ENERGY

11

White River Junction Solar Farm | © *Advanced Energy*

A. Introduction

The energy goals, policies, and recommendations in this chapter are intended to direct future development and to describe how energy development and generation shall occur in this Region in support of Vermont's 2016 Comprehensive Energy Plan (CEP). It is also intended to ensure that the TRO Region maintains a safe, efficient energy system that encourages energy conservation and the generation of renewable resources in a manner that does not negatively impact the rural nature of our communities. The primary purpose of this chapter is to identify a path to implement the VT 2016 CEP 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, the Vermont Energy Investment Corporation (VEIC), the Energy Action Network, Green Mountain Power, Washington Electric Corporation, and other organizations.

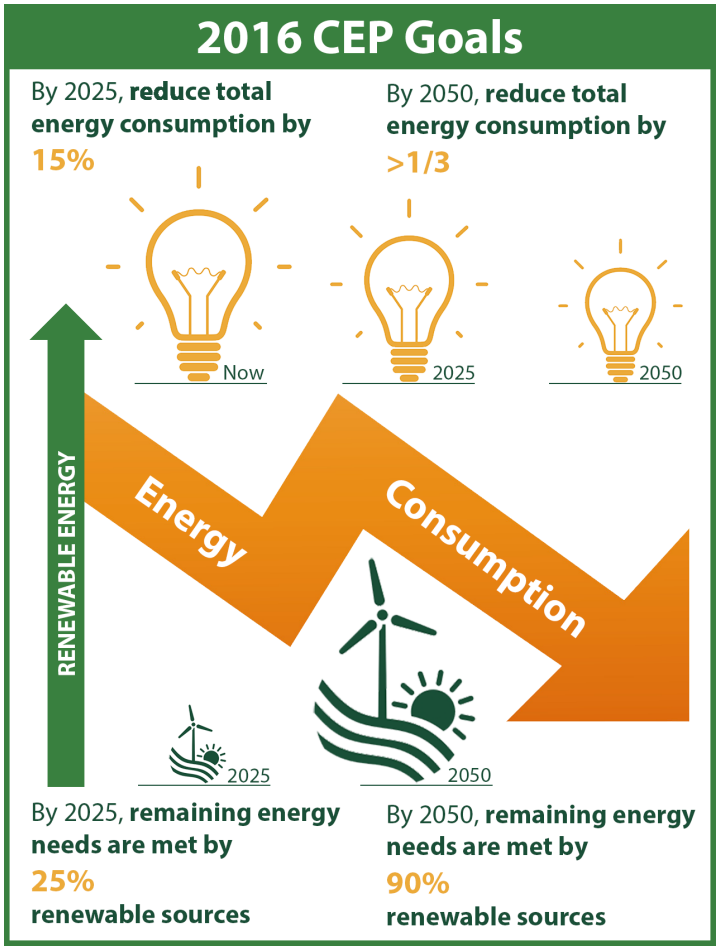
B. Background

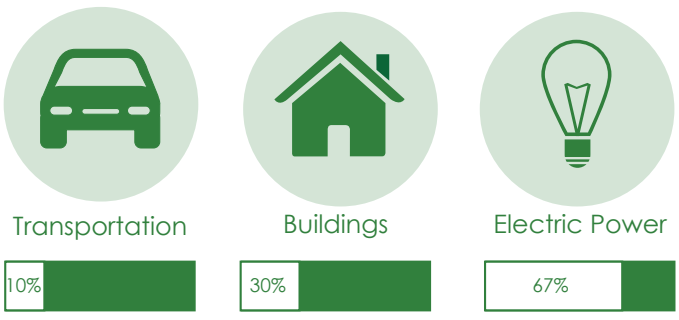
Vermont's energy planning began in the 1970s following the oil crisis at that time. The first comprehensive state energy plan was created in 1991 and required periodic updates. Vermont's energy policy, as codified in 30 VSA § 202a(1), establishes these state goals:

- 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.

Energy adequacy, reliability, security, and affordability are essential for a vibrant, resilient, and robust economy.[1] Environmentally sound and sustainable energy use ensures that we

Figure 11-1: 2016 CEP Goals





Source: VT DPS, 2016

are responsible stewards of Vermont and our children's future.

Expanding upon the statutory goal of 25% renewable by 2025 (10 VSA § 580(a)), the 2016 CEP established the following set of goals:

- Reduce total energy consumption per capita by 15% by 2025, and by more than one-third by 2050.
- Meet 25% of the remaining energy need from renewable sources by 2025, 40% by 2035, and 90% by 2050.
- Sectors that need to be renewable by 2025: 10% transportation, 30% buildings, and 67% electric power.

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)

- "It is the goal of the state to reduce greenhouse gas emissions . . . from the 1990 baseline by 25% by 2012; 50% by 2028; and, if practicable by using reasonable efforts, 75% by 2050."

25 by 25 state goal (10 VSA § 580)

- To produce 25% of energy consumed within the state through renewable energy by 2025.

Building efficiency goals (10 VSA § 581)

- To substantially improve the energy fitness of at least 20% of the state's housing stock by 2017 (more than 60,000 housing units) and 25% of the state's housing stock by 2020 (approximately 80,000 housing units);
- To reduce annual fuel needs and fuel bills by an average of 25% in the housing units served;
- To reduce total fossil fuel consumption across all buildings by an additional 0.5% each year, leading to a total reduction of 6% annually by

2017 and 10% 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 and/or the scope of services provided, as revenue becomes available in the home weatherization assistance trust fund.

Renewable energy goals (30 VSA § 8001-8014)

- To support the development of in-state renewable energy resources;
- To include renewable energy plants in the state's energy portfolio.

C. Energy Defined

Energy, as used in the 2016 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 thousand million BTUs (TMBTUs). A BTU is a measure of the energy content in fuel and is a helpful unit of energy when comparing different energy sources.

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

Table 11-1: Power and Energy Unit Defitions and Energy Unit Conversions

Power and Energy Unit Definition	
BTU	Unit measure of the heat content of fuels
kW	Unit measure for power equivalent to one thousand watts
kWh	Unit measure of power use as a function of time. One kWh is using one hour of electricity at a rate of 1,000 watts.
MW	Unit measure of power equivalent to 1,000 kW
MWh	Unit measure of power use as a function of time. One MWh is using one hour of electricity at a rate of 1,000 kilowatts.
Energy Unit Conversions	
1 kWh	3,412 BTUs
1 MW	1,000 kW
1 MWh	1,000 kWhs
1 gallon heating oil	138,500 BTUs
1 gallon gasoline	120,429 BTUs
1 pound wood pellets	8,400 BTUs
1 gallon propane	91,333 BTUs

consequences of climate change will alter human civilization.

"Climate change is the defining issue of our time – and we are at a defining moment. We face a direct existential threat. Climate change is moving faster than we are. If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change with disastrous consequences for people and all the natural systems that sustain us."

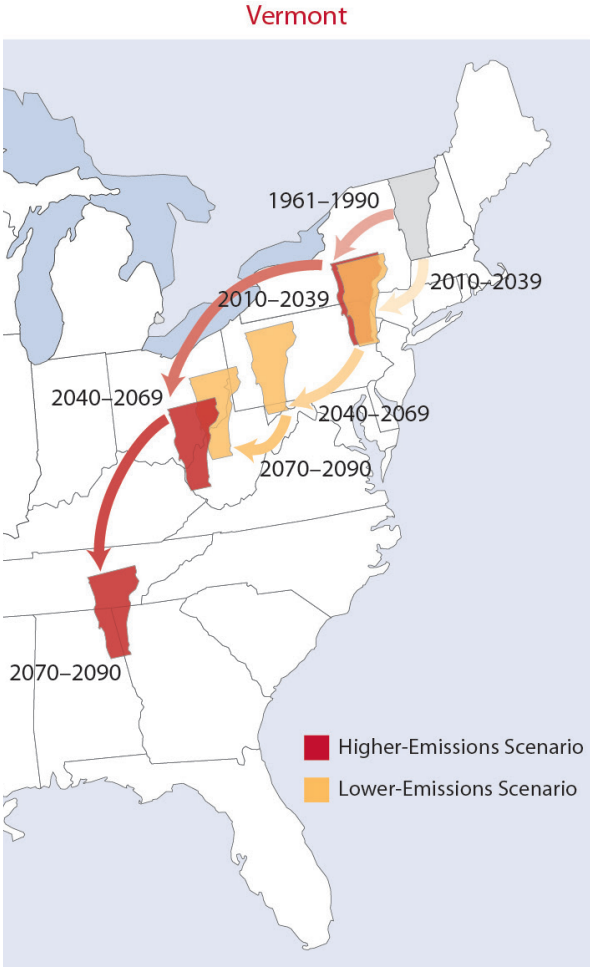
-UN Secretary-General António Guterres, September 10, 2018

An Intergovernmental Panel on Climate Change (IPCC) special report on the impacts of global warming was released October 8, 2018.[2] The 91 authors and review editors from 40 countries found that if greenhouse gas emissions continue at the current rate, the atmosphere will warm up by as much as 2.7 degrees Fahrenheit (1.5 degrees Celsius) above preindustrial levels by 2040, resulting in inundated coastlines, intensifying droughts, flooding and wildfires, increasing loss of ecosystems, greater poverty, and an increase in climate refugees. The report stated that to prevent 2.7 degrees F of warming, **greenhouse pollution must be reduced by 45 percent from 2010 levels by 2030, and eliminated completely (100 percent) by 2050.** The report also estimated the financial impact of the effects of climate change. The estimated $54 trillion in damage from 2.7 degrees of warming would grow to $69 trillion if the world continues to warm by greater than 3.6 degrees. The report concludes that the world is already more than halfway to the 2.7-degree mark and that humanity has only an estimated twelve years to keep temperatures contained to a maximum of 2.7 degrees before climate catastrophe occurs. Limiting global warming to 1.5 degrees C would require "rapid and far-reaching" transitions in land, energy, industry, buildings, and transportation.

Similarly, the Fourth National Climate Assessment issued by 13 U.S. federal agencies on November 23, 2018, presents the stark warnings of the consequences of climate change for the United States, including rising temperatures, extreme heat, drought, wildfires, heavy downpours, challenges to livestock health, declines in crop yields, and changes in extreme weather events that threaten rural livelihoods, food security, and price stability.[3]

According to the Vermont Department of Health's Vermont Climate and Health Profile Report (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:

Figure 11-2: Higher vs. Lower Emissions Scenarios



Source: Union of Concerned Scientists

- 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 dependence on fossil fuels is significant. The primary use of these fuels is for space heating and transportation. According to the U.S. Energy Information Administration, about 3/5 of Vermont households use fuel oil, kerosene, or propane for heating.[4] In the TRO Region, roughly 13,000 households rely on oil for heating, which means a substantial portion of the Region is subject to oil price and availability fluctuations. Of the total $885 million spent on residential energy in the State of Vermont, just over 50 percent ($445.8 million) was spent on fuel oil, kerosene, or light propane gas.

Where the Region's energy 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 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 secure, especially in a future where electricity demand is anticipated to increase as the use of fossil fuels decreases.

The demand for electricity across residential, commercial, and industrial sectors grew rapidly during the second half of the twentieth century but has leveled off in recent years. A variety of aggressive energy conservation programs implemented through the State's energy efficiency utility, Efficiency Vermont, contributed to slowing the growth of electricity demand. The need for electricity conservation and efficiency improvements will continue and become more important with increases in electricity demand due to the switching away from fossil fuel energy use for transportation and space-heating needs. 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 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 and/or modern wood heat systems.

Vermont and the TRO Region can be more energy self-reliant. Energy conservation and efficiency, coupled with in-state renewable energy generation, will decrease energy security concerns.

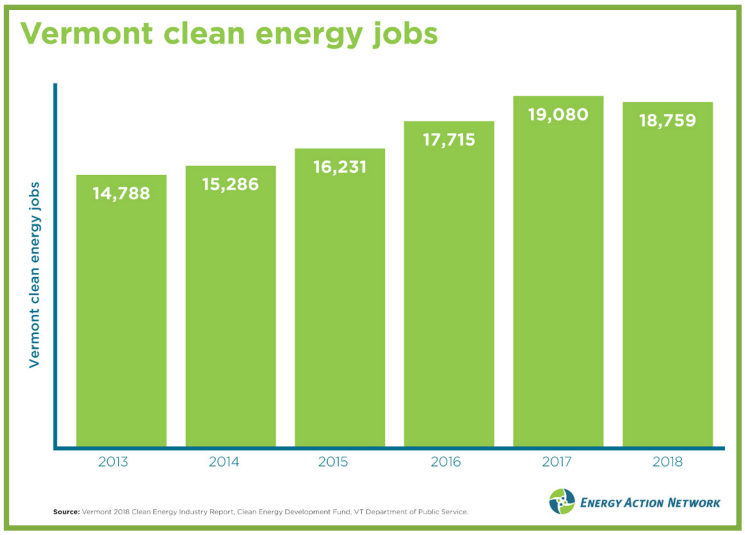
Economic Needs and Opportunities

Vermont spends nearly $2.4 billion[5] and the TRO Region approximately $160 million annually on energy, with the vast majority of those dollars

Air sealing a window frame with caulk
Photo Credit: Capstone Community Action

exported out of state as we buy gas and oil. This Plan, like Vermont's 2016 CEP, states that overall energy consumption will need to decline by about one-third 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.

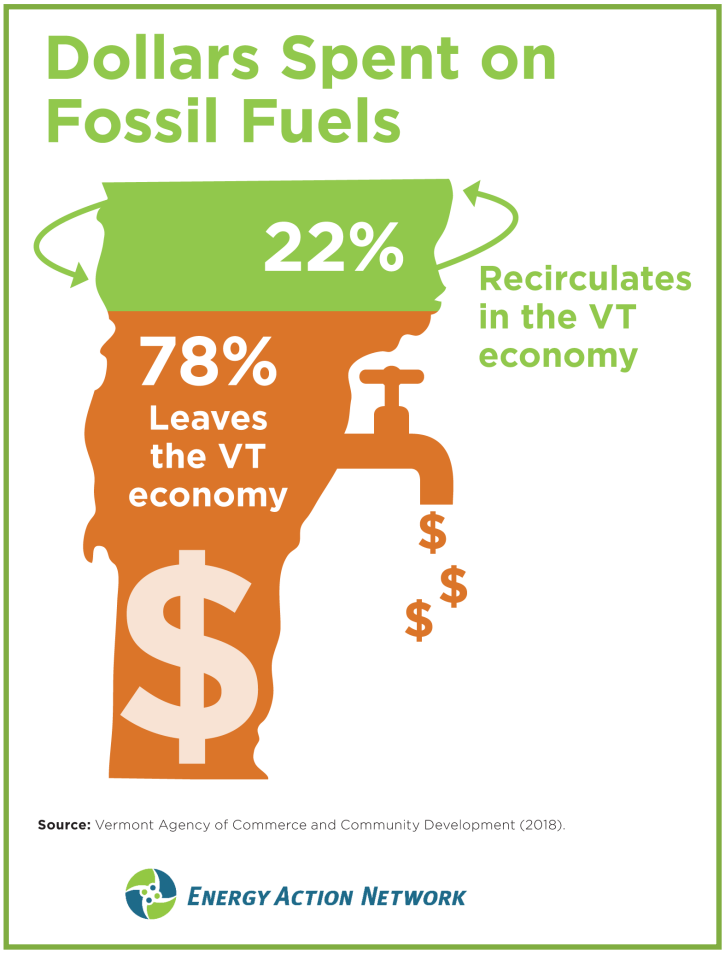
Figure 11-4: Vermont Clean Energy Jobs



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.

Weatherization of buildings, installation and servicing of new heating systems, procurement and delivery of biofuels such as wood pellets and cord wood, and constructing and servicing local renewable energy generation facilities offer new jobs and business development opportunities while providing opportunities for existing fossil fuel-based businesses to diversify using their existing capacity and customer networks. Economic growth in the renewable energy sector has been robust over the past five years. Vermont has seen a roughly 20 percent growth in clean energy employment sectors overall.[6] In 2016, 6 percent of Vermont's total jobs were in the clean energy sector. Clean energy jobs include those in renewable energy, energy storage, energy efficiency, and advanced transportation and heating.

Figure 11-3: Dollars Spent on Fossil Fuels



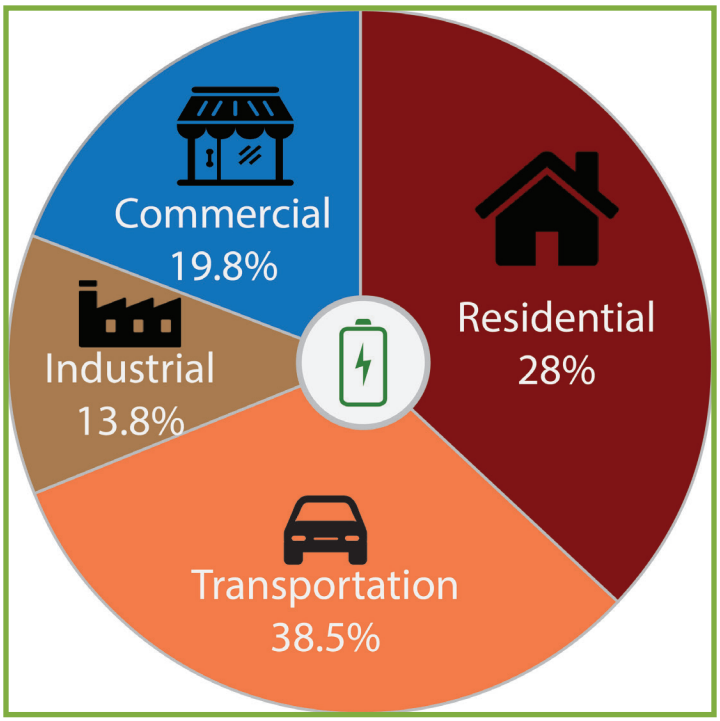
E. Regional Energy Supply, Demand, and End Use

Energy use in Vermont is dominated by the transportation (38.5%) and residential (28.0%) sectors. To meet the 2016 CEP goals, based on the Vermont Energy Investment Corporation modeling described in Appendix J of this Plan, the **TRO Region will have to reduce energy consumption nearly 50 percent — from 11,000 TMBTUs to 5,550 TMBTUs by 2050**. As seen in the Figure 11-7, in this model, overall energy use will decrease due to efficiencies; fossil fuel (non-renewable) energy use will dramatically decrease; and renewable energy will meet 90 percent of total energy demand.

The State's goal of getting 90 percent renewable energy from renewable sources by 2050 represents a substantial shift from our current energy portfolio. Sixty percent of Vermont's electricity currently comes from renewable sources, a majority of which is hydropower generated by Hydro Quebec. A growing percentage of energy is now coming from wind and solar sources, but most energy used in the Region today is still coming from fossil fuels (see Figure 11-6) and is used for transportation and heat. The Region does get some thermal energy from wood as well. To reach the State's renewable energy generation targets, more renewable generation will need to be developed and we believe most of this will be from solar.

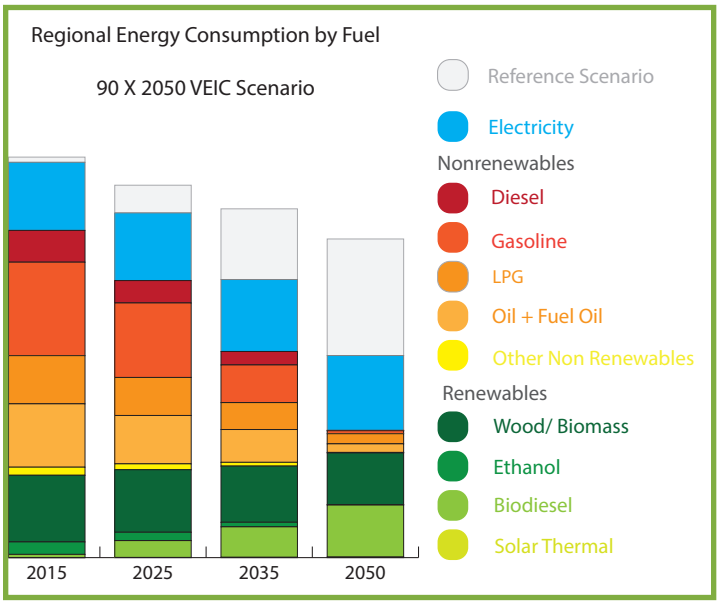
The growth of the renewable energy generation industry in Vermont over the last six years has been substantial. As of December 2018, Vermont generates roughly 361 MW of solar power—37 MW from the TRO Region. The proliferation of commercial wind energy generation in Vermont has been decidedly slower, primarily due to the costs of development and the complicated permitting requirements. Vermont generates roughly 151 MW of wind power and 634 MW of hydro power.[7] Hydro development has dropped off significantly since the early 1990s, due to a number of factors including the loss of economic incentives and stricter permitting requirements.[8]

Figure 11-5: Vermont Energy Consumption



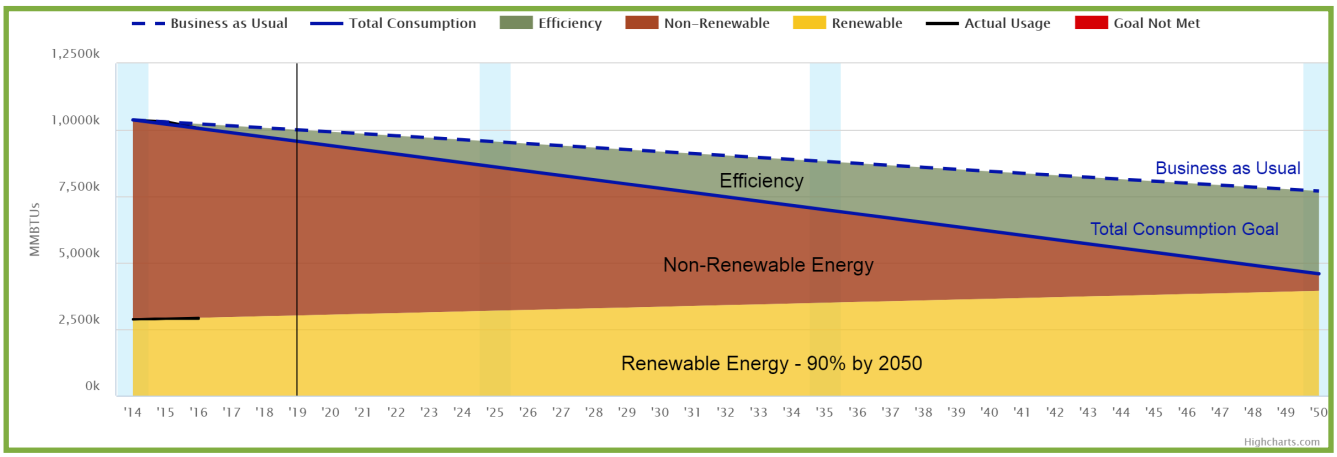
Source: U.S. Energy Information Agency, 2016

Figure 11-6: Regional Energy Consumption by Fuel



Source: VEIC

Figure 11-7: TRORC Energy Goals Time Table



Source: Energy Action Network, 2019

F. Electricity Conservation and Renewable Generation

The data modeling used to create the scenario that this Plan uses to achieve the goals of the 2016 CEP projects a 50 percent decrease in overall energy use in the TRO Region. The significant reduction in the use of fossil fuels ultimately requires an increase in our dependence on electricity. One possible path for the Region to achieve 90 percent renewable energy use by 2050 includes increasing electricity demand by roughly 10 percent (from 2015 levels) to offset decreases in fossil fuel use. The increase in electricity consumption will be due to the utilization of new electric technologies, such as cold climate heat pumps and electric vehicles. This fundamental change in the type of energy we use will require substantial changes at the utility scale.

Energy demand management is the lowest-cost option to help meet expected demand. Installation of energy efficient devices or equipment and improving building shells to reduce the need for building heat 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. Residential energy demand is seen in Figure 11-8.

New technology, demand-side management, gains in efficiencies in appliances, upgraded building codes, and renewable generation alone will not be sufficient to achieve the State's energy goals. People will have to alter their behavior to conserve energy and use less. Much of what we do depends, in one form or another, on energy. Where we live and work; how we get from place to place; how we design, build, and heat our houses; and how we use our land are all patterns of behaviors, controlled by social norms. Energy savings can be achieved by small behavior changes such as turning down thermostats,

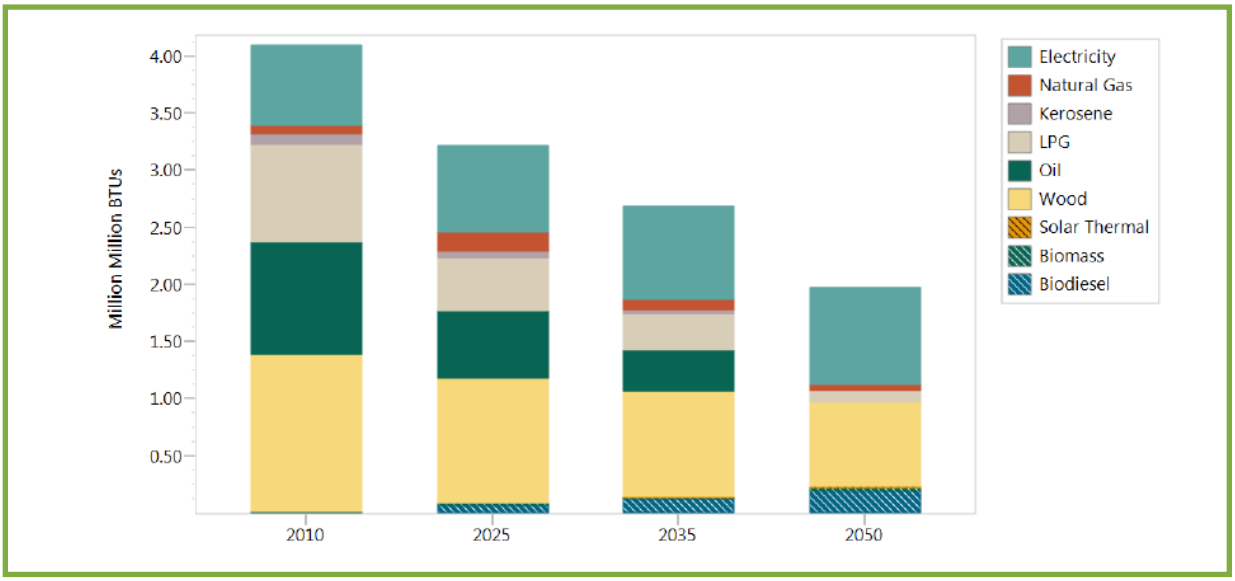
air drying clothes, and turning off electronic devices when not in use. Programs such as Efficiency Vermont (EVT), Go VT, and Button Up! are designed to educate people on ways they can change their behavior to reduce energy consumption and greenhouse gas emissions. If provided with good materials, local energy committees can successfully implement programs like these at the local level. Additionally, properly designed smart rates can either encourage or discourage usage at certain times of the day. Small changes in routine, such as shifting power-hungry activities to "off-peak" hours in the morning or evening, can help ease the load on the Region's power grid. Electrical storage can closely align customer loads with periods of lower electricity demand, store solar electricity to use during peaks or provide some backup during power outages. TRORC can only indirectly implement many of the strategies related to electricity conservation. These strategies require action from utilities; state, federal, and municipal governments; and individual citizens.

Meeting the goals of the 2016 CEP will mean that in the TRO Region, we will go from using 1.8 TMBTU of electricity to 2.1 TMBTU. Because 90 percent of our energy must be from renewable energy, new renewable energy generation facilities will need to be built throughout our Region. TRORC and its municipalities will need to clearly identify areas where and what kind of renewable energy generation facilities are appropriate.

The Vermont electric grid was developed to function as an importer of electricity. As with the rest of the United States, Vermont has depended on a small number of centralized power plants, the vast majority of which are located outside of the State. This classic model of energy distribution has a number of significant disadvantages due to inefficiencies and power loss over lengthy transmission lines.

Our existing electric grid is not yet fully capable of allowing the placement of small 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 instantaneously kept in balance, even as customers change their end uses or renewable energy facilities respond to changes in generation. As the Region transitions

Figure 11-8: TRORC Residential Demand by Fuel



Source: Vermont Energy Investment Corporation, 2015

Figure 11-9: What will it take to reach 90% by 2050?

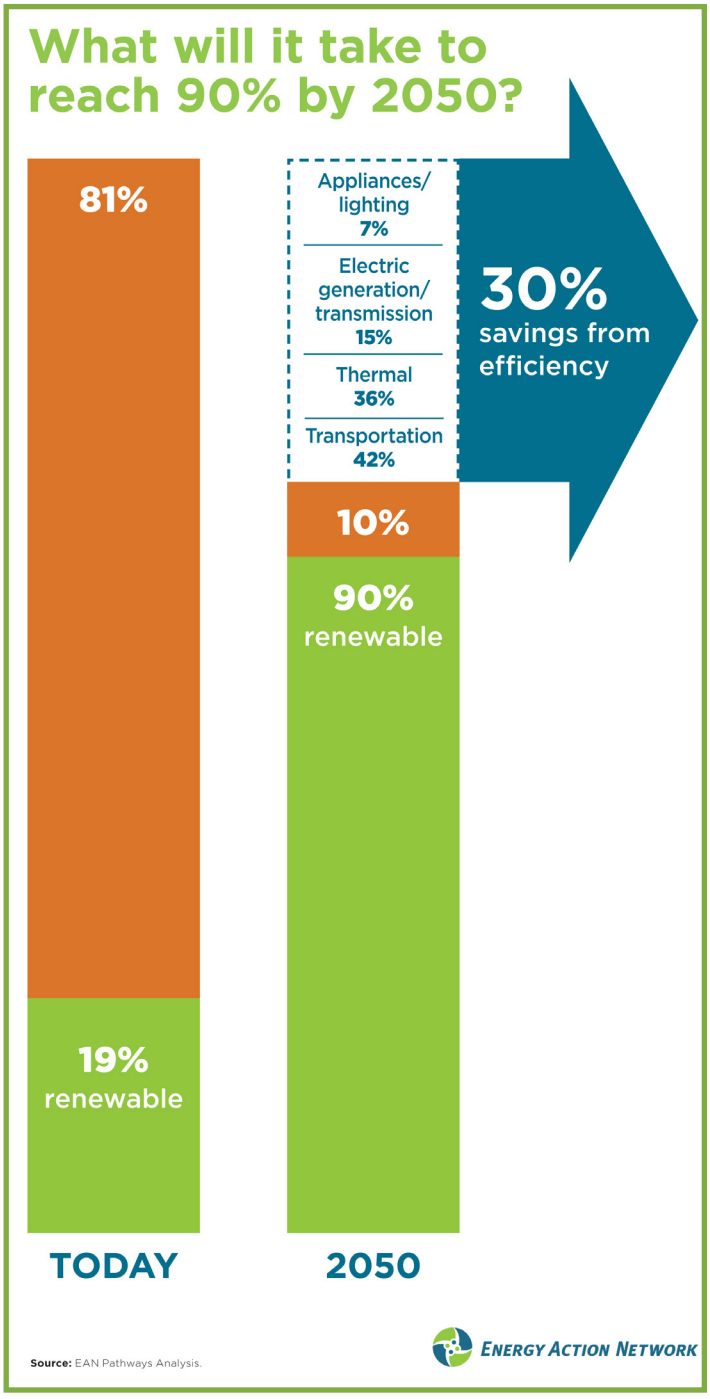
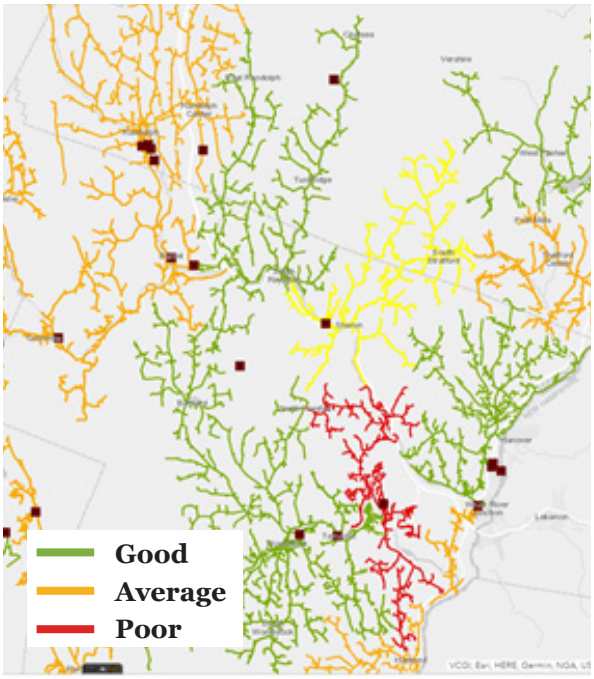


Figure 11-10: GMP Circuit Rating for Distributed Generation



to 90 percent renewable energy (with much of it produced in state), power companies and VELCO will need to increase the pace of system-wide upgrades. This will include line upgrades and, once the technology becomes readily available, the provision of storage technologies such as Tesla's new Powerwall battery system. 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.

New England states are required to meet state-mandated renewable energy requirements. When renewable energy generation facilities are built, the development gains renewable energy credits (RECs), which utilities throughout New England can purchase to claim the renewable attributes of generation that they do not own. In Vermont, many 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. Act 56, which was passed in 2015, has increased the number of RECs that need to be retired in state. Efforts to increase that cap or encourage their retirement in state should continue in order to ensure that the goals of the CEP are reached.

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

Goals

1. Twenty-five percent of overall energy needs comes from renewables by 2025, 40 percent by 2035, and 90 percent by 2050. Sixty-seven percent of energy uses will be powered by renewable electricity by 2025.
2. The amount of renewable energy generated in the TRO Region increases from 2015 levels by 163 MW by 2050.

Policies

1. TRORC supports using demand-side management to manage the expected electric energy demand increase by 2050 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, or advanced appliances.
3. TRORC encourages state policy to adopt energy storage mandates and incentive programs.

Recommendations

1. TRORC will provide education and outreach to municipalities on energy generation.
2. TRORC will advocate for continued incentives that lead to the retirement of renewable energy credits in state.
3. TRORC will help interested towns meet the standards set forth in Act 174 for enhanced energy planning so that local preferences receive "substantial deference" in the Public Utility Commission's Section 248 proceedings. "Substantial deference" is a term used in statute but has not been further defined in proceedings or litigation.
4. TRORC should promote the use of programs such as eHome and Zero Energy Now! in conjunction with Green Mountain Power and the Building Performance Professionals Association of Vermont (BPPA-VT) through outreach and education.
5. The Department of Public Service (DPS) should work with BPPA-VT to encourage HVAC and weatherization providers to join the organization to provide holistic energy advice to the Region.
6. DPS 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.
7. TRORC and DPS should support efforts to develop programs that encourage energy conservation through behavioral change by advocating for a roll-out of smart rates in the Region.
8. TRORC should fully integrate energy planning into the technical assistance it provides its member towns.

Goals, policies, and recommendations continued on next page

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

Recommendations (continued)

9. TRORC will work with partners to promote a wide variety of renewable energy generation types, including adding photovoltaic solar installations and wind turbines, optimizing existing hydroelectric dams, promoting sustainable use of biomass and bio-digesters, and encouraging passive solar building designs.
10. TRORC will develop easy to understand materials about the State's energy goals and how they interact with local and regional planning.
11. TRORC will maintain an enhanced energy compliant Regional Plan in order to play a stronger regional role in the Public Utilities Commission (PUC) permitting process.
12. TRORC will work with member towns on exploring possible shared energy program services aimed at improving efficiency and adoption of electrification and conservation measures, including hiring a multi-town energy coordinator.

F. Transportation and Land Use

This section addresses the intersection of transportation, energy, and land use. The Land Use and Transportation 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: 38.5 percent of the total energy consumed in Vermont. To reach the 2016 CEP goals, Vermonters will need to switch from petroleum powered vehicles to electric vehicles and vehicles powered with biofuels. 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. The 2016 CEP seeks to reduce transportation energy use by 20 percent from 2015 levels by 2025.

Progress toward the goal of changing 90 percent of Vermont's vehicles to electric vehicles may be slow at first since cars and trucks have long operating lives. An electric vehicle using the same amount of BTU energy as a gas car travels four times farther. To meet the 2016 goals for transportation, reducing the amount of daily driving would also be necessary.

Vermont's land use and transportation 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.

The rural nature of our Region also means that there are limited locations for key centers of employment. Out of the 30 towns in the TRO Region, only seven could be considered centers of employment. These are Bethel, Bradford, Hartford, Norwich, Randolph, Royalton, and Woodstock. Further, a significant number of those who live in Orange and Windsor Counties work outside of the Region in the Hanover/ Lebanon or Montpelier areas.

This dispersed pattern of development is currently furthered by the way we regulate development locally. Many communities allow residential development in much of their towns, and often at village-scale densities (one to two acre) in rural areas. 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 undue costs to taxpayers for road maintenance, increasing vehicle miles traveled (VMT), and making it more difficult to use transit.

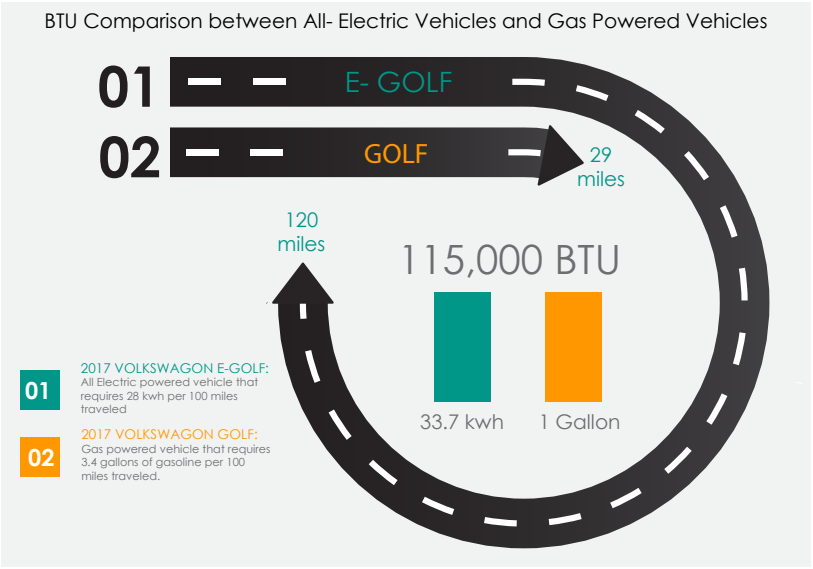
Another challenge for Vermont's transportation patterns is the lack of available public transit. The Regional Transit Network map in Figure 4-10 illustrates that access to public transit is currently difficult or nonexistent in many parts of our Region. Public transit provides less than 1 percent of 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.

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. Capacity is also an issue. Buses could expand to hold 50 riders versus 24, but that would require transit stops to be reconfigured to accommodate larger vehicles.

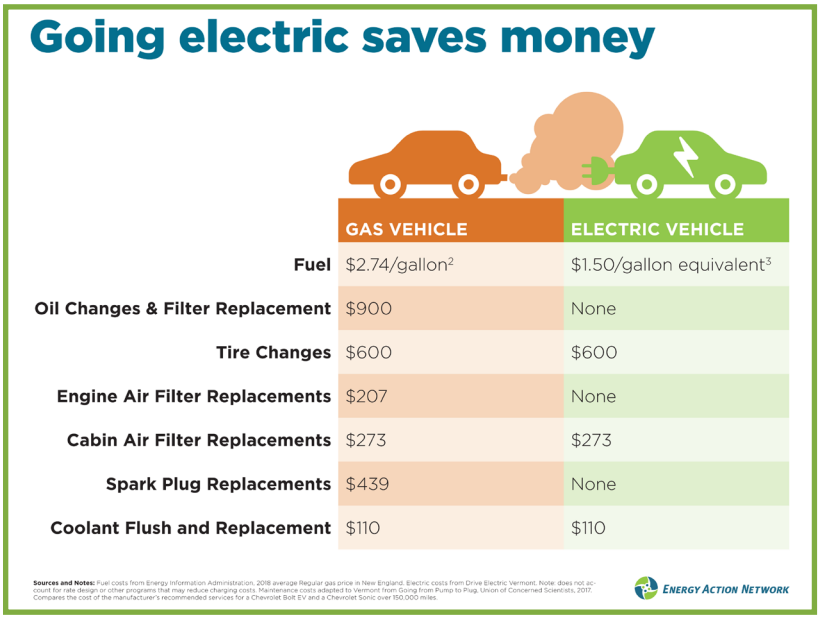
Developments that occur in areas that are either right on or nearby a public transit route are

Figure 11-11: BTU Comparison between All-Electric Vehicles and Gas Powered Vehicles



Source: Fueleconomy.gov

Figure 11-12: Going Electric Saves Money



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.

Act 250 considers public transit as part of Criterion 5 (Transportation), but at the local level, integration of public transit services into the development review process is less common. Public transit agencies are generally involved in the beginning of the planning or conceptual design process. This means that design standards for bus pull-offs, sufficient stopping distances and sight lines, bus shelter amenities, bike racks, and sidewalks are not included as part of the permitting process.

Regular fixed route 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 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 by 67 percent since 2012, and the Region has added seven new park and ride lots with over 200 more spaces in the last seven years, existing park and rides are struggling to meet demand due to space limitations. A number of existing areas could likely serve twice the population of commuters if they had adequate area for expansion. 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). Additionally, there are very limited locations where new commuter lots could be built. New lots are needed at Exits #1 and #3 on I-89 and more spaces are needed at Exit #2 on I-89. In addition, as of 2017, only five state park and rides and three municipal lots provide EV charging infrastructure.[9]

The lack of EV charging station infrastructure is an impediment to reaching the State's ambitious EV goals. The range of an EV is currently limited to an average of 120 miles on a full charge, although a few models can travel as far as 200 to 300 miles. Given the distance between our communities and centers of employment, it is essential that the ability to recharge EVs is readily available to the EV owner. There are currently only six locations with public EV charging stations in the TRO Region. To support the State's EV goals, EV charging stations will need to become ubiquitous.

Transportation and Land Use Strategies

In order to achieve the CEP's goals, transportation energy use must be lessened 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 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. 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 reduce VMT. Likewise, communities can support infill development and concentrated commercial and institutional activities in our villages and downtowns.

Goals, Policies, and Recommendations: **Transportation and Land Use**

Goals

1. Statewide vehicles miles traveled (VMT) per capita does not exceed 2011 levels (11,402 VMT per capita).
2. The number of single-occupant vehicle trips is reduced by 20 percent by 2030 through carpooling and public transit.
3. The percentage of electric vehicles is increased to 5 percent by 2025, 38 percent by 2035, and 82 percent by 2050 in the Region.
4. Land use policy and regulation are designed to encourage daily use of EVs.
5. The use of sustainable biofuels increases.
6. The number of park and ride spaces triples in size. (In 2019, TRORC has a total of 18 state and municipal park and rides, totaling 558 spaces).
7. Public transit ridership is increased by 110 percent, to 1.9 million trips annually. (At the time of this writing, Stagecoach and Advance Transit together count for 950,000 trips annually.)
8. The number of Vermont based passenger rail trips is quadrupled annually.

Policies

1. 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.
2. TRORC supports continued expansion of high-speed Internet to allow for telecommuting.
3. Developments that have a Substantial Regional Impact (as defined in the Plan) under Act 250 must demonstrate that they have consulted with transit providers about reasonable, accommodating transit.
4. All residential and large commercial land developments subject to Act 250 should evaluate the appropriateness of installing or reserving space for a transit stop.
5. TRORC will support new bike and pedestrian projects in the Region.
6. TRORC supports programs and planning initiatives that will reduce single-occupant trips throughout the Region.
7. TRORC supports community car sharing by promoting programs such as Go Vermont and CarShare Vermont.
8. Developments subject to Act 250 should demonstrate that they have taken or will take reasonable steps to incorporate parking with EV charging stations in order to meet regional goals.
9. TRORC encourages state policy changes to offer state buyer incentives for EVs.
10. TRORC supports investments and development of sustainable biofuels.
11. TRORC supports the Vermont Bioenergy Initiative in cooperation with the VT Sustainable Job Fund's Bioenergy Initiative to address on-farm biofuel production under Act 250.

Goals, policies, and recommendations continued on next page

Goals, Policies, and Recommendations: **Transportation and Land Use**

Recommendations

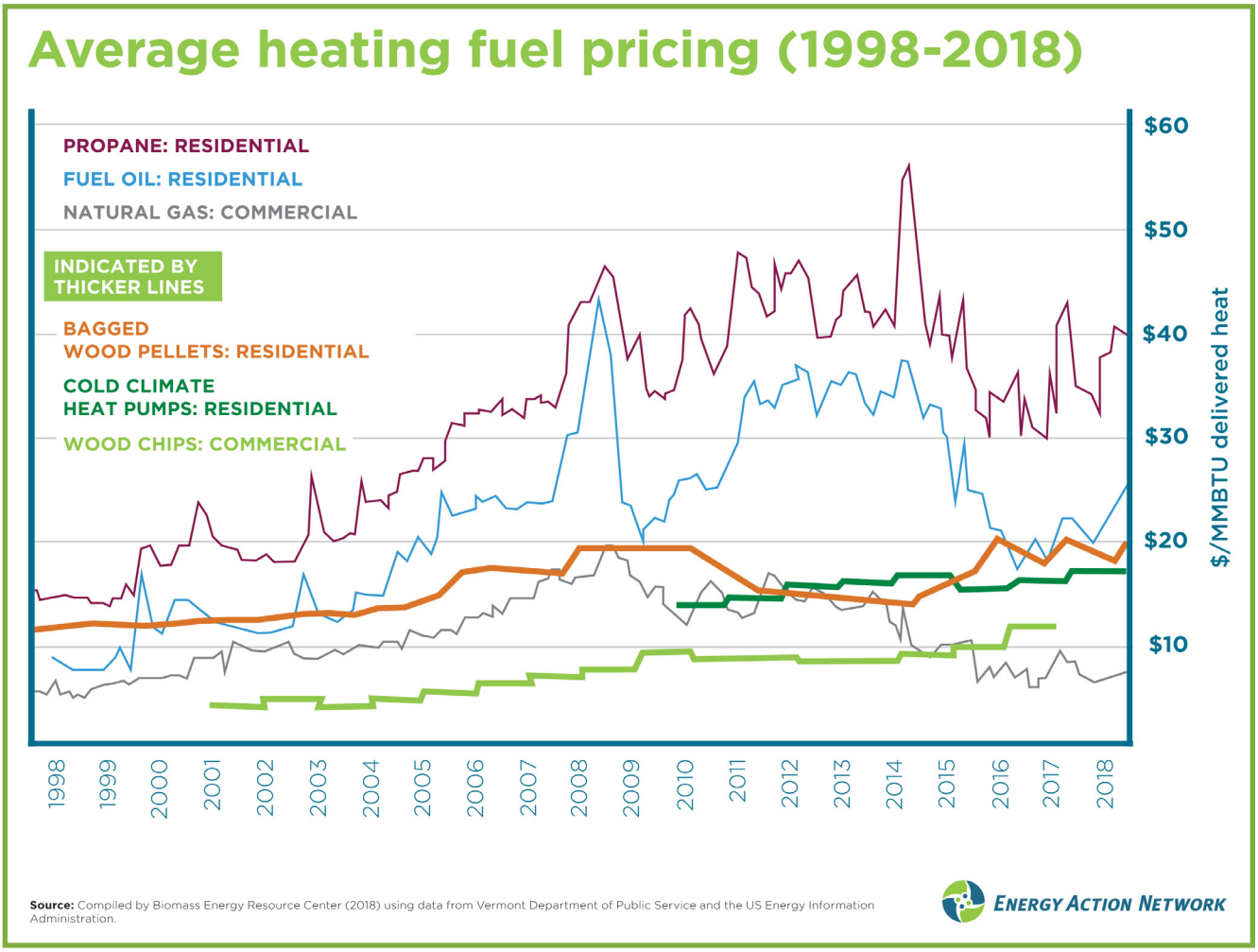
1. TRORC will encourage compact development, particularly housing, within town villages and downtowns and encourage a reduction of planned density in more rural areas.
2. TRORC will encourage communities to develop bylaws that allow for the development of co-working spaces as a way to reduce VMT.
3. Employers should invest in workplace incentives for carpooling, cycling, public transportation use, and telecommuting.
4. 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.
5. TRORC will provide technical assistance to communities interested in implementing Complete Streets to increase density and mixed uses in compact settlements and to foster transit-oriented development along major roads in rural areas.
6. TRORC will continue to identify locations for additional park and rides (state and municipal) and work to expand existing park and ride infrastructure.
7. TRORC will push for increased capacity and continue to support local transit providers through technical assistance.
8. TRORC will work with VTrans and local transit providers to ensure a seamless regional transit system and to explore possibilities for additional buses or routes.
9. TRORC will work with VTrans to investigate the feasibility of commuter rail along the I-91 corridor.
10. TRORC will work with communities to incorporate the principles of smart growth into their municipal plans and bylaws and to support creative economic development concepts that allow residents to live and work in their communities.
11. TRORC will promote and share information provided by Drive Electric Vermont, including their video highlighting the costs and benefits of EVs.
12. TRORC should identify locations for alternative fuel stations (electric, biodiesel, etc.) in the Region and modify the Regional Plan to include them as allowed uses in appropriate locations.
13. TRORC should support efforts to switch municipal medium and heavy duty vehicles to biodiesel blends.

G. Thermal Energy

According to the 2016 Comprehensive Energy Plan, 28 percent of energy demand in Vermont is associated with heating fuels. 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 2010, Vermont ranked 44th out of 50 states for energy affordability.[10] In 2010, low-income Vermonters spent an average of $1,870 more per family, per year, on energy bills than is considered affordable.[11]

The 2013 Thermal Efficiency Task Force's Report to the General Assembly notes, "Investing in thermal efficiency improvements – primarily air sealing, insulation, and heating system replacements – can dramatically reduce heating energy use in a building. At current fuel prices, thermal efficiency investments in a home can bring savings of approximately $1,000 per year over the lifetime of the investment. The value of these savings increases as fuel prices rise."[12] Converting to more efficient heating and improving thermal efficiency will have the effect of reducing financial impacts on communities and moving the Region toward 90 percent renewable energy by 2050.

Figure 11-13: Average Heating Fuel Pricing (1998-2018)



The CEP promotes efficiency and conservation as top priorities in all energy sectors. Retrofit investments in thermal energy efficiency by Efficiency Vermont and Vermont Gas have reduced energy demand in about 6,700 homes, and investments in thermal efficiency for low-income households eligible for weatherization assistance have reached more than 10,700 homes since 2008, equivalent to roughly $10 million in annual savings.[13] However, the current pace of weatherization improvements will need to increase exponentially to meet the State's goals.

In addition to thermal efficiency improvements, the 2016 CEP is seeking a statewide change in how we heat our buildings. This approach will focus primarily on the installation of cold climate heat pumps, which consume far less energy than electric resistance, propane, or oil heating systems. In order to contribute to the State's heat pump installation target (100,677 installed statewide by 2025), a total of over 9,000 will need to be installed in the TRO Region by 2025.[14] Because cold climate heat pumps are inadequate during extreme sub-zero days (-20 degrees F), homes may require a secondary heat source – preferably one that utilizes some form of woody biomass (wood, wood chip, wood pellet). Pellet stoves are fueled with pellets made primarily of sawdust and wood chips and can effectively heat a home 2,000 square feet and under.[15] Replacement of older wood stoves with advanced wood or pellet stoves may cost less than installing heat pumps and is a shorter-term solution that uses available low-grade wood resources.

Also worth considering are geothermal or "ground source" heat pumps. These systems are substantially more expensive than cold climate heat pumps but can result in significant energy savings. They are better suited to new development than retrofitting into existing buildings due to the technology's requirements. While cold climate and geothermal heat pumps will work for residences, they cannot adequately meet the demands of some large industrial and commercial users. These larger users could benefit from an automated wood heat system. Where they are located next to a concentration of other buildings, the CEP has recognized the need to identify locations for district heating and combined heat and power, which is a system for distributing heat in a centralized location.

New buildings will need to be built to a significantly higher standard than is provided for by the State's current Residential and Commercial Building Energy Code. Net-zero constructed buildings are highly efficient and save 30 to 45 percent on overall energy costs in comparison with standard buildings.[16] Efficiency Vermont's 2015 Net Zero Energy Feasibility Study 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 code buildings from the first year into the long term.[17]

There are barriers to reaching the CEP's thermal efficiency goals. The purpose of this plan element is to begin to identify these barriers and to put forth policy and action steps that will effectively remove these barriers when properly implemented.

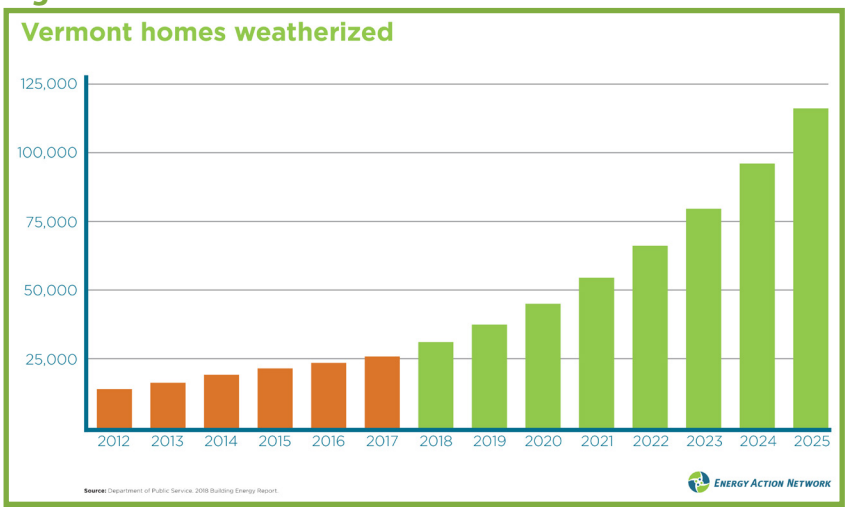
There are many challenges to improving thermal energy efficiency in Vermont. Residential houses constitute the majority of Vermont's built environment. Residential energy represents 30 percent of Vermont's total energy consumption (second only to transportation), with heating being the largest energy consumer.[18] Vermont's climate demands heating.

In Orange and Windsor Counties, 47 percent of homes were built before 1970.[19] 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 homes utilize wasteful amounts of energy and are expensive to maintain. According to the Massachusetts Zero Net Energy Buildings Task Force: "With buildings contributing close to 40 percent of greenhouse gas emissions and consuming 40 percent of energy in the United States, energy efficiency and renewable energy technologies must become central to the way we design and build."[20]

In the TRO Region, it is estimated that only 4.58 percent of houses built before 2000 have been weatherized. To achieve the State's goal of 25 percent of homes being weatherized, approximately 6,000 of the Region's housing units will need to be weatherized by 2025. By 2017, only 7.6 percent, or 25,409, of Vermont's homes had been weatherized. To achieve the statewide goal of 25 percent of homes being weatherized by 2025, 80,000 will need to be improved.

Another challenge to thermal efficiency is large home sizes and the costs of improvements. New homes have

Figure 11-14: Vermont Homes Weatherized



grown in size over the past 40 years. In 1973, the average home in the Northeast was roughly 1,700 square feet. In 2014, the size of homes in the Northeast had increased by 60 percent, to 2,600 square feet.[21] While homes are generally more efficient than in the past, more square footage requires more heating.

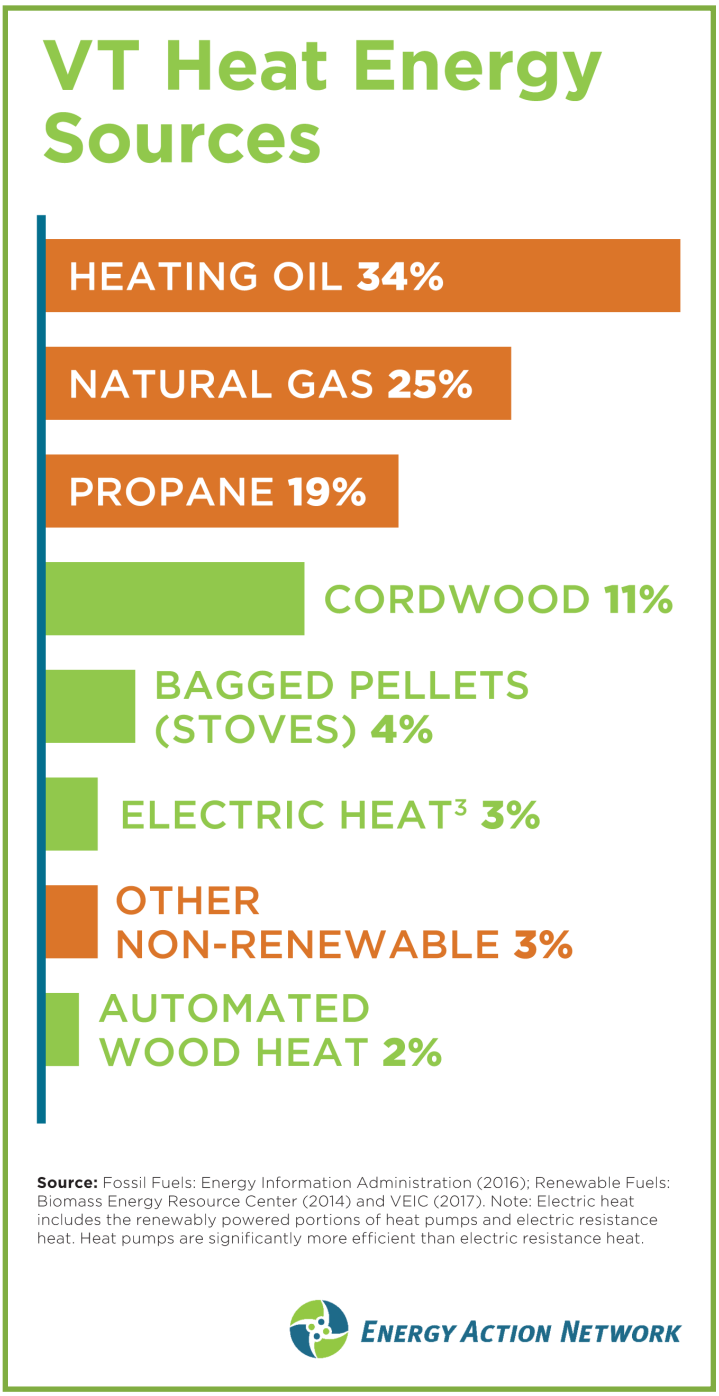
The upfront cost of energy efficiency improvements and building-scale renewable energy generation remains a challenge. Despite the demonstrated long-term savings benefits, the capital needed to significantly reduce energy consumption and add renewables is a significant barrier to implementation. When 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.

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 of energy improvements.

Vermont's system of energy code and energy efficiency standards enforcement is somewhat problematic. As of January 2019, both the Residential Building Energy Standards (RBES) and the Commercial Building Energy Standards (CBES) in Vermont are in the process of being updated. The DPS has outlined a pathway to increased energy code compliance in its Energy Code Compliance Plan of 2012. The State needs to follow this plan. Concurrently, the State needs to continue to improve and make more effective both commercial and residential building codes. Standards for achieving net-zero design must be incorporated. Some regional builders such as Prudent Living's Southscape community (http://southscapewilder.com/) and VERMOD (http://vermodhomes.com/) are currently constructing net-zero possible homes. TRORC can assist communities with continued outreach regarding code compliance. We can also support the DPS as they move forward on adoption of more effective energy efficiency codes.

Energy efficiency standards are one challenge,

Figure 11-15: VT Heat Energy Sources



while Vermont's Residential Building Energy Standards are another challenge for developers. 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 just under half (9) of them require a COO.

To move toward net-zero energy use in the built environment, energy efficiency codes must be substantially improved and enforced, while contractors and homeowners must be educated about the codes' existence and purpose.

Thermal Energy Strategies

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. Current financing programs include:

1. Vermont's Heat Saver Loan: http://heatsaverloan.vermont.gov/
2. Property Assessed Clean Energy (PACE): Available for towns that have adopted a PACE district. Repayment of PACE financing is tied to the property, not to the owner.
3. Neighborworks of Western Vermont Energy Loan: https://www.nwwvt.org/energy-loan/
4. Vermont State Employees Credit Union VGreen Energy Savings Solutions loans: https://www.vsecu.com/energy-savings/about/about-vgreen/what-is-vgreen
5. Vermont Economic Development Authority offers energy loans to commercial enterprises (http://www.veda.org/financing-options/vermont-commercial-financing/commercial-energy-loan-program/) and small businesses (https://www.veda.org/financing-options/vermont-commercial-financing/small-business-energy-loan-program/)
6. United States Department of Agriculture Section 504 Home Repair Program: https://www.rd.usda.gov/programs-services/single-family-housing-repair-loans-grants
7. Efficiency Vermont rebates for central wood pellet furnaces and boilers – $6,000 cash back: https://www.efficiencyvermont.com/rebates/list/central-wood-pellet-furnaces-boilers-residential

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) is needed. Projects such as the Vermont Fuel Efficiency Partnership, which provides "deep-energy" retrofits in multi-family buildings whose tenants are income-eligible for the WAP, must be encouraged and supported. Fuel distributors must be encouraged to become energy service providers, expanding what they offer so that more homes can be weatherized and energy efficiency increased.

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.

TRORC can provide education and outreach to our communities and support other statewide programs for weatherization and thermal

efficiency. If adequate funding was available, TRORC could develop a staff position 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 Energy Planner could act as a clearinghouse of energy information for our communities. Through education and outreach at the municipal level, TRORC could ensure that our residents were aware of the opportunities available to them. We could work closely with active municipal energy committees and energy coordinators to continually update them on new programs, policies, or financing mechanisms for weatherization assistance or alternative heating improvements.

Ideally, a Regional Energy Planner would have a basis of knowledge grounded in implementation, so that this staff person would have experience directly related to the installation and implementation of thermal efficiency and renewable energy improvements. This skill set would be particularly valuable in working with builders and energy service providers to help educate them about their customers' needs, but would also provide homeowners with an independent voice that would help them understand weatherization and other energy efficiency options. 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.

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

Goals

1. At least 25 percent of the Region's housing stock is weatherized by 2025.
2. By 2020, 30 percent of new buildings are built to net-zero energy use and 100 percent by 2030.
3. 7,280 efficient cold climate heat pumps are installed by 2025.
4. The Region has shifted away from fossil fuels as a source of heat.

Policies

1. TRORC supports state efforts to provide additional funding for weatherization improvements, especially for low- and moderate-income populations.
2. TRORC supports net-zero energy construction throughout the Region.
3. DPS should adhere to the Vermont Energy Code Compliance Plan and improve upon residential and commercial building codes.
4. TRORC supports the adoption of advanced wood and biomass heating systems for new construction as replacements for fossil fuel furnaces and backup heat systems for heat pumps.
5. TRORC encourages increased state incentives and rebates for advanced wood heating equipment, including woodstove change-out programs to lower heat costs and reduce particulate emissions.
6. Local energy committees and planning commissions should identify potential users of district heating 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.

Goals, policies, and recommendations continued on next page

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

Recommendations

1. TRORC will support programs such as Zero Energy Now!, Weatherize Upper Valley with Vital Communities, and GMP's eHome by providing outreach and education to local planning commissions and energy committees and their communities.
2. TRORC will support and promote the Energy Action Network (EAN) energy dashboard and educate towns as to its use and benefits.
3. TRORC will distribute information regarding the available financing mechanisms for weatherization assistance, including information about the financial advantages of energy improvements.
4. TRORC should seek funding for an energy planning staff person who can work with towns, homeowners, and businesses to implement weatherization, energy efficiency, and renewable energy projects.
5. TRORC will work with utilities to implement their Renewable Energy Standard (RES) Tier 3 fuel-switching mandates through education and outreach to help promote weatherization.
6. DPS should work with fuel dealers to encourage them to become energy service providers.
7. 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.
8. DPS should support K-12, higher education, and vocational education initiatives to bring energy ideas and solutions into the classroom by working with organizations such as the Vermont Energy Education Program (http://veep.org/).
9. Local energy committees should work with Neighborworks Heat Squad, COVER, and community action agencies to promote their weatherization services.
10. DPS should work with local educational institutions such as Vermont Technical College to encourage continued technical training related to energy efficiency improvements.
11. TRORC and towns should support programs and initiatives that encourage the development of small homes (less than 1,000 square feet) as a way to reduce energy use.
12. TRORC will provide outreach to towns and contractors on the use and enforcement of residential and commercial building energy standards for all new construction.
13. TRORC will support statewide efforts to increase energy efficiency code standards and statewide energy code enforcement by communicating regional concerns about enforcement with the Legislature and encouraging communities that have zoning to include a certificate of occupancy when they revise their regulations if they do not already have one.
14. TRORC should provide outreach to communities with a COO to ensure that they are tracking submissions of the RBES certificate.
15. TRORC will partner with Efficiency Vermont, Green Mountain Power, HVAC contractors, and others to promote cold climate heat pumps.
16. DPS should coordinate all outreach efforts with fuel dealers and electrical contractors (potentially creating opportunities for electrical contractors to work with fuel dealers).
17. TRORC should provide communities with an analysis of potential areas that are suitable for geothermal ground source heat pumps when data is available.
18. Local energy committees should provide information to builders and developers regarding the benefits of geothermal systems (including heat pumps).
19. TRORC, towns, and relevant nonprofits, including the Northern Forest Center, should conduct outreach and education by coordinating with advanced wood heat system vendors and contractors to hold informational public forums.

Goals, policies, and recommendations continued on next page

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

Recommendations (continued)

20. TRORC should provide outreach and education to communities to ensure residents are aware of existing incentives and rebates.
21. DPS should provide guidance to communities seeking to develop district heating systems.
22. DPS should conduct outreach efforts to public and nonprofit entities and housing organizations to provide information on biomass heating options.
23. Local energy committees should partner with project developers to promote the possibility of combined heat and power and district heating options.
24. TRORC will work to maintain forest health as a prerequisite to a sustainable wood energy fuel supply by updating the Regional Plan to protect forests and habitat.
25. The State should support woodstove change-out programs to lower heat cost and reduce particulate emissions.

H. Utility-Scale Renewable Energy Facility Siting

Background

The State of Vermont has spent a number of years analyzing the issues relating to energy siting. In 2012, Governor Shumlin formed the Energy Generation Siting Policy Commission. The Siting Commission was tasked with developing recommendations and guidance on best practices for the siting approval of large-scale renewable energy generation projects (those projects that exceeded the net metering threshold at the time), and for public representation in the siting process. Ultimately, one of the key components of the Siting Commission's final report was an "increased emphasis on planning."[22]

In 2015, in response to the rapid growth of solar development, the Legislature created the Solar Siting Task Force. In their report to the Legislature in 2016, the Solar Siting Task Force echoed the recommendations of the Siting Commission, acknowledging that "effective planning has the potential to shape the municipal, regional and state energy future."[23] One of the most important parts of such planning is mapping where projects should and shouldn't go.

Utilize Available Map Data

TRORC has generated map data that indicates where raw energy generation potential exists for solar, wind, and hydro.* This does not mean that they should go there, only that these are the areas where solar, wind, and hydro resources are present. This data should be the **starting point** for the local identification of where renewable energy generation should be located within your community.

Solar Siting

Sites with raw solar potential are flat to gently sloping and face east, south, or west. 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

**A map of biomass land cover is included as well, but it is not a representation of potential beyond identifying what could be harvested for biomass energy production.*

agricultural soils. While it is possible to conduct some forms of farming on land occupied by a solar system (such as small ruminant grazing – see Appendix L), most agricultural uses become impractical. 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 farming with needed income.

Wind Siting

Only certain ridges are tall enough and big enough to have raw wind potential. Wind energy generation, although not as prevelant as solar, also has opposition due to aesthetic and noise impacts. Because these facilities must locate on ridgelines in order 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.[24]

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. LEAP modeling suggests that additional hydro capacity can be achieved by retrofitting existing dams.

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.

Hierarchy of Suitability

All of the lands within the Region have been analyzed on a rough scale using map data supplied by DPS to rank them in terms of areas of "raw potential": areas that are unsuitable because of high value resources; areas with constraints; areas with no known or possible constraints (prime area); "preferred" areas. The 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 resource to justify building a wind turbine. As mentioned earlier, 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.) Preferred locations come in two forms: state preferred areas that are defined as such in 30 VSA § 8005a (Act 174) and specified locations identified by the town.

Raw Generation Potential Locations

This type of area is shown on the solar and wind maps and includes solar generation potential based on solar radiation, slope, and direction, as well as wind generation potential based on topography. Solar potential does not distinguish between open or forested areas.

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 displayed in this section state the unsuitable areas in the Region.

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. These areas are neither preferred nor unsuitable. 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. 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 Areas

Recognizing that there may be areas that are also well-suited to the development of renewable energy generation, the following criteria should be applied to proposals that are not in constraint areas. These areas are shown on the maps under prime. If a proposed development is not on the list above, but meets all of the criteria below, it shall be considered a prime area for the purposes of this Plan. Such an area:

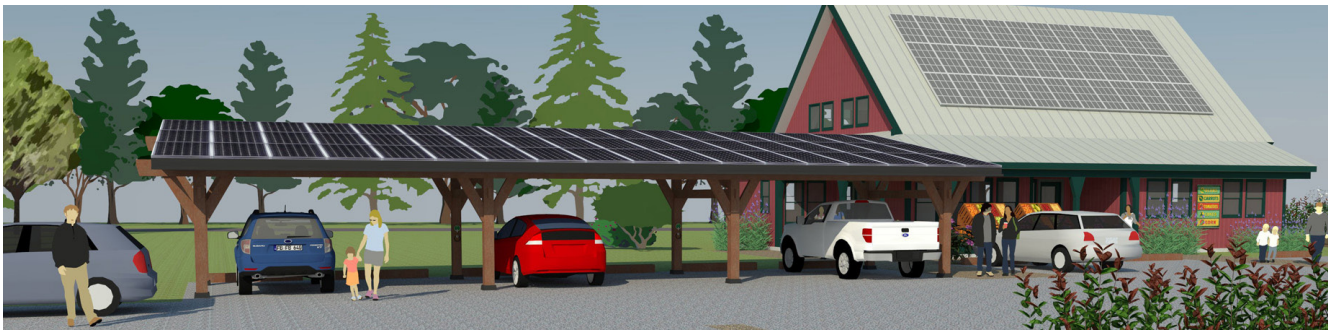
- Must not be identified as an Unsuitable Area
- Must not be identified as a Constraint Area
- Must be located in an area that has reliable and safe access to the grid (as determined by the local power provider)

Preferred Areas

While the development of any type of renewable energy generation facility is subject to review on a site by site basis, some areas are better suited than others. Act 174 specifically identifies state preferred areas. These areas are typically small and are not shown on the energy siting potential maps. They are:

- A parking lot canopy over a paved parking lot, provided that the location remains in use as a parking lot and is not located in an area identified as unsuitable by this Plan or the Municipal Plan of the municipality in which the development is proposed.
- A new or existing structure that is not located in an area identified as unsuitable by this Plan or the Municipal Plan of the municipality in which the development is proposed.
- Land certified by the Secretary of Natural Resources to be a brownfield site as defined under 10 VSA § 6642, provided that the location is not in an area identified as unsuitable by this Plan or the Municipal Plan of the municipality in which the development is proposed.
- A sanitary landfill as defined in 10 VSA § 6602, provided that the Secretary of Natural Resources certifies that the land constitutes such a landfill and is suitable for the development of the plant.
- The disturbed portion of a gravel pit, quarry, or similar site for the extraction of a mineral resource, provided that all activities pertaining to site reclamation required by applicable law or permit condition are satisfied prior to the installation of the plant.
- A specific location designated in a duly adopted municipal plan under 24 VSA chapter 117 for the siting of a renewable energy plant or specific type or size of renewable energy plant, provided that the plant meets any siting criteria recommended in the plan for the location, provided that it is not located in an area identified as unsuitable by this Plan.
- A site listed on the National Priorities List (NPL) that has received confirmation from the U.S. Environmental Protection Agency or the Vermont Agency of Natural Resources (ANR), and is not located in an area identified as unsuitable by this Plan or the Municipal Plan of the municipality in which the development is proposed.
- A new hydroelectric generation facility at a dam in existence as of January 1, 2016, or a hydroelectric generation facility that was in existence but not in service for a period of at least 10 years prior to January 1, 2016, and that will be redeveloped for electric generation, if the facility has received approval or a grant of exemption from the U.S. Federal Energy Regulatory Commission.
- A tract previously developed for a use other than siting a plant on which a structure or impervious surface was lawfully in existence and use prior to July 1 of the year preceding the CPG application.

The maps included as part of this guide were



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

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.

Goal, 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 CEP.
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 in these areas are encouraged.
3. The following locations shall be considered regionally 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, Wilderness Areas, including National Wilderness Areas, 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.

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.

I. 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 more healthy 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 plan 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 and food systems are inter-related must consider energy efficiency and the prudent development of renewable energy generation. The TRORC Energy chapter provides a basis for this comprehensive energy planning.

VERMONT ENERGY FACTS

- **More than one-third of VT schoolchildren attend facilities heated by wood, and almost one in six homes in VT heat with wood.**
- **VT produces 40% of the electricity it consumes and depends on power from Canada and neighboring states to meet customer demand.**
- **VT's electricity generation comes almost entirely from renewable resources, and more than half of it is hydroelectric power.**
- **In the years 2011 through 2017, 74.2 megawatts of utility-scale solar photovoltaic capacity and 89 megawatts of small-scale PV capacity were installed in VT.**
- **In 2015, VT enacted the nation's first integrated renewable energy standard (RES), which requires 75 percent of retail electricity sales to come from renewable sources by 2032.**

JULY 19, 2018, U.S. EIA

Solar panels | *Source: Unknown*

Energy Endnotes

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