of energy use are increasingly alarming and urgent. National and international experts agree that if humanity does not immediately and dramatically reduce the use of fossil fuels, the negative consequences of climate change will alter human civilization.

According to the Vermont Department of Health's Vermont Climate and Health Profile Report[9] (September 2016), without a sharp reduction in greenhouse gas emissions, Vermont's climate will change substantially. By the end of the century, these changes may include:

- An increase in average annual temperatures of between 4 degrees F and 7 degrees F
- Increased dangerously hot days from 5 to more than 30 per year
- Lengthened tick and mosquito activity by about 40 days
- More frequent heavy rainfall events

Energy Security

The TRO Region's current dependence on fossil fuels is significant. The primary use of these fuels is for space heating (thermal) and transportation. In the TRO Region, roughly 13,000 households rely on oil as their primary source for heating, which means a substantial portion of the Region is subject to oil price and availability fluctuations.

Where the Region's electricity is generated is also a concern. Vermont currently obtains much of its electricity from hydroelectric facilities located out of state, primarily in Quebec. While these sources of electricity currently provide the Region with low-cost, renewable generation, the prospective construction of high-capacity transmission lines from Quebec to southern New England may create increased competition for electricity between Vermont and other New England states that are also seeking electricity from renewable sources. Reducing or maintaining current levels of the Region's reliance on imported energy will make the State and Region more energy self-reliant, especially in a future where electricity demand is anticipated to increase as the use of fossil fuels decreases.

Electricity provides the most viable path toward meeting the State's energy goals in several key areas. Electrification of passenger vehicles will dramatically reduce energy use and emissions in the transportation sector through use of more efficient vehicles. Similarly, the easiest transformation in space heating of existing residential buildings is to weatherize the structure and install highly efficient electric cold climate heat pumps.

Energy Justice

Equity is of critical importance in developing any public policy related to energy. Everyone in our society depends on energy for their daily life and livelihood, but the costs—both financial and environmental--of providing this energy are not distributed equitably. Historically, people of color and poor people have suffered disproportionately from adverse health impacts caused by energy production and from the effects of climate change. The concept of energy justice[10] holds that these marginalized populations should be among the first to benefit from the transition to clean energy.

In Vermont, and in the TRO Region, a just transition to clean energy will ensure that poor and other marginalized people have equitable access to home weatherization and green technologies such as solar power, electric vehicles, and heat pumps. Such technologies often have high up-front installation costs, but come with lower operations and maintenance costs. For instance, installing a high efficiency heat pump can cost upwards of $20,000, but a household can save approximately $500 annually on heating bills. TRORC has an important role to play in bridging the gap between local communities and the federal, state, and utility incentives that can help reduce installation costs and allow marginalized people to reap the full benefits of green technology.

Undergirding this conversation about energy justice is the importance of keeping the cost of electricity affordable for all, even as demand soars due to the electrification of the thermal and transportation sectors. However, it is also

important to note that electrification will reduce the exposure of the Region's households and businesses to the volatile cost of fossil fuels. Any increase in the retail cost of electricity is subject to an intensive state regulatory process, while the cost of fossil fuels such as gasoline, home heating oil, and propane follow the fluctuations of the global market on a daily basis.

Economic Needs and Opportunities

Vermont spends nearly $2.4 billion and the TRO Region spends approximately $160 million annually on energy, with the vast majority of those dollars exported out of state when we buy gas and oil. This Plan, like Vermont's 2022 CEP, states that overall energy consumption will need to decline by about one-half by 2050 to meet our energy goals. That reduction can be accomplished through changes in land use patterns and the transportation system (by reducing the need for driving and by introducing more energy-efficient vehicle technologies); through extensive building upgrades and weatherization; and with energy conservation by means of more efficient appliances and devices, avoiding peak use, and by electricity storage technologies.

These improvements will also keep more of the money we spend on energy in the Region so that millions of dollars will be retained to circulate in local economies, supporting employment and social services, and improving the quality of life of our communities. The changes needed to reduce our energy demand and to produce local renewable energy offer a wide array of business and employment opportunities in renewable energy, energy storage, energy efficiency, and advanced transportation and heating.

E. Regional Energy Supply, Demand, and End Use

Energy use in Vermont is dominated by the transportation (38%) and residential (28.0%) sectors. According to Vermont Pathways Model modeling (energy modeling done by the State), in order to meet CAP mitigation goals, the TRO Region will have to reduce energy consumption nearly 50 percent — from 8,800,000 MMBTUs to 5,586,000 MMBTUs by 2050—and shift away from fossil fuels.

The State's goal of meeting 90 percent of energy needs from renewable sources by 2050 represents a substantial shift from our current energy portfolio. While 65 percent of Vermont's grid electricity came from renewable sources and 21 percent from nuclear (which is carbon-free) in 2022, electricity is just one source of energy consumption. Most energy used in the Region today still comes from fossil fuels burned for transportation and heat. The Region does get some thermal energy from wood as well. To reach the State's energy targets, transportation and heating will largely shift to electric. In turn, that electricity will require more renewable generation to be developed, and we believe most of this will be from solar.

The growth of renewable energy generation in Vermont and the Region over the last several years has been substantial. According to PSD data, Vermont has an installed capacity of 511 MW of solar power—57 MW in the TRO Region.

The proliferation of commercial wind energy generation in Vermont has been decidedly slower, primarily due to the costs of development and the complicated permitting requirements. Vermont has an installed capacity of roughly 151 MW of wind power. Our Region has not added any commercial wind power. Vermont has 575 MW of hydro power, largely developed in the early to mid-1900's. Hydro development has dropped off significantly since the early 1970s, due to a number of factors including stricter permitting requirements and the simple fact that many of the best sites were already developed. The TRORC Region has almost 40 MW of hydro, with the largest being the plant on the Connecticut River in Hartford.

F. Electricity Conservation and Renewable Generation

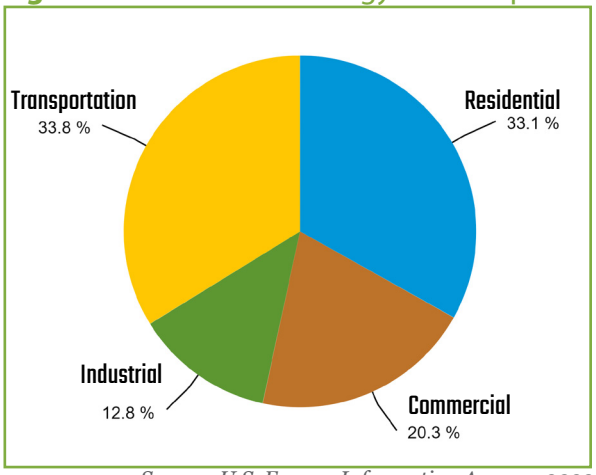
PSD-provided Low Emissions Analysis Platform (LEAP) data modeling shows that a nearly 50 percent decrease in overall energy use in the TRO Region is required to meet the CEP's goals for 2050, as well as the GWSA. At the same time, we must decarbonize the thermal and transportation sectors—mainly by converting to new electric technologies, such as cold climate heat pumps and electric vehicles. This means that electricity consumption is expected to increase significantly, even as our overall energy use declines. This fundamental change in the type of energy we use will require substantial changes at the utility scale.

Demand management is the lowest-cost option to help meet expected electricity demand. Installing energy efficient equipment and improving building

shells to reduce the need for space heating is essential to reducing our overall energy use. Proper load management can reduce demand during peak hours. Demand response techniques include time-of-use rates, smart rates, and energy use feedback. For example, water heaters can be timed to use power in the middle of the day when electric loads are less. Utilities can install advanced meter infrastructure (AMI), which increases system reliability and load management capabilities with two-way communications technology. AMI includes smart meters to enable utilities and customers to track and manage the flow of energy more efficiently, curb peak demand, lower energy bills, and integrate renewable energy sources and storage to the grid. AMI data and smart meter technology allow utilities to implement smart rates, which can vary the price of electricity to accurately reflect the cost of electricity: lower rates for low demand and higher rates during peak demand. This incentivizes lower electric use during peak times. But even with fully implemented demand-side management, fuel-switching to electricity will require new sources of renewable energy.

Our existing electric grid is not yet fully capable of allowing the placement of large renewable energy generation facilities in every community in our Region. Currently in the GMP region, for example, parts of Hartford and Hartland have poor circuit ratings, while the Washington Electric territory has no remaining capacity. In addition, energy supply (generation) and loads (end uses) must be kept in balance, even as customers change their end uses or renewable energy facilities respond to changes in generation. As the Region transitions to 90

Figure 11-1: Vermont Energy Consumption



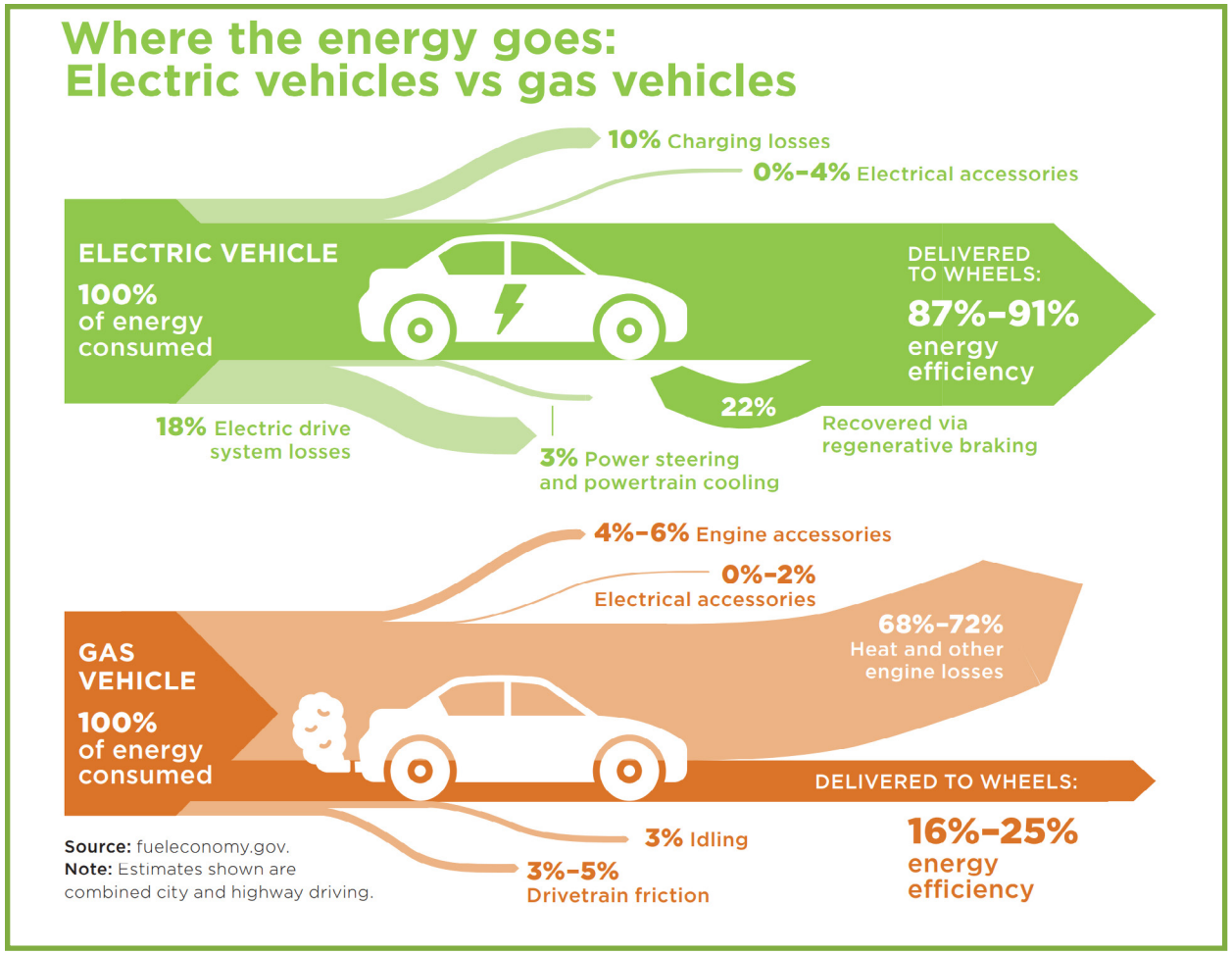
Source: U.S. Energy Information Agency, 2022

percent renewable energy by 2050 (with much of it produced in state), power companies and VELCO will need to undertake upgrades in places to expand grid capacity as well as manage load stability. This will include line upgrades, additional circuit connections, and, once the technology becomes readily available, greater provision of demand-side management (altering the timing of power use in places) and storage technologies. Electrical storage can closely align customer loads with periods of lower electric demand, store solar electricity to use during peaks, or provide some backup during power outages. EVs will eventually offer both a storage and generation capacity (pulling from their batteries). Paying for these additions to the grid will be costly, but needed to meet the transition to renewables.

Most electric utilities in the U.S. are required to meet state-mandated renewable energy requirements called Renewable Portfolio Standards[11]. Vermont's Renewable Portfolio Standard policy is called the Renewable Energy Standard, or RES[12], under which all utilities must be 100% Renewable by 2035. Because utilities constantly import and export power in order to meet demand, keeping track of how much renewable energy each utility uses is not easy to do. A clear system of accounting is needed to ensure that renewables are not being claimed by multiple utilities. That system of accounting is called Renewable Energy Certificates, or RECs[13]. RECs are created for every unit of renewable energy fed into the grid. Once created, RECs can then be purchased and traded among utilities; this way, utilities can accrue enough RECs to demonstrate compliance with their respective states' Renewable Portfolio Standards, even if they did not actually purchase the renewable power those RECs are associated with. RECs are not a perfect system, but they help regulators track renewable generation while accounting for the way electricity wholesale markets function—across multiple state jurisdictions and highly dependent on what type of power is available for import when it's needed.

In Vermont, many energy developers utilize the sale of RECs to help fund the construction of a project. The challenge is that RECs are often sold to utilities outside of Vermont. The energy generated by a renewable energy generation facility that has sold its RECs out of state does not count toward the state's energy goals. But it does count toward local and regional targets. Changes in legislation have made it possible to 'retire' RECs in state, thus allowing us to further increase our renewable energy portfolio. Efforts to increase that cap or encourage

Figure 11-2: Going Electric Saves Money



Source: Energy Action Network

their retirement in state should continue in order to ensure that the goals of the CEP are reached.

G. Transportation and Land Use

This section addresses the intersection of transportation, energy, and land use. The Land Use[14] and Transportation[15] chapters in this Regional Plan complement this section and have additional relevant policies and actions.

Vermont uses more energy for transportation than for any other sector: 38 percent of the total energy consumed in Vermont. To reach the GWSA targets for transportation greenhouse gas emissions (40% below 1990 levels by 2040 and 80% below 1990 levels by 2050) goals, Vermonters will need to switch from petroleum powered vehicles to electric vehicles at a large scale. It is also important to recognize that land use choices are inextricably linked to our transportation system. Vermonters travel far from their homes to jobs, services, and shopping.

Vermont's land use patterns are key reasons why transportation uses the largest portion of our energy. Where we work, go to school, shop, utilize services, and recreate is often not close to where we live.

Much of Vermont's appeal to homeowners is the ability to own a house in the country. While many communities have small villages or downtowns, residential development in our towns is mostly located outside of these areas on rural roads. The choice to live in a rural setting leads to longer commutes for work, shopping, and services.

This dispersed pattern of development is currently furthered by the way we regulate development locally. All communities allow residential development across much of their towns at low densities. In effect, this does not direct most growth to core areas, but spreads it throughout town. If this pattern of development persists, these communities will need to improve roads in rural areas to serve new development, resulting in higher costs to taxpayers for road maintenance and increasing vehicle miles traveled (VMT). Even with the electrification of vehicles, this will entail greater energy usage than needed if we have more compact settlement that enables walking, biking and greater use of public transit.

Another challenge for Vermont's transportation patterns is the lack of available public transit.

The Regional Transit Network map illustrates that access to public transit is currently difficult or nonexistent in many parts of our Region. Public transit provides less than 1 percent of the transportation in our Region. The rural character of the Region presents challenges for a traditional public transportation system. Long distances between homes and employment centers strain existing commuter bus routes, while the need for transportation in low population density areas presents a uniquely rural challenge to the system. However, transit systems could still replace many single-occupant vehicle (SOV) trips at a significant cost savings to drivers. The main impediment to greater transit is not that it costs more than cars; it is simply that we like to own cars.

The Region does have several public transportation services which are vital to our Region's population, and elderly and disabled transportation services give alternatives to people who wish to live independently but who are unable to drive themselves (a sector of the population that is rapidly growing).

In areas where local transit services are available, other challenges exist. Commuter bus routes that stop at regular intervals along their routes extend the length of the trip, making it quicker for someone with a car to drive themselves instead. The impact of regular stops can also make it challenging to time arrivals and departures in an economic center with hours of employment.

Developments that occur in areas that are either right on or nearby a public transit route are sometimes planned without considering public transit. If not considered during the planning stage, it is difficult to integrate public transit services into completed site plans. In addition, the location of residential subdivisions away from transit lines limits public access. Diverting an existing route to a new location is expensive and can have negative impacts on existing services.

Regular fixed route transit services, such as those in Hartford and Norwich, could increase ridership by adding additional buses and increasing the frequency of service. But to do so requires additional buses and drivers, both of which require significant funding. Funding also limits the hours of operation. Fixed route transit services in our Region are currently limited to early morning through evening, which means potential riders who work shifts outside of the traditional 9-5 model cannot take advantage of most public transit.

Finally, there are perceptions that public transit is a service geared toward low-income citizens. While it is true that these demographic groups benefit from public transit, public transportation services are available and useful to everyone.

A significant portion of commuters drive alone to get to work. This could be lessened with more carpooling, but Vermont's commuter lots are currently insufficient. While the State has increased the number of park and ride spaces significantly in recent years, expansion and facility upgrades are still needed. For example, many existing park and ride areas are not designed or sized to accommodate public transit services (allowing for bus circulation and efficient transfer of passengers). Furthermore, a new lot is needed at Exit #1 on I-89, and no state park and rides in the region provide EV charging above level 1 (equivalent to a 110-volt wall outlet). This is due to restrictions on for-profit venders at facilities that have received federal funds. TRORC encourages VTRANS to work with its federal partners on reforms that will allow for EV chargers throughout the state park and ride system.

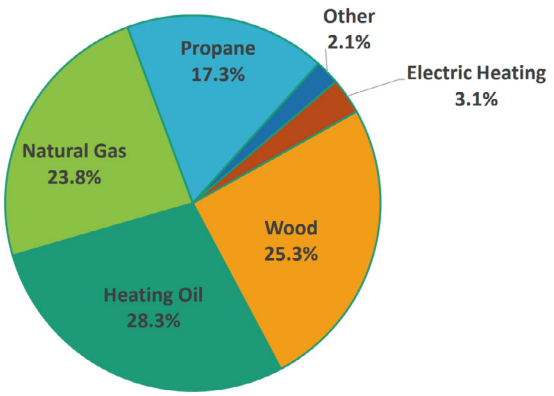
The lack of EV charging station infrastructure is an impediment to reaching the State's ambitious EV goals. While numerous models of EVs now have ranges of 250 miles or more, 'range anxiety' remains a major factor in the decision to purchase an EV. To support the State's EV adoption goals, EV charging stations will need to become ubiquitous. While, according to the Alternative Fuels Data Center[16], 50 publicly-accessible level 2 (240-volt) charging ports and 16 level 3 DC fast charging (or DCFC) ports are now available throughout the TRO Region, we have still not achieved this ubiquitous status where it will be as easy to charge as it is to buy gasoline.

Transportation and Land Use Strategies

To achieve the CEP's goals, transportation energy use must be reduced by embracing smart growth that directs development into existing centers, providing cost savings for households and municipalities while creating vibrant communities and taking pressure off our natural resources.

Development that is more effectively directed within and adjacent to historic downtowns, villages, and neighborhoods will reduce the need for motorized transportation and make better use

Figure 11-3: Thermal Sources Energy 2021



Source: 2024 Vermont Annual Energy Report

of transit. In 2006, via Act 183, Vermont codified its own detailed guiding principles for local and regional land use decisions based upon smart growth principles. Although communities are not required to plan, those that do are encouraged to uphold planning and development goals that reinforce smart growth principles, such as Complete Streets[17]. Complete Streets focus on multi-modal transportation, public transit, and pedestrian travel.

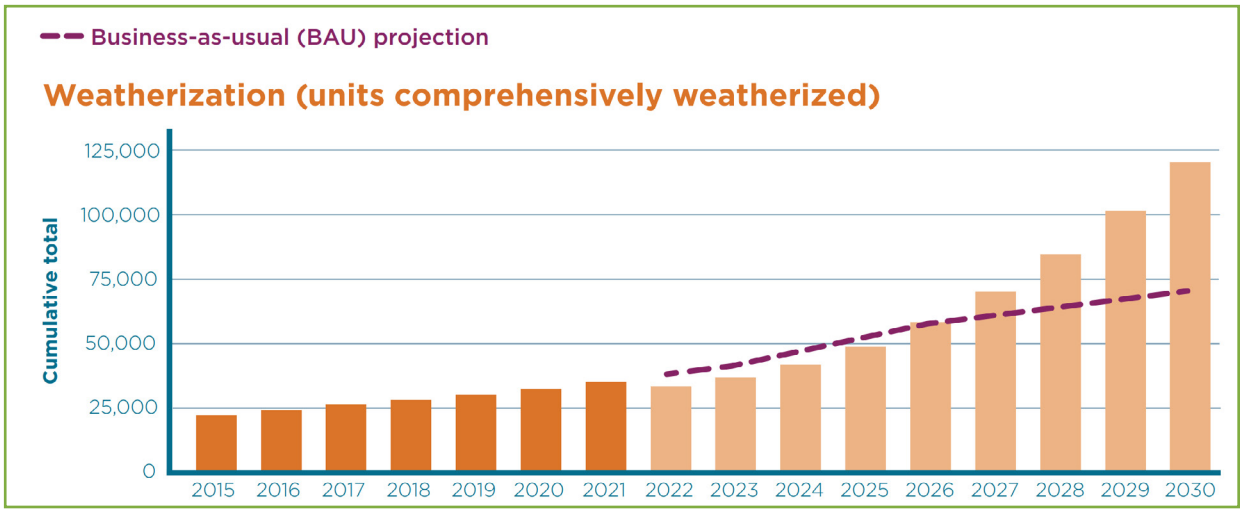
Encouraging economic development initiatives that enable individuals to work in their home communities, such as "maker" or "coworking" spaces and expanded high-speed Internet will also reduce VMT. Likewise, communities can support infill development and concentrated commercial and institutional activities in our villages and downtowns.

H. Thermal Energy

According to the 2022 Comprehensive Energy Plan, thermal and process energy use accounts for 31 percent of all energy use in Vermont. The reliance on heating from non-renewable sources (fuel oil, natural gas, and propane) creates a challenge for Vermonters that extends beyond energy issues. Low-income residents may find it challenging to stay comfortable in their own homes due to fuel costs.

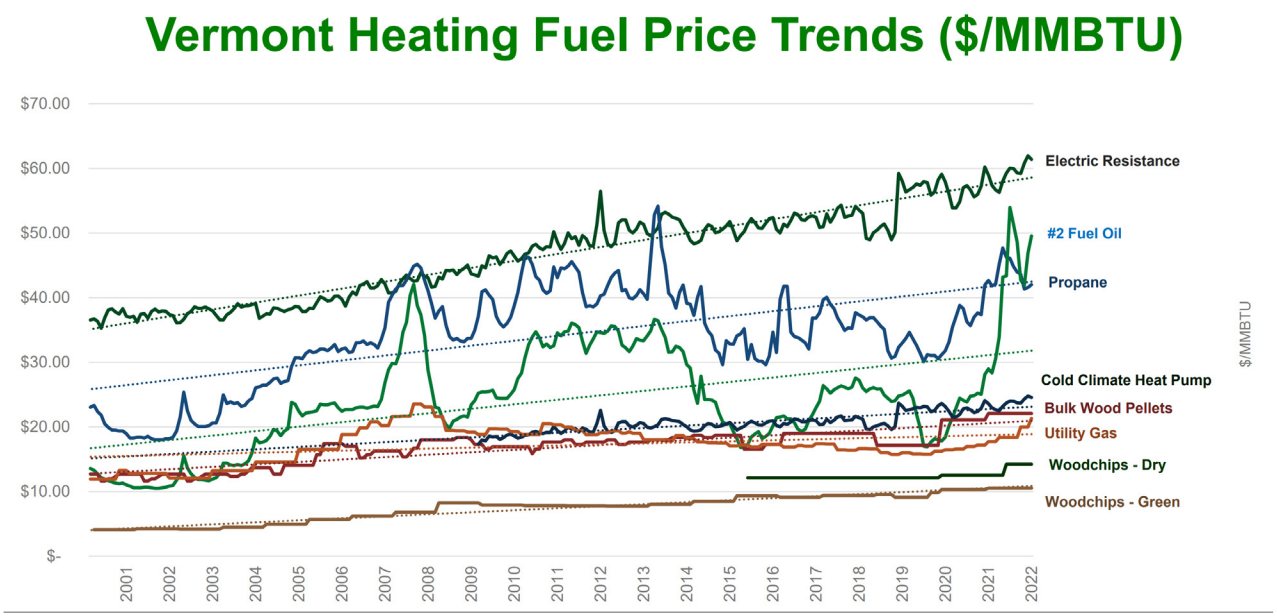
In addition to thermal efficiency improvements, the 2022 CEP is seeking a statewide change in how we heat our buildings. This approach will focus primarily on the installation of cold climate air-source heat pumps[18], which consume far less energy to produce the same amount of heat than electric resistance, propane, or oil heating systems. In order to meetcontribute to the Vermont Pathways model State's heat pump installation target (411,659 installed statewide by 2035), a total of over 30,610 heat pumps (residential and commercial sector combined) 26,982 will need to be installed in the TRO Region by 2035. In some cases, cold climate air-source heat pumps may be inadequate to meet a building's heating load during extreme sub-zero days (-20 degrees F). For example, air-source heat pumps for large commercial buildings may require substantial grid upgrades to meet demand on severely cold days, so secondary heating systems may still be required. It is always best to follow the advice of licensed, reputable professionals when installing new equipment in a building. In general, though, cold climate air-source heat pumps are effective, cheaper to operate than fossil fuel furnaces, and will fully meet the needs of Vermont households during 99% of the year. Because of this, TRORC

Figure 11-4: Vermont Homes Weatherized



Source: Energy Action Network, 2023

Figure 11-7: Vermont Heating Fuel Price Trends



Source: VT Public Service Department and the fuel price data came from the Energy Action Network, 2023.

expects cold-climate heat pumps to become the most common primary heating source in Vermont.

Geothermal or "ground source" heat pumps[19] are also a tremendous opportunity. These systems are substantially more expensive to install than air-source heat pumps but are even more efficient. They are better suited to new development than retrofitting into existing buildings due to the technology's requirements.

Where many buildings are located next to a concentration of other buildings, the CEP has also recognized the potential for district heating and/or combined heat and power, which are systems for producing heat in a centralized location and distributing it throughout the local area. District heating requires significant up-front investment to build infrastructure but can offer economies of scale.

New buildings will need to be built to a significantly higher level of performance than is required by the State's current Residential and Commercial Building Energy Standards[20]. Net-zero buildings are highly efficient and save 30 to 45 percent on overall energy costs in comparison with standard buildings. Efficiency Vermont's 2015 Net Zero Energy Feasibility Study[21] determined that new construction of residential and office net-zero energy buildings is a cost-effective investment. These buildings cost less to own and operate than standard code buildings from the first year into the long term. Towns can assess how far along they are in their energy target goals by contacting TRORC.

Meeting energy goals will be difficult in existing homes. In Orange and Windsor Counties, 47 percent of homes were built before 1970. These older homes were constructed before high energy costs made energy conservation a priority in the built environment. As a result, a substantial number of our homes utilize wasteful amounts of energy and are expensive to maintain.

To achieve GWSA requirements, approximately 15,697 of the Region's housing units will need to be weatherized by 2035.

The upfront cost of energy efficiency improvements and building-scale renewable energy generation remains a challenge. Despite the demonstrated long-term savings benefits, the capital needed to significantly reduce energy consumption and add renewables is a significant barrier to implementation. When surveyed as part of the East Central Vermont Sustainability Project, 39.5 percent of those who responded indicated that they could not afford to make their home more energy efficient. Another 33.8 percent were unable to make energy efficiency improvements because they rent instead of own. Cost is an issue for all homeowners, but especially for low- and moderate-income homeowners.

With upfront capital cost being a significant barrier to the implementation of thermal efficiency and renewable energy improvements, it is essential that programs that provide funding and financing grow.

In particular, programs providing assistance to middle- and low-income households must increase in funding. A list of current financing programs can be found on Efficiency Vermont's website[22].

These financing programs offer key features such as great interest rates, flexible terms, and ease of application. The loans can also be combined with Efficiency Vermont incentives.

While fuel assistance programs are essential, increased funding to Vermont's Weatherization Assistance Program (WAP)[23] is needed. In addition, fuel distributors must be encouraged to become energy service providers, expanding what they offer so that more homes can be weatherized and increase their energy efficiency. Some form of this model is likely to be implemented under Vermont's Clean Heat Standard[24].

TRORC can support these programs and initiatives by communicating directly with energy providers, state agencies, and the Legislature. We can provide input on state level initiatives, and we can, if the opportunity presents itself, pursue federal funding to support these programs within our Region. At the commercial and public sector levels, capital and operating budgets are often set independently of each other, resulting in lack of awareness of financial incentives for energy improvements.

Incorporating better insulation and air exchange is required for many renovations, but Vermont's system of building codes and energy efficiency standards enforcement is somewhat problematic. New Residential Building Energy Standards (RBES) and Commercial Building Energy Standards (CBES) came into effect on July 2024, but these rule changes do nothing to solve the Standards' weak enforcement mechanisms. Currently there are no state permits or code officials for energy efficiency. Energy efficiency is self-certified by the building contractor, with a requirement that a completed certificate be submitted to the municipality. However, some communities may be unaware of this requirement and how to track the submission of certificates. Towns with local code officials may enforce energy efficiency codes and towns with certificate of occupancy (COO) requirements must receive an energy code certificate before issuing the COO. Nearly two-thirds of TRORC's communities (19) have zoning bylaws, but less than half of those (9) require a COO.

Concurrently, the State needs to rachet up the standards set forth in the RBES and CBES. Standards for achieving net-zero design must be incorporated. Some regional builders such as Prudent Living's Southscape community[25] and VERMOD[26] are currently constructing net-zero possible homes.

If adequate funding was available, TRORC could develop additional staff positions that would focus specifically on energy assistance, education, and outreach. Without duplicating existing services, such as those that Efficiency Vermont, Vital Communities, Energy Action Network, and GMP offer, a TRORC staffer could act as a clearinghouse of energy information for our communities. Acting as a bridge between state-level service providers, contractors, and municipal organizations, TRORC would effectively move the Region toward meeting the CEPs goals relating to thermal efficiency. These services are already offered through our shared energy coordinator program, but only to member towns that buy into the program.

I. Utility-Scale Renewable Energy Facility Siting

Vermont's Public Utility Commission (PUC)[27] is the state's principal authority for granting permits to new grid-connected energy generation facilities, through a permitting review process known as "Section 248[28]." Under Act 174 of 2016[29], the PUC is obligated to give "substantial deference" to the portions of regional plans addressing energy development, if the plan has been submitted to and approved in advance by the Public Service Department (PSD). In addition, the PUC is obligated to give "substantial deference" to the energy chapters of town plans, if the plans have been reviewed and approved by the relevant regional planning commission. Essentially, by putting in the effort to gain this "enhanced energy plan" status, TRORC and towns can ensure that their preferences on siting are given greater weight in the PUC permitting process when new generation facilities are proposed in the regionir town, provided there are clear and mandatory standards in the plans.

Hierarchy of Suitability

All lands within the TRO Region have been analyzed on a rough scale using map data supplied by PSD. The energy potential maps were made by first identifying areas that have raw potential for certain types of power production based upon

certain qualities of the landscape. For example, only certain ridgelines are believed to have enough wind potential to justify building a wind turbine, and, usually, only lands with good exposure and gentle slopes make sense for solar development. It should be noted that the maps do not take into account whether lands are clear or forested.

These maps are not a policy document, and the "prime" areas on them do not necessarily mean that TRORC supports generation there, only that these are the areas where solar, wind, and hydro resources are present, and that they have good grid access

Solar Siting

Significant growth in the solar energy production sector in Vermont has sometimes led to a backlash against proposed facilities. The primary concern is one of aesthetics. For some, it is challenging to reconcile the appearance of a solar farm with the traditional rural character of the Region. Residents may also perceive a loss of property value when a solar facility locates near their home, although there is no hard data available to support this perception.

Also of concern are the natural resource implications of solar farms. Often these facilities are proposed in areas that are being used for agricultural purposes on valuable prime agricultural soils. While it is possible to conduct some forms of farming on land occupied by a solar system (such as small ruminant grazing), most agricultural uses become impractical, though the underlying land remains intact for future cultivation. For those farmers that lease land for feed production, the removal of actively used farmland from the pool of available land has the potential to negatively impact their operation. On the other hand, solar generation on marginal lands may provide farmers with needed income.

Ground-mounted solar arrays in areas served by sewer and water needlessly use up valuable space. Solar arrays in forests require clearing large amounts of trees that sequester carbon, negating their benefit.

Wind Siting

Only certain ridges are tall enough and big enough to have raw wind potential. Wind energy generation, although not as prevalent as solar, also has opposition due to aesthetic and noise impacts. Because these facilities must locate on ridgelines to maximize production, they are visible from a much greater distance than solar. Additionally, residents neighboring a wind facility may experience negative effects from the noise and flicker of the spinning turbines.

Large-scale wind energy facilities can have environmental impacts as well. Much of the land on our ridges is undeveloped, making it prime wildlife habitat. The installation of wind energy generation facilities and the infrastructure needed to maintain them (primarily roads), leads to the fragmentation of continuous blocks of forestland, which can disrupt migration patterns for wildlife.

Hydro Siting

Not surprisingly, sites with hydro potential are along rivers with steep drops. Most good hydro sites have been developed. The development of new hydroelectric projects is challenging. All new hydro projects that are grid-connected must seek permitting from the federal government, which is time consuming and expensive. Any development in our waterways requires a strict analysis of potential environmental impacts.

Unsuitable (Prohibited Locations)

The Regional Plan identifies some areas as poor locations for most forms of development due to their natural or scenic value or to protect our citizens from potential natural disasters. These areas have already been removed from consideration and are not shown in the constraint or prime areas on the maps. The policies at the end of this section state the unsuitable areas in the Region. Additional lands that the region has deemed unsuitable still leave many times over the needed amount of land to reach renewable energy targets, principally through solar installations.

Constraints

There are many areas that have the potential for renewable energy generation but include known or possible constraints that may make these locations less desirable. Constraint areas are neither preferred nor unsuitable; they simply identify potential issues for siting energy generation facilities. Development in these areas will require more detailed mapping at the site level as well as an evaluation of the impacts on

the particular resources present. State supplied map data used in this Plan has "known" constraint areas removed and therefore these do not show on the maps as potential or prime areas. From a policy level this Plan makes no distinction between "known" or "possible" and simply combines both as constraints. Areas with constraints include:

- Historic districts, landmarks, sites, and structures listed, or eligible for listing, on state or national historic registers
- State or federally designated scenic byways, and municipally designated scenic roads and viewsheds
- Special flood hazard areas identified by National Flood Insurance Program maps (except as required for hydro facilities)
- Public and private drinking water supplies, including mapped source protection areas
- Primary agricultural soils mapped by the U.S. Natural Resources Conservation Service
- Agricultural Soils (VT Agriculturally Important Soil Units)
- Protected Lands (Updated 07/26/2016 – State Fee Lands and Private Conservation Lands)
- Deer Wintering Areas (as identified by ANR)
- Act 250 Agricultural Soil Mitigation areas (as Identified by ANR)
- ANR's Vermont Conservation Design Highest Priority Forest Block Datasets
- Priority Forest Blocks – Connectivity, Interior and Physical Land Division (as identified by ANR)
- Hydric Soils (as identified by ANR)
- River Corridor Areas as identified by the Vermont Department of Environmental Conservation
- Class 2 Wetlands as indicated on Vermont State Wetlands Inventory maps or identified through site analysis
- Vernal pools (as identified by ANR or through site analysis)
- State-significant Natural Communities and habitats of rare, threatened, and endangered species

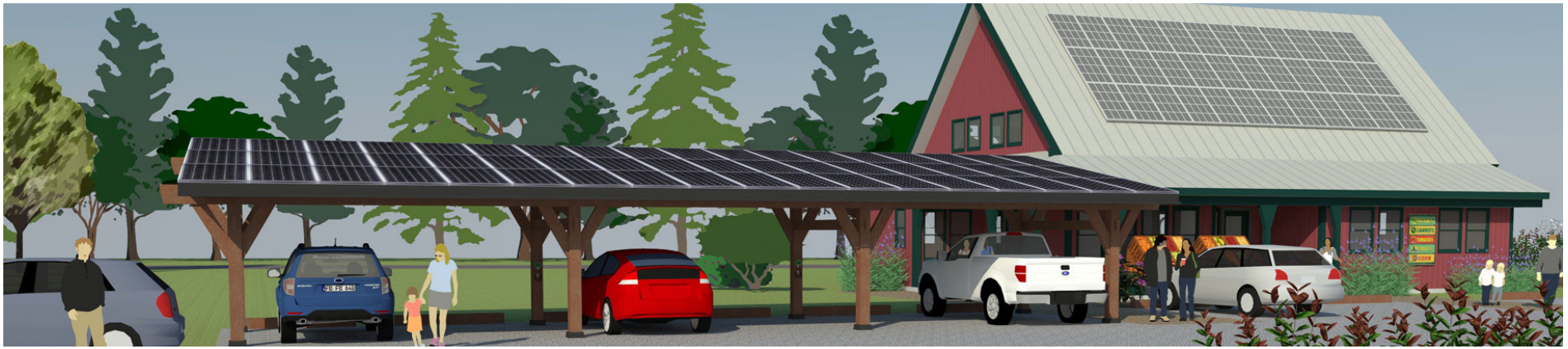
Prime and Preferred Areas

Areas that have good potential for renewable energy generation that are not in constraint areas and with good grid access are shown on the maps as "prime". Prime areas are neither a local or regional indication of approved for a site. Areas with local or regional approval are called "preferred" sites. Statewide preferred sites are identified in the PUC's net-metering rule 5.100[30] (page 8). These areas are typically small and are not shown on the energy siting potential maps. The maps included as part of this guide were developed at the regional scale. As such, they do not include preferred locations. Communities should use their local knowledge to identify additional preferred areas. They can include preferred locations as legislated in Act 174. Other considerations when identifying preferred areas within communities include existing infrastructure. For example, an area with immediate access to three-phase power or an upland area with existing road access may be more desirable than an area without. TRORC evaluates sites for preferred status after a local determination.

J. Conclusion

Vermont has established ambitious but needed energy goals that will require all of us to reduce energy use and to transition to using renewable energy for our thermal, transportation, and electricity needs. This will result in a safer, cleaner, and healthier world for us and our children. This chapter should be used to guide TRORC in its development of work plans, to focus attention on key issues and opportunities, and to provide a framework to evaluate energy conservation and development projects in the Region. TRORC will fully integrate energy planning into the technical assistance it provides its member towns and continue to coordinate with the Vermont Energy Investment Corporation, the Energy Action Network, the Department of Public Service, and other state agencies and departments to update and improve energy planning as necessary.

Improvements in the development and maintenance of accurate estimates of energy demand, fuel use, and renewable electricity generation will be needed to track progress toward goals and to help adjust local, regional, and statewide strategies and actions. TRORC will also remain engaged in statewide energy planning to ensure that future updates and information provided to municipalities remain current and consistent with state policies. A core message of the Energy chapter is that the quality of life and economic future of the Region is dependent on the efficient use of energy and access to a sufficient and sustainable amount of renewable energy. Planning for land use, transportation, community and economic development, and agriculture are interrelated must consider energy efficiency and the prudent development of renewable energy generation. The TRORC Energy chapter provides a basis for this comprehensive energy planning.



Concept Design of Parking Lot Solar Canopy | *Source: SunCommon*

Goals, Policies, and Recommendations: **Electricity Conservation and Fuel Generation**

Goals

1. Twenty-five percent of overall energy needs comes from renewables by 2025, 40 percent by 2035, and 90 percent by 2050.
2. The amount of renewable electricity generated in the TRO Region increases from 2022 levels by 86,740 MWh by 2050.

Policies

1. TRORC supports using demand-side management measures, such as Flexible Load Management (FLM), to manage the expected electric energy demand increase in the TRO Region.
2. TRORC supports Efficiency Vermont and other incentive programs to reduce electric energy use and encourage the use of devices and equipment that perform work using less energy input than otherwise necessary, such as Energy Star or CEE2, CEE[31] or advanced appliances.
3. TRORC encourages the deployment of grid resilience measures such as energy storage, microgrids, and grid hardening that lead to improved reliability of electric service for the region's residents.
4. TRORC will promote a wide variety of renewable energy generation types, including adding photovoltaic solar installations, wind turbines, and run-of-the-river hydroelectric facilities, optimizing existing hydroelectric dams, promoting sustainable use of bio-digesters, and encouraging passive solar building designs.

Recommendations

1. TRORC will advocate for the continuation of policies that lead to the retirement of Renewable Energy Credits in state.
2. TRORC will help interested towns meet the standards set forth in Act 174[32] for enhanced energy planning so that local preferences receive "substantial deference" in the Public Utility Commission's Section 248[33] proceedings.
3. PSD and TRORC should support and provide outreach for Energy Action Network's Community Energy Dashboard and Efficiency Vermont's customer engagement web portal and home energy reports.
4. TRORC and PSD should support efforts to develop programs that encourage energy conservation through behavioral change by advocating for smart grid technology[34] and a pilot of advanced meter infrastructure and time-of-use rates in the Region.
5. TRORC will maintain an enhanced energy compliant Regional Plan in order to play a stronger regional role in the Public Utility Commission (PUC) permitting process.
6. TRORC will work to expand its shared energy coordinator (SEC) program and encourage other RPCs to duplicate the model around the state.

Goals, Policies, and Recommendations: Transportation and Land Use

Goals

1. Regionwide vehicles miles traveled (VMT) per capita is reduced to 9,500. (In 2019, the statewide VMT per capita was 11,772[35]).
2. The number of single-occupant vehicle trips is reduced by 5 percent from 2024 figures by 2035 through remote work, carpooling, and public transit.
3. The percentage of light-duty vehicles registered in the region that are electric is increased to 5 percent by 2025, 57 percent by 2035, and 100 percent by 2050.
4. Usage of state and municipal park and rides triples by 2040.
5. By 2040, public transit ridership has increased by 100 percent compared to pre-pandemic levels, to 2 million trips annually. (In 2019, Tri-Valley Transit and Advance Transit reported a combined 1,040,776 unlinked passenger rail trips.)

Policies

1. Land use policy and regulation shall be designed to encourage use of public transit, cycling, and walking for daily trips.
2. All new residential, commercial, and industrial developments subject to Act 250 that provide five or more off-street parking spaces shall install level 2 (240V) EV chargers at a rate of one port for every five employees or residential units, as applicable. Developments with fewer than five employees or residential units must install at least one port. If the developer can demonstrate that installing on-site charging stations would be unduly onerous due to poor utility access or other site constraints, they may meet the requirements of this policy by installing the requisite number of chargers at a comparable in-region location. Nothing in this policy shall prohibit the developer from charging user fees at charging stations.
3. The development of new fossil fuel service stations is strongly discouraged in the TRO region. New service stations that provide alternative transportation fuels, such as electric vehicle charging and/or hydrogen, and the conversion of existing service stations to provide these fuels, is encouraged.
4. TRORC supports efforts to provide the Region with opportunities to work closer to home and to require public transit opportunities for large scale development, likely to result in conservation of energy.
5. All developments subject to Act 250 must demonstrate that they have consulted with transit providers about reasonable accommodation of public transit. This consultation shall include the appropriateness of a dedicated transit stop and covered transit shelter.
6. TRORC supports new bike and pedestrian projects in the Region.
7. The inclusion of bike racks and e-bike charging stations at new developments, particularly in the region's village centers and downtowns, is encouraged.

Policies (continued)

8. TRORC supports programs and planning initiatives that will reduce single-occupant trips throughout the Region, including Go Vermont and CarShare Vermont.

Recommendations

1. TRORC will encourage communities to develop bylaws that allow for the development of co-working spaces as a way to reduce VMT.
2. TRORC should work with large employers to create incentives for carpooling, cycling, public transportation use, and telecommuting.
3. TRORC will work with groups such as the Vermont Bicycle and Pedestrian Coalition (VBPC), Local Motion, Green Mountain Bicycle Club, and towns to encourage safe bicycling as a transportation alternative in the Region.

Goals, Policies, and Recommendations: **Thermal Energy**

Goals

1. By 2035, at least 63 percent of the Region's housing stock is weatherized.
2. By 2025, 30 percent of new buildings are built to zero energy ready standards[36] and 100 percent by 2030.
3. By 2035, 26,982 residential cold climate heat pumps are installed.
4. By 2035, 50% of new residential, commercial, and industrial developments of 20,000 sq ft and above will use geothermal heating systems.

Policies

1. TRORC supports state efforts to provide additional funding for weatherization improvements, especially for low- and moderate-income populations, and weatherization programs through Capstone and COVER.
2. New residential, commercial, and industrial developments subject to Act 250 shall not use fossil fuel combustion as a primary heating source.
3. Developers of new residential, commercial, and industrial projects subject to Act 250 shall demonstrate due consideration of ground-source (geothermal) heat pumps as a method of heating. Developers must also demonstrate due consideration of heat recovery technologies such as Energy Recovery Ventilators (ERVs)[37] and heat recovery from large-scale refrigeration and/or industrial processes as applicable.
4. TRORC supports net-zero energy construction throughout the Region.
5. TRORC supports the creation of enforcement mechanisms to enhance compliance with Vermont's Residential and Commercial Building Energy Standards (RBES and CBES).

Recommendations

1. TRORC should work with local energy committees, planning commissions, and developers in identifying potential users of district heating, Thermal Energy Networks (TENs)[38], and combined heat and power systems—schools, college campuses, apartment complexes, shopping centers, industrial parks, and village centers—and incorporate this information into local plans.
2. TRORC will work with other organizations to distribute information regarding the available financing mechanisms, rebates, and incentives for weatherization assistance, electrification, and fuel-switching, focusing on those most in need.
3. TRORC will partner with Efficiency Vermont, Green Mountain Power, Washington Electric Coop, HVAC contractors, and others to promote cold climate heat pumps.
4. TRORC should work to expand its shared energy coordinator program and support other RPCs in replicating the program in their own regions.
5. TRORC and local energy committees should work with owners of rental housing to educate them on the financial benefits of weatherization investments and should connect owners with contractors to complete weatherization projects.
6. TRORC and its towns should support programs and initiatives that encourage the development of small homes (less than 1,000 square feet) as a means of reducing energy use.
7. TRORC will provide outreach to towns and contractors on the use and enforcement of residential and commercial building energy standards for all new construction.
8. TRORC will encourage communities that have zoning to include a certificate of occupancy when they revise their regulations if they do not already have one.
9. TRORC should provide outreach to communities with a COO to ensure that they are tracking submissions of the RBES certificate.
10. TRORC will work to maintain forest health as a prerequisite to a sustainable wood energy fuel supply and carbon sequestration.
11. TRORC can assist communities with continued outreach regarding code compliance. We can also support the PSD as they move forward on adoption of more effective energy efficiency codes.
12. The State should support woodstove change-out programs to lower heat cost and reduce particulate emissions.

Goals, Policies, and Recommendations: **Utility-Scale Renewable Energy Siting**

Goal

1. Carefully sited renewable energy facilities are built in the Region to meet generation goals.

Policies

1. TRORC supports the continued development and siting of renewable energy generation that counts toward the goals of the RES, especially on preferred sites.

2. Ground mounted solar arrays above 15kW in capacity should not be constructed in Regional Growth Areas if a reasonable alternate location is available, in order to preserve these areas for compact development. Solar arrays on structures, included shaded parking in these areas are encouraged.

3. The following locations shall be considered regionally prohibited as unsuitable for renewable energy generation facilities: floodways shown on FEMA Flood Insurance Rate Maps (except as required for hydro facilities); Class 1 Wetlands as indicated on Vermont State Wetlands Inventory maps or identified through site analysis; National Wilderness Areas; projects in TRORC's Forest Based Resource Areas (please see Future Land Use, Map #3) and not in compliance with policies #12 and #14 under Forest-Based Resource Areas; and any unsuitable areas as identified in a duly adopted municipal plan that has received a determination of energy compliance from the Department of Public Service or TRORC.

4. Ground-mounted solar array facilities greater than 150 kW shall be designed to allow for permeability by small wildlife according to the standards set by the Agency of Natural Resources.

Recommendations

1. TRORC will encourage communities and residents to identify areas with the potential for renewable energy generation.

2. TRORC should provide support for grid improvements that will allow improved renewable energy generation facility coverage in our Region by actively participating in the Act 250 and Section 248 review process.

3. TRORC encourages ground-mounted solar array facilities to follow accepted best practices for maintaining wildlife-friendly grassland habitat, pollinator habitat[39], or agrivoltaics[40] within the facility's boundaries.

Energy Endnotes

1 https://publicservice.vermont.gov/about-us/plans-and-reports/department-state-plans/2022-plan
2 tes/section/30/005/00202a
3 https://legislature.vermont.gov/statutes/section/10/023/00578
4 https://legislature.vermont.gov/statutes/section/10/023/00580
5 https://legislature.vermont.gov/statutes/section/10/023/00581
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8 https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf
9 https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_CH_ProfileReport.pdf
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35 https://www.energy.gov/eere/buildings/zero-energy-ready-home-program
36 https://en.wikipedia.org/wiki/Heat_recovery_ventilation
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38 https://www.uvm.edu/sites/default/files/UVM-Extension-Cultivating-Healthy-Communities/horticulture/pollinators/VT_NRCS_Biology_TechNote_4.pdf
39 https://www.energy.gov/eere/solar/agrivoltaics-solar-and-agriculture-co-location#:~:text=Co%2Dlocation%2C%20also%20known%20as,or%20adjacent%20to%20solar%20panels.

Energy Endnotes (continued)

40 https://puc.vermont.gov/sites/psbnew/files/documents/5100-net-metering-effective-3-1-2024.pdf