

ACRPC Enhanced Energy Plan

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Section 1—Purpose of the Plan

The Addison County Regional Planning and Development Commission developed the Region’s first energy plan in 1980. That plan indicated that Addison County imported an estimated \$16 million more in energy than it produced in 1977. The policies in that plan expressed concern about the future location of large-scale electric generation and transmission facilities in the Region. It supported the development of locally generated energy sources and pointed to their potential contribution to the Region’s economy. The plan also recommended encouraging the concentration of new residential development near existing employment centers and discouraging a scattered pattern of residential development in the rural countryside, thus reducing gasoline consumption. ACRPC subsequently updated its Energy plan in 1994, 2005, 2011, 2018, and 2024. By supporting the completion of in-depth energy planning within each region, Vermont Department of Public Service (“PSD”) intends to enable Vermont to achieve state and regional energy goals including:

- Be consistent with state energy policy (described below) in the manner described in 24 V.S.A. § 4302(f)(1): To make efficient use of energy, provide for the development of renewable energy resources, and reduce emissions of greenhouse gasses. Including: increasing the energy efficiency of new and existing buildings; identifying areas suitable for renewable energy generation; encouraging the use and development of renewable or lower emission energy sources for electricity, heat, and transportation; and reducing transportation energy demand and single occupancy vehicle use.
- Greenhouse gas (GHG) reduction requirements under [10 V.S.A. § 578\(a\)](#)
 - 26% from 2005 levels by 2025
 - 40% from 1990 levels by 2030
 - 80% from 1990 levels by 2050
- The 25 x 25 goal for renewable energy under [10 V.S.A. § 580](#)
 - 25% in-state renewables supply for all energy uses by 2025
- Building efficiency goals under [10 V.S.A. § 581](#)
 - e.g., reduce fossil fuel consumption across all buildings by 10% by 2025
- State energy policy under [30 V.S.A. § 202a](#) and the recommendations for regional and municipal planning pertaining to the efficient use of energy and the siting and development of renewable energy resources contained in the State energy plans adopted pursuant to [30 V.S.A. §§ 202](#) and [202b](#)
- The distributed renewable generation and energy transformation categories of resources to meet the requirements of the Renewable Energy Standard under [30 V.S.A. §§ 8004](#) and [8005](#)

Although the energy picture often appears abstract and beyond the influence of local communities, sound regional and municipal planning can effectively guide certain types of energy decisions. The Region can move toward a position of sustainable energy use that will maintain a healthy environment and build a foundation for economic vitality. ACRPC and its member municipalities can promote appropriate land use patterns, participate in energy generation development decisions, facilitate

alternative transportation options and encourage energy conservation strategies in the Region. The purpose of this plan is to identify the opportunities for the region and municipalities to facilitate the transition to a more efficient and sustainable energy system.

Introduction

The Addison County Regional Planning Commission (“ACRPC”) created this Plan, within the overall energy planning framework of the State, in order to plan for our future energy usage and infrastructure. This Plan addresses the Region’s best interests in three key energy policy goals:

- Pursuing a Just Energy Transition
- Improving our Climate Change Resilience;
- Enhancing our Energy Security.

Energy Justice

Profound changes to the energy system of Vermont have been underway—our Brave Little State has been a leader in pursuing renewable energy development for decades. To have a just energy transition however, it is crucial that all Vermonters are treated fairly as these changes unfold. As such, it is critical to consider these four questions so that we can conduct more just energy planning in Addison County:

1. *Who is being helped?*
2. *Who is being harmed?*
3. *Who is missing from the conversation?*
4. *How will we respond?*

In addition, ACRPC’s Energy Plan aspires to follow the overarching goals and principles detailed in the [Energy Equity Project \(EEP\) Framework](#):

- Everyone has continuous access to energy.
- Everyone lives in a healthy, safe, and comfortable home.
- No one spends more than 6% of their income on energy bills.
- Those who are most impacted have the most powerful voice in decision making and receive a share of benefits.

Ultimately, ACRPC’s Regional Energy Plan strives to improve the outcomes for environmental justice populations, as defined by Act 154, meaning “any census block group in which: (A) the annual median household income is not more than 80 percent of the State median household income; (B) Persons of Color and Indigenous Peoples comprise at least six percent or more of the population; or (C) at least one percent or more of households have limited English proficiency.” Priority populations also include older, and chronically ill Vermonters and people with disabilities. For more information on how to internalize equity into policy and a list of populations vulnerable to the impacts of climate change, see the State of Vermont Climate Council's Guiding Principles for a Just Transition.

Our region’s strategy for enhancing environmental and energy justice is two-fold: 1. transitioning from energy fuels that produce pollutants that could have negative public health impacts; 2. reducing the “energy burden,” defined as

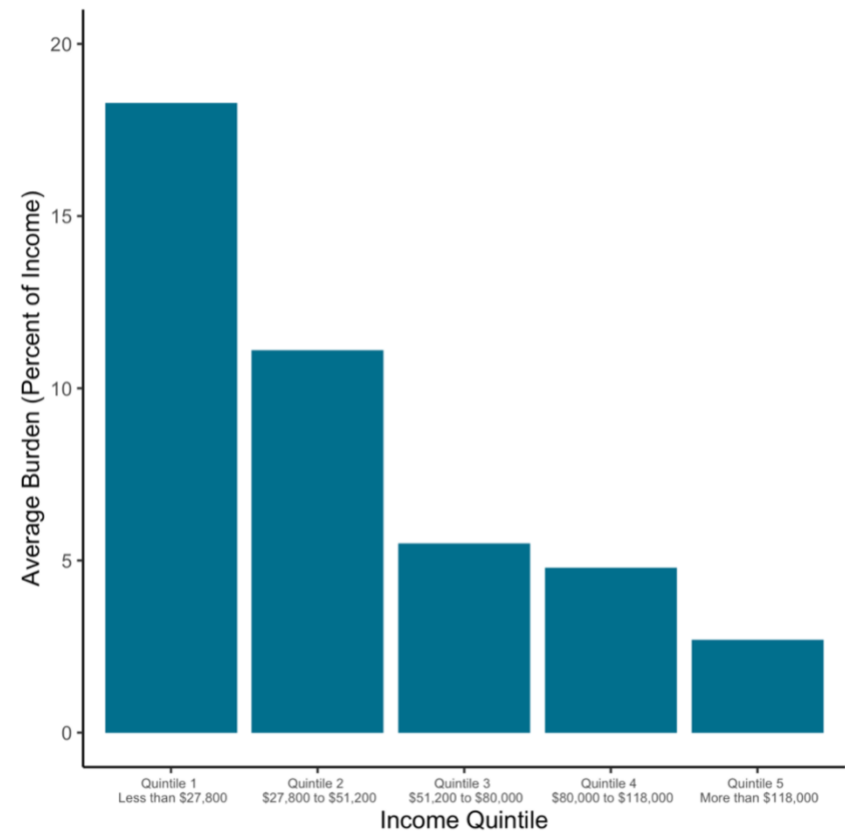
Table 1—Energy Burden by Municipality, 2023

	Total Burden
Addison	8.4%
Bridport	11.5%
Bristol	9.1%
Cornwall	8.2%
Ferrisburgh	8.3%
Goshen	9.5%
Leicester	12.8%
Lincoln	10.8%
Middlebury	9.3%
Monkton	6.7%
New Haven	9.0%
Orwell	11.6%
Panton	9.5%
Ripton	8.3%
Salisbury	8.7%
Shoreham	10.2%
Starksboro	10.0%
Vergennes	9.7%
Waltham	8.8%
Weybridge	7.4%
Whiting	11.2%

the proportion of household income spent on energy costs, for our communities (Efficiency Vermont 2023 Report).

Addison County residents live with an energy burden equal to about 10% of the median income on average, reflecting around \$7,300 in household annual energy expenses. Table 1—Energy Burden by Municipality, 2023 provides a municipality-level breakdown of energy burden within the Region. Of Addison County household average energy costs, nearly half (45%) is spent on transportation, followed by heating (33%), then electricity expenses (22%). Nationally, an energy burden greater than 6% is considered high and is correlated with a “greater risk for respiratory diseases, increased stress and economic hardship, and difficulty in moving out of poverty” (ACEEE). These costs take up too much of our community members’ income, which could cause them make hard choices between sufficient nutrition, medical care, and healthy energy use. Energy burden data continues to inform state, regional and local energy programs and strategies and is intended to steer resources to reach those in greatest need due to income constraints.

Figure 1—Total Energy Burden in Vermont by Income



In Vermont, energy expenses disproportionately hurt those who are rural, lower-income, non-white, and non-homeowners (UVM). It is also important to note how energy spending often competes with other basic needs such as housing, healthcare, and food. According to one Energy Action Network [report](#) (see Figure 1—Total Energy Burden in Vermont by Income Quintile), households earning less than \$27,800 pay more than 18% of their income towards heating and electricity bills, compared to less than 5% for households earning more than \$80,000. This issue is compounded by the reality that lower-income households are more likely to rent or own older homes, which in turn are less efficient and more expensive to heat and cool (VHFA).

Vermont has long benefitted from energy generation that occurs beyond its borders, avoiding the environmental burdens of polluting energy sources while reaping the benefits of clean air and a robust natural environment. An example of this is the impact on Canada's indigenous communities located in many areas developed by Hydro Quebec. However, as we transition to a distributed renewable energy future, Vermont must recognize its responsibility to contribute equitably to energy generation. This means embracing local, renewable energy systems that not only reduce reliance on out-of-state power but also ensure that the benefits and challenges of energy generation

are shared more fairly. By taking on this responsibility, Vermont can lead by example, demonstrating how states can contribute to a more just and sustainable energy system.

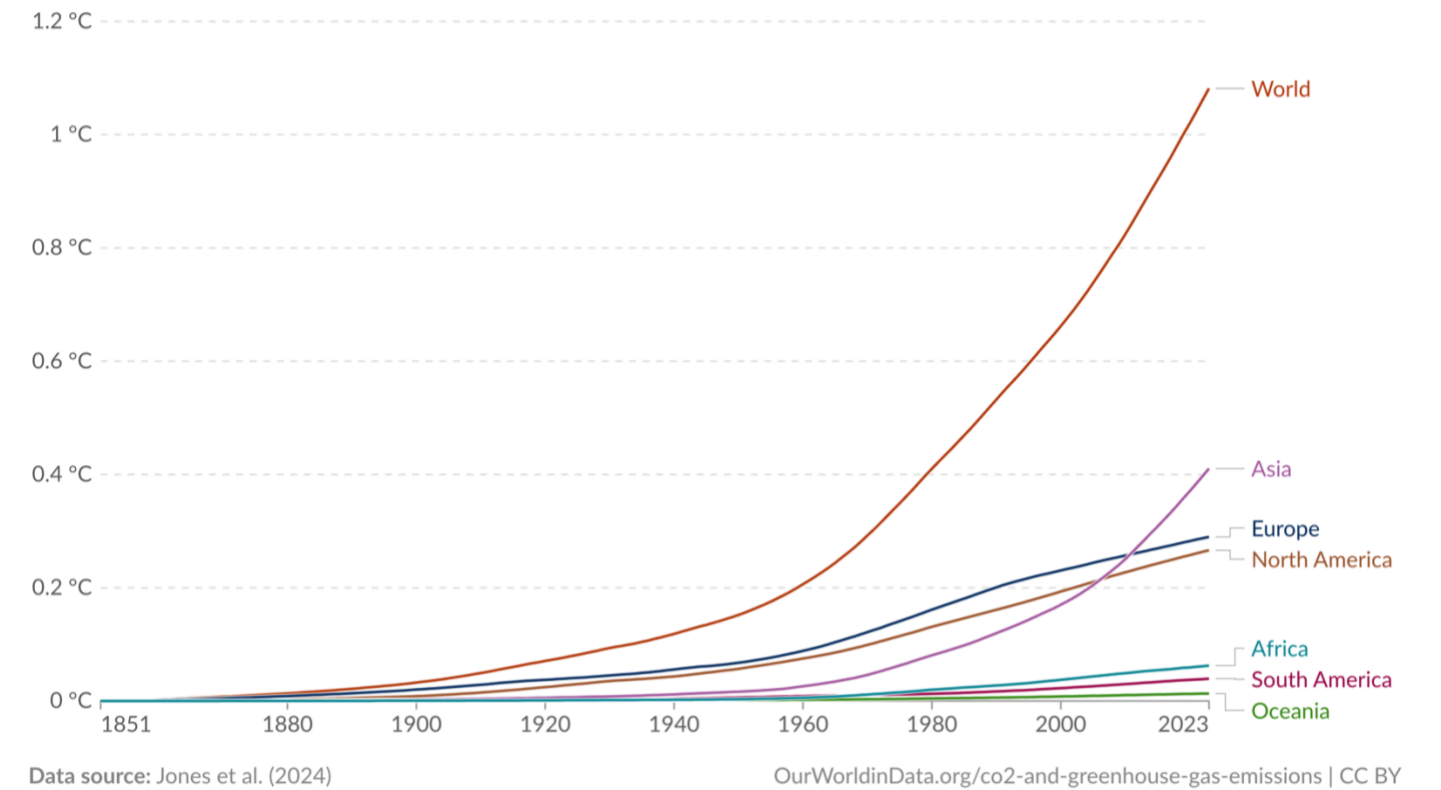
Climate Change Resilience

This plan also seeks to enable greater climate resilience, defined as the ability to mitigate the climate change through greenhouse gas emissions reductions, while preparing for and adapting to the impacts of climate change across Addison County ([IPCC](#)).

It is the scientific consensus that the burning of fossil fuels has substantially increased the concentration of greenhouse gases in the Earth's atmosphere over the last two centuries. The adoption of coal and oil-based fuels during the industrial revolutions in Great Britain and the United States started this trend, it was accelerated by the post-World War II economic recovery in North America, Europe, and in parts of Asia in 1950s, and continues to this day. The greenhouse gases produced by the combustion of fossil fuels in transportation, electric power, and heat generation processes, among other sources, directly impacts the earth's climate and many of its natural systems. The impact of fossil fuel use on the average global surface temperature, for example, has been substantial and can be viewed below (Figure 2—Contribution to global mean surface temperature rise from fossil sources, 1851 to 2023).

Figure 2—Contribution to global mean surface temperature rise from fossil sources, 1851 to 2023

The global mean surface temperature change as a result of a country or region's cumulative emissions of carbon dioxide, methane, and nitrous oxide. This is for fossil fuel and industry¹ emissions only – it does not include land use or agriculture.



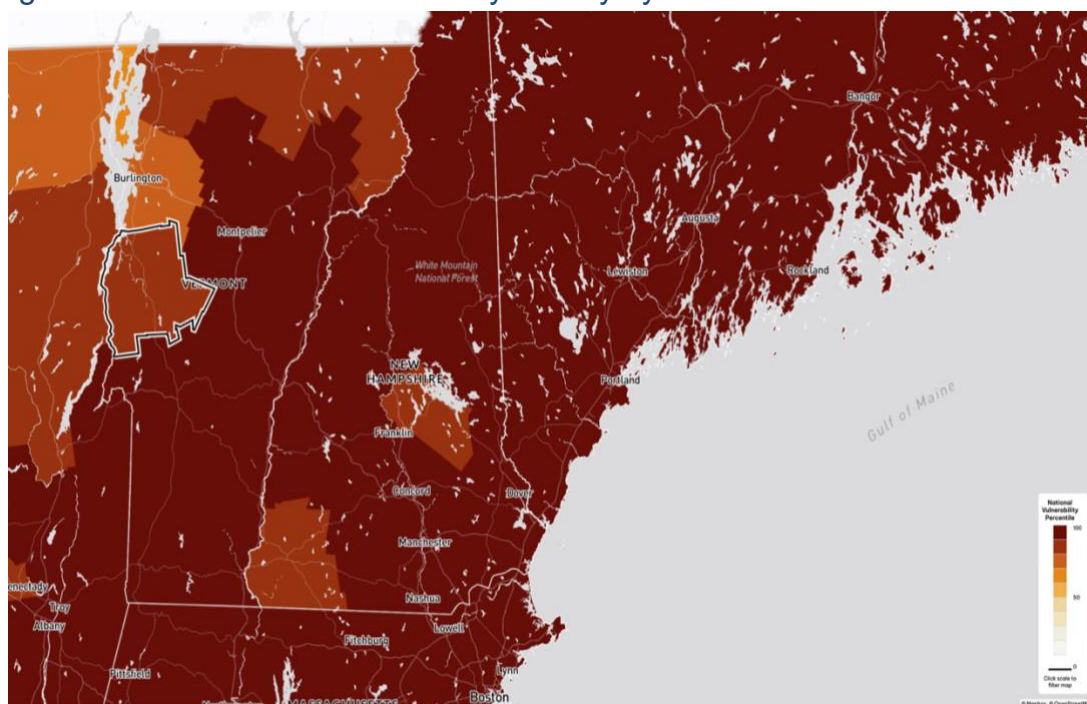
Another extremely potent source of GHG emissions are refrigerants that leak from air conditioners, refrigerators and freezers, and heat pumps. To increase the climate resilience of Addison County, actions must be taken to transition away from fossil fuel powered energy generation and minimize energy consumption as a whole.

Vermont is a small state, and its per capita CO₂ pollution from energy use is already much less than other U.S. states.¹ Vermonters should be proud of their state's status as a comparatively low polluter by U.S. standards; however, the severity of the threats posed by climate change to our state and to the planet more broadly demand that we continue to respond to the climate crisis. ACRPC is aware of this responsibility, and it is ready to do its fair share to advance state, national, and global climate goals. Further, it will do so while also promoting other important regional values. The Region's natural beauty and other valued environmental attributes deserve protection as well. Accordingly, the ACRPC strongly suggests that best practices for orderly development and land-use—such as siting energy transmission and generation projects in suitable locations, avoiding over-development, and using habitat friendly project design—should be followed.

Unfortunately, Addison County has already begun to see the impacts of climate change. Temperatures in Vermont have risen about 3°F since the beginning of the 20th century and will continue to increase. Higher temperatures not only threaten human health but also disrupt Vermont's ecosystems as indigenous species that rely on cold winters to grow migrate north, and invasive species expand their range northward into the State. Vermont's average annual precipitation has increased by nearly six inches since the 1960s, causing frequent and significant flooding throughout the state. More frequent and extreme rainfall and flooding threatens private and public infrastructure, including energy generation and transmission systems.

This trend is likely to continue. The U.S. Climate Vulnerability Index, for example, ranks Vermont as the 7th most vulnerable state to climate change influenced extreme weather events. The

Figure 3—Extreme Weather Risk by County by State



¹ Between 2001 and 2022, the five-year average of Vermont's per capita energy related CO₂ production was significantly lower than other U.S. states even when controlling for State GDP (2017 \$s), and Heating and Cooling Degree Days. Data analyzed was sourced from the Energy Information Agency's State Energy Data series and analyzed via a linear regression.

threat to Addison County specifically is significant as well—the Region is ranked at the 87th percentile nationally in vulnerability to extreme weather events, which can be seen in Figure 3—Extreme Weather Risk by County by State above. Therefore, a climate resilient future for the Region not only requires that we significantly reduce fossil fuel use, but also that we adapt our built infrastructure and natural environments to address increasingly frequent and severe extreme weather events.

Green Mountain Power’s [“Zero Outages Initiative”](#) is one noteworthy case that, among other measures, pairs the “hardening” of rural distribution infrastructure with strategically placed battery systems to enhance energy system resilience in the region. Further, with a target of 2030, their initiative will enhance the resilience of the Region’s energy system in advance of the delivery of other important climate proposals and as the effects climate change are emerging.

This two-pronged approach to climate change resilience—one that centers both climate change prevention and climate change adaptation—is crucial for providing a safe, just, and prosperous future for the Region. Writing in “Building for a Resilient Tomorrow: How to Prepare for the Coming Climate Disruption,” researchers Alice C. Hill and Leonardo Matinez-Diaz argue that “cutting emissions is the best resilience strategy of all because it can safely spare us from some of the worst impacts of Climate Change.” The authors note that adaption measures function as a shock absorber against climate change influenced disruptions—much like a seat belt or an airbag—and are crucial to limiting harm and expediting recovery from those events. Adaptation measures alone however are unlikely to be able to comprehensively protect us from the variety of threats from climate change however, nor will they be capable of addressing the most extreme of potential impacts. A seat belt only works if one is not driving so fast that they exceed the protection that a seatbelt is capable of providing when one gets in an accident. A climate resilient Region is one in which has done what it can to limit the warming of planet while also addressing the negative outcomes that come with a warmer world because there is likely to be a limit to our effective capacity to adapt to a warmer world. As such, the Region supports both climate change prevention and adaption as the core elements of its climate change resilience goal as it pertains to energy planning.

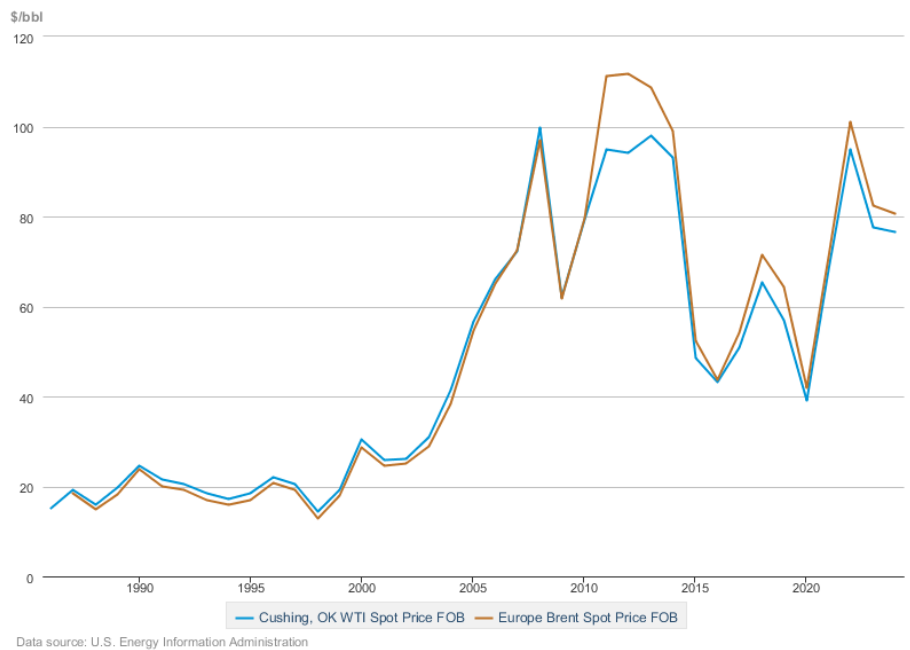
Energy Security

From the OPEC induced Oil Crisis of the 1970s to the shocks produced by the Covid-19 Pandemic and expanded Russian invasion of Ukraine in 2022, the threats posed to our energy system by geopolitics are neither new nor waning. The more dependent an energy system is upon non-domestic energy sources, the more likely it is that the system will experience disruptions from external forces that are beyond its control. Over time, the importance of enhanced energy security has revealed itself through the impacts of increased and unstable energy prices and, in extreme cases, outright scarcity. As can be seen in Figure 4—WTI and Brent Crude Spot Prices (1987 to 2024) below, the price of the primary input to the oil-based energy products that many Vermonters rely upon is increasingly unstable and trending upwards as well. Noting the key role of available and affordable energy for health, happiness, and prosperity, the ACRPC suggests that energy security must also be a primary concern when developing its energy plan.

Since 2004, ACRPC’s Energy plan has recommended that the Region reduce its energy usage by promoting conservation and efficiency. It has also promoted deploying new renewable energy generation and replacing fossil fuel using technologies with those powered by electricity. ACRPC has

engaged in a number of planning projects to support this approach. These projects include planning for energy production on municipally owned properties and engaging in local energy conservation education and outreach. The ACRPC suggests that the Region has the potential—and the responsibility—to safely reduce its energy demand and to increase its domestic energy supply to further enhance its energy security. As such, the ACRPC remains interested in promoting energy security within the region, including, for example, through the continued expansion of renewable energy generation and the deployment of advanced energy storage, SMART Grid, and thermal energy network infrastructure.

Figure 4—WTI and Brent Crude Spot Prices (1987 to 2024)

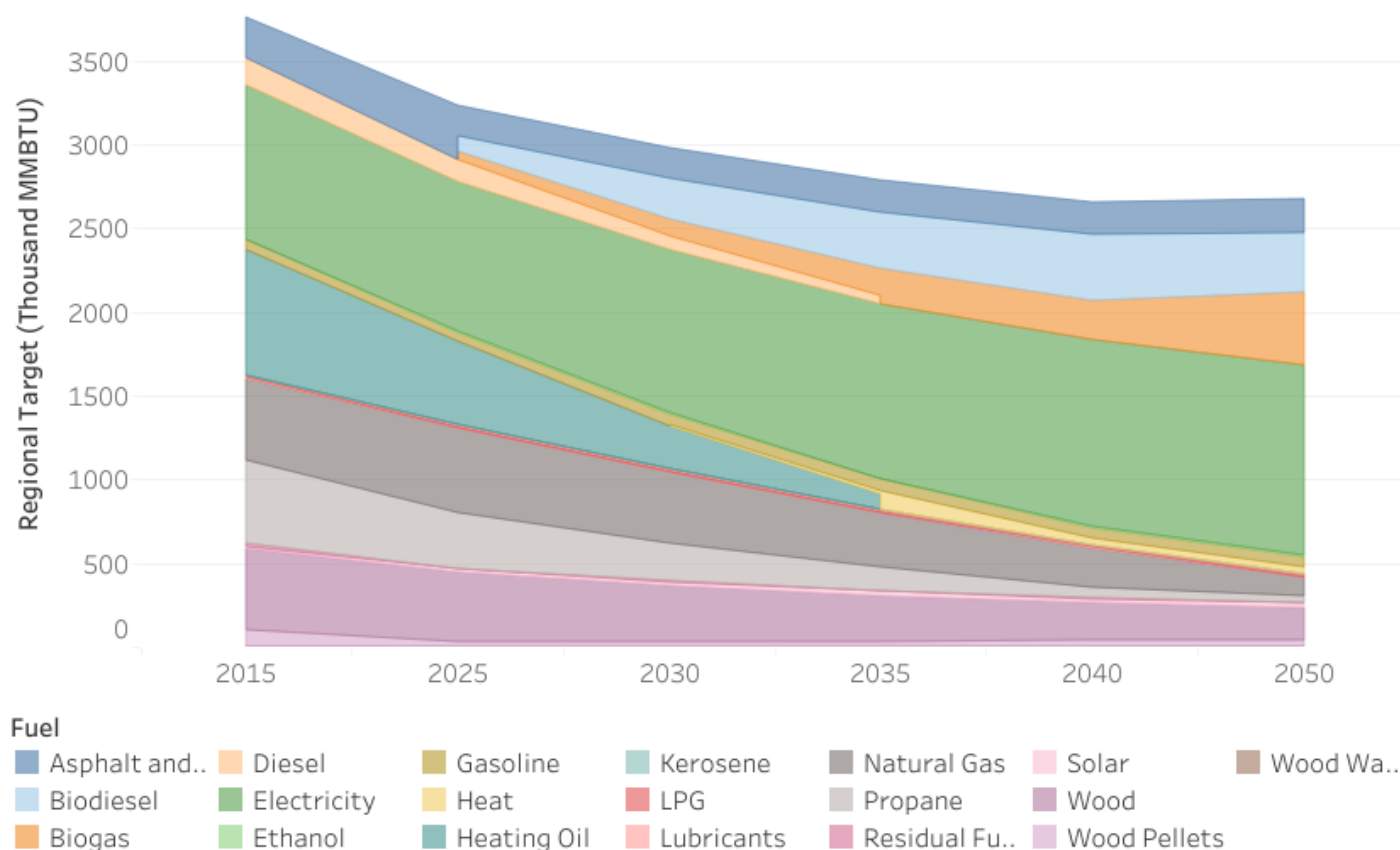


Concluding, the ACRPC is planning for our region's energy future by promoting energy justice, climate resilience, and enhanced energy security. It will do so while balancing these goals with other important and related social and environmental concerns, such as orderly development and sustainable land-use. By doing so, it is the intention of this plan to promote the health, safety, opportunity, and happiness of region's residents as well as that of Vermonters and global citizens writ large.

Section 2—Energy Use

The Addison Region’s more than 36,000 residents consume energy for transportation, space and water heating, and powering lights and appliances. By identifying technologies and practices that promote transformation away from greenhouse gas intensive energy systems, this energy plan provides the region with the tools necessary to realize the state’s energy goals. Figure 5—Projected Energy Use by Fuel Type illustrates how energy use could change over the next several decades to meet state energy and emissions goals. Under this scenario, Total Energy Use is projected to decline somewhat due to demand reduction, fuel switching, and energy efficiency improvements.

Figure 5—Projected Energy Use by Fuel Type



Note. Projected energy use reduction by fuel type under the climate mitigation pathway to meet state emissions targets.²

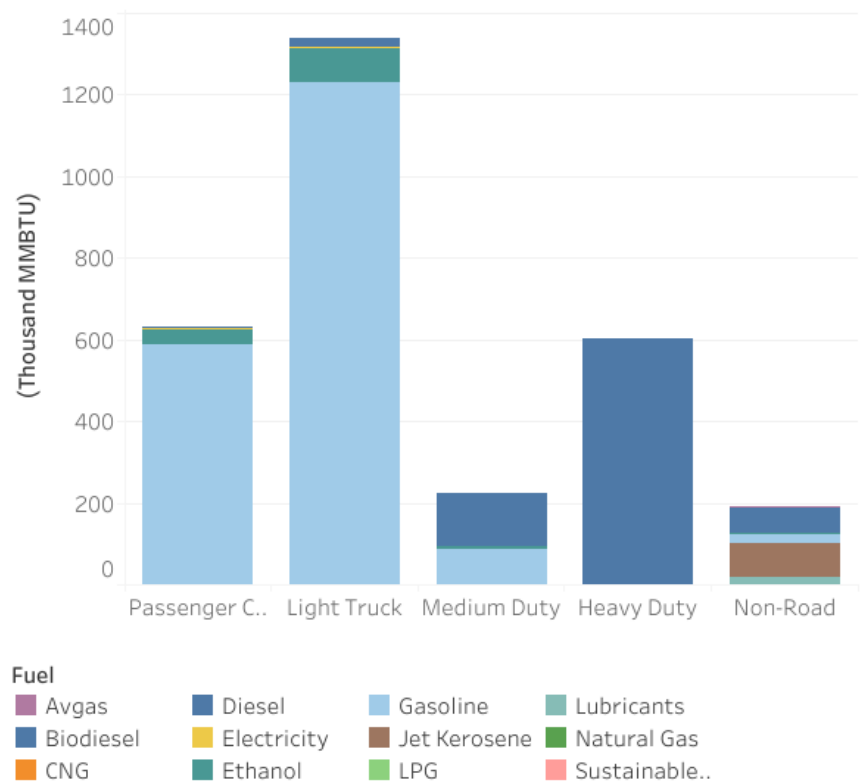
² Charts such as this are generated from the PSD provided LEAP model targets and can be found in interactive dashboards on the ACRPC website.

The Transportation Sector

The Addison Region is a largely rural area of working farms and forests, interspersed with small villages, rural residential single-family homes, and three larger, more densely populated urban centers. Most of the commercial and industrial development in the Region is currently located within these urban centers. Because of its existing settlement patterns, many residents in the Region are dependent upon their cars and trucks for commuting to work, school, and commercial, civic, and recreational activities. As a result, the Addison Region currently consumes an estimated 1,591,281 thousand MMBTUs of energy for transportation. Further, as illustrated by Figure 6—Transportation Sector Fuel Mix by Vehicle Type below, fossil fuels remain the dominant source of energy for transportation in the region.

The majority of that fossil fuel use comes from passenger vehicles and light trucks and some of that demand could be reduced through increased use of public transportation, carpooling, walking or biking to destinations. Many of these options are easy to access through the [Go! Vermont website](#). Additionally, the adoption of EVs, which are more energy efficient than ICE powered vehicles, will itself reduce overall energy demand ([Kirk 2022](#)). Further, while the Region desires to retain its rural feel, it can adopt land use policies that encourage more densely settled, urban centers while maintaining its rural aesthetic. These urban centers have the capacity to allow for more transportation alternatives within those areas, like walking or biking, which reduce energy use and also promote public health. As with other conservation goals, conserving energy by reducing the need for cars can be more cost effective for its citizens than fuel-switching to electric or other alternatively powered vehicles discussed in the previous chapter. Therefore, the Land-use Section of this Plan promotes greater density and housing options in the Region's villages.

Figure 6—Transportation Sector Fuel Mix by Vehicle Type



The third largest consumer of transportation fuels in the Region are Heavy Duty vehicles, a class that consumes nearly as much energy as passenger vehicles. As also seen in Figure 6, Heavy-Duty vehicles are almost exclusively fueled by climate change inducing fuels. Unfortunately, alternatives—both fuel switching and behavioral changes—are currently more limited for Heavy-Duty vehicles than they are for Passenger and Light Duty Truck vehicles. As such the Region would like to express emphatic support for expanded research, development, demonstration, and deployment projects for

low-to-no CO₂ equivalent Heavy-Duty Trucking, while also remaining technologically agonistic in the process.

From Gasoline to Electricity

Gasoline distribution in the Region is primarily through individual stations affiliated with major oil companies. In the Region's rural towns, many stations are small, locally owned convenience stores with franchises. Along the major highways, gasoline stations are more likely to be corporate-owned chain stores.

This distribution network has historically served the Region well and fuel for gasoline engines is readily available. During the past 30 years, changes to the economic climate, consumer purchasing patterns and regulations on underground storage tanks have affected the gasoline distribution system. Smaller stores with limited sales volumes are finding it increasingly difficult to justify the expense associated with gas sales. Consequently, residents in more rural parts of the region have been gradually losing local access to fuel and must drive increasing distances for a fill up.

Above ground storage and transport of highly flammable petroleum products also carry fire and explosion risks to communities. In the 1980s, transport of petroleum products to the Region shifted modes from a combination of Lake Champlain barge, rail and truck to primarily truck transport with limited rail use. A 2003 study of the Region's major highways indicated that more than three-fourths of all hazardous materials transported within the Region fall within the petroleum category. Additionally, all of the Region's local roads also have some risk associated with the transport of petroleum products to customers for heating and cooking fuels.

Like fuel oil and propane, this plan envisions reducing the Region's dependency upon gasoline and other petroleum-based fuels in favor of renewably generated electricity. In addition to encouraging a reduction in gasoline consumption through higher efficiency vehicles, public transportation, and active transportation options, this Plan supports a transition away from fossil fuel powered vehicles to electric vehicles. To that end, this Plan supports the further development and distribution of electric vehicle charging stations that serve all vehicle types and users and discourages the development of new greenhouse gas creating infrastructure.

As of spring 2024, there are nearly 400 public EV charging stations across the state. In Addison County, public chargers can be found in 20 locations with about 32 level 2 chargers located in Ferrisburgh, Panton, Starksboro, Shoreham, New Haven, Vergennes, and Middlebury, while the 18 fast chargers in the region are located in Vergennes and Middlebury³. While many EV drivers across the state charge at home (typically overnight), increasingly workplace and public charging infrastructure has been identified as key to support longer trips/commutes, visitors, or those without charging access at home. ACRPC continues to encourage municipalities and local businesses to install EV charging stations at convenient and desirable locations including public transportation stops, workplaces, schools, community centers, recreation sites, libraries, multi-unit buildings, etc., where users could park for several hours in our regional downtowns, village centers, and other designated growth areas. Building electric vehicle charging infrastructure should include all reasonable places for electric charging stations, including existing service stations.

³ <https://www.driveelectricvt.com/about-evs/charging-map>

The Thermal Energy Sector

Residential

Residential users are the biggest user group of thermal energy in the Region. Next to transportation, the largest share of total energy demanded by residential customers is for space heating and cooling, and domestic water heating. After applying housing estimates from the American Community Survey (ACS) to a heating model distributed by the Public Service Department, it was revealed that region level heating demand was about 1,610,180 million British Thermal Units (MMBtu), which is reflected in Table 2—Estimated Residential Thermal Energy Demand below.

Table 2—Estimated Residential Thermal Energy Demand

Households in the Region	Average Annual Heating (MMBtu)	Total Residential Heating Demand (MMBtu)
14,638	110	1,610,180

A breakdown of that total demand can be seen in Table 3—Residential Heating by Fuel Type to the right. Table 3 contains five-year average estimates of the share of Addison County households that use a given fuel to heat their homes. Taken from the ACS, this data shows that the majority of residences in the Region heated with fuel oil, (~46%), followed by propane (~22%) and wood (~17%) in 2023. These three fuels comprise ~85% of the region’s residential heating fuel mix. Notably, the estimated share of households that use fuel oil decreased by ~16% over the ten-year period ending in 2023. The share of households using wood declined by ~13% during the same period; however, the share of households using propane increased by ~9%. Two other key changes highlighted within Table 3 are the increases in the share of households that are using electricity (~117%) and natural gas (~289%) to heat their homes. While these two fuel sources still constitute relatively small shares of household heating—about 6% and 7%, respectively—they are clearly the fuel types with the fastest growing demand in the Region.

Table 3—Residential Heating by Fuel Type

Fuel Type	Share of Total Households		
	2014	2023	Change
Bottled, tank, or LP gas	20.12%	22.00%	9.37%
Electricity	2.67%	5.81%	117.48%
Fuel oil, kerosene, etc.	54.55%	45.91%	-15.84%
Utility gas	1.78%	6.92%	288.82%
Wood	19.28%	16.68%	-13.49%
No fuel used	0.05%	0.23%	357.81%
Other fuel	1.55%	2.45%	57.75%
Household Estimate	14,215	14,638	2.98%

Fuel oil, propane, conventional natural gas, and other fossil fuels have limited supplies and their use contributes to climate change. Dependence upon these fuel types will reduce our region’s energy security and our resilience to climate change. Due to these considerations—and the need to meet State mandates—their use must be largely eliminated by 2050. While progress has been made in reducing fuel oil demand, growth in the share of households using propane and natural gas should give policy makers pause. New residential adoption of these fuels, unless no other alternative is feasible, should be discouraged.

There are a variety of methods for reducing fossil fuel consumption from residential heating. Making homes more thermally efficient is one way to reduce fossil fuel use. Another is to install new heating technologies to make are themselves more energy efficient. The third and best long-term solution is to substantially reduce fossil fuel use by replacing fossil fuel powered equipment with technologies that use renewable, net-zero greenhouse gas emitting fuel sources such as electricity, advanced biomass,

or geothermal. The upfront capital cost of new equipment is the primary barrier to fuel switching. While the Region has little control over energy pricing, it can and does work to encourage conservation, efficiency, and affordability for low-income residents. Additionally, the cost of transition to newer technologies can be eased with subsidies and tax credits for all residents.

Services available currently providing cost subsidies and/or promoting weatherization and efficiency include:

- The Champlain Valley Office of Economic Opportunity (CVOEO)
 - provides fuel assistance to income-qualified residents either on a seasonal basis (call CVOEO at 800-479-6151) or on a crisis basis (call CVOEO Addison Community Action at 388- 2285). The CVOEO website [CVOEO.org](https://cvoeo.org) describes additional fuel assistance programs available to Vermont residents;
 - Champlain Valley Weatherization Service, part of CVOEO, provides free weatherization services to income-qualified Addison County households;
- Efficiency Vermont has a number of programs to improve energy efficiency. It describes most on its homepage at [Efficiencyvermont.com](https://efficiencyvermont.com).
- Neighborworks of Western Vermont also offers audits and subsidized weatherization services through their HEAT Squad program <https://heatsquad.org/>;
- Lastly, many of the Region’s municipalities run services that supply firewood or other sources of heat to their residents.

Additionally, Vermont has enacted new residential energy standards. Officially called the “Residential Building Energy Standards” (RBES), the Residential Energy Code contains [minimum standards and stretch code](#) for energy efficiency for all new residential construction in Vermont. The Vermont Residential Energy Code Handbook 2024⁴ includes two primary requirements:

1. A list of technical requirements that includes minimum standards for energy-efficient building components and construction practices; and
2. A certification requirement for reporting compliance. Upon completion, state law requires every Vermont builder to self-certify that the home complies with the RBES standards as built. The builder must complete and sign a certificate and submit it to the Town Clerk for filing. This must be on record before the Zoning Administrator issues a Certificate of Occupancy.

The Zoning Administrator’s duty to distribute information about the Energy Codes provides an opportunity for all towns to communicate with homeowners regarding energy programs and conservation opportunities.

Finally, not all barriers to fuel switching, particularly in the residential space, are financial. Some are behavioral and social.⁵ Programs such as the Climate Economy Action Center of Addison County’s (CEAC) “Energy Navigator” program which provides residents of the region with energy-use and weatherization consultations from volunteers from within their community to is one such attempt to address the non-financial, social barriers of residential fuel switching. The ACRPC supports these and

⁴ <https://publicservice.vermont.gov/efficiency/building-energy-standards/residential-building-energy-standards>

⁵ https://sciencepolicy.colorado.edu/students/envs-geog_3022/seto_2016.pdf

similar efforts that are designed to address the non-economic challenges that might be preventing our residents from adopting new technologies

Commercial

Estimates for commercial and industrial thermal energy use are more difficult to calculate. An estimate of total commercial energy use (thermal and electricity) is provided in Table 4 and based on data from the Vermont Department of Labor (VT DOL) and the Vermont Department of Public Service (PSD)⁶. While these are only estimates, they do indicate the substantial thermal energy use by commercial establishments in the Region and therefore the need for their participation in conservation and efficiency efforts.

Table 4—Estimated Commercial Thermal Energy Demand

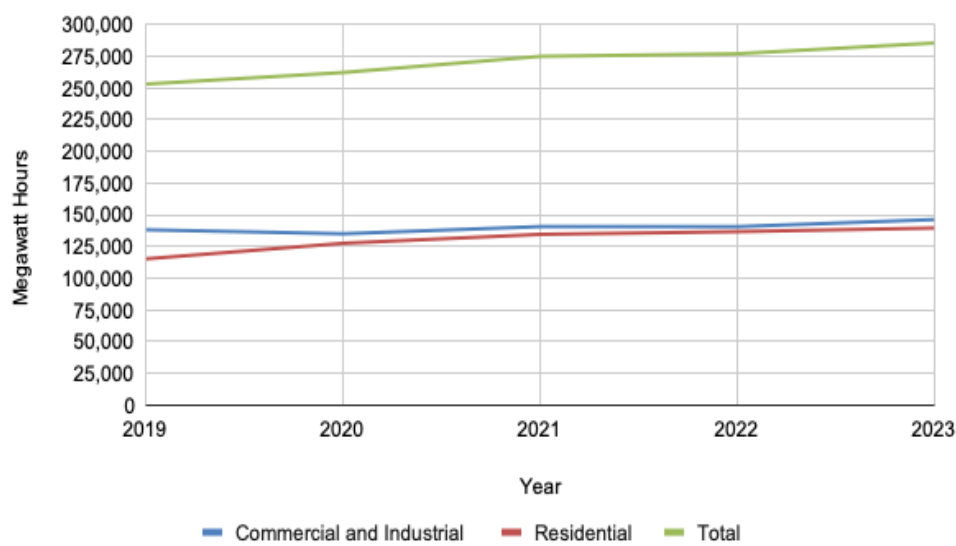
Number of Commercial in the Region	Average Annual Heating Load per Building (MMBTU)	Total Heating Load for Commercial Buildings (MMBTU)
1,053	919	968,127

It is important to note that the total Thermal Energy Demand presented in the table above is the true estimate of the demand based on the average energy demand of each of the types of commercial and industrial buildings in the region. The Average Energy Demand is the average of the various building demands, but the calculation from this table will not provide the same total estimate.

The Electric Sector

Electrical energy constitutes a significant portion of the Region’s current energy use. Current, and recent, demand for electricity in the Region can be viewed in Figure 7. This Plan projects that the Region’s energy use will likely shift from non-renewable fossil fuels to electricity powered vehicles, heat pumps and other new technologies. It is also projected that the supply of electricity that will come from local, distributed, renewable generation sources will increase. The traditional pattern of electrical generation and supply will also change, driving changes in local energy delivery systems. This section evaluates the electric consumption in the region and discusses opportunities to reduce demand over time.

Figure 7—Regional Demand for Electricity



⁶Please see appendix

Residential Use

Using data provided by Efficiency Vermont, it has been estimated that residential electricity demand for the region increased from about 115,000 MWh to about 139,500 MWh between 2019 and 2023. This corresponds with an average change in electricity demanded of about 5% annually during that period. Additional data about regional, residential electricity demand can be viewed in Table 5—Regional Electricity Demand, Residential (MWh) below.

Table 5—Regional Electricity Demand, Residential (MWh)

End User Type	2019	2020	2021	2022	2023	Avg. Change
Residential	115,091.38	127,369.86	134,454.59	136,588.07	139,482.19	4.98%

This increase is to be expected. As can be seen in Table 3—Residential Heating by Fuel Type, the American Community Survey (ACS) estimates that the number of households in the region grew by about 3% between 2014 and 2023. Further, it would also be reasonable to note that, as more households in the region adopt electricity fueled appliances and EVs, electricity demand would rise. Still, policymakers and citizens alike should be mindful of this growth in the demand for electricity and also consider ways in which—formally and informally—truly conspicuous consumption can be limited.

Simple, inexpensive measures such as turning off lights in empty rooms or replacing light bulbs with new, more efficient bulbs can substantially reduce energy usage. Using timers or sensors to regulate lighting, heating or cooling in a home can also significantly decrease energy consumption. Other conservation measures that can have a profound impact on energy usage include improved insulation and weatherization of new and existing structures. New, more efficient appliances, motors and heat pumps can also help reduce electricity usage.

Commercial and Industrial Use

As shown in Table 6—Regional Electricity Demand, Commercial and Industrial (MWh) below, commercial and industrial electricity users in the Region demanded about 146,159 mega-watt hours of electricity in 2023, the last year for which data is currently available. This is slightly more than residential demand and a little more than half of the electric energy used in the Region. Though commercial and industrial users used more electricity than residential consumers, their demand has increased at a lower rate on average. Commercial and Industrial electricity demand increased by about 1.5% between 2019 and 2023 from about 138,092.25 to 146,158.67 MWhs.

Table 6—Regional Electricity Demand, Commercial and Industrial (MWh)

End User Type	2019	2020	2021	2022	2023	Avg. Change
Commercial and Industrial	138,092.25	134,912.31	140,627.20	140,543.43	146,158.67	1.47%

The electricity used by the Region's businesses powers the pumps and motors that drive their industrial processes. It is also used, as residential users will be familiar, to power the associated lights, computers and appliances of our business community. While some growth in electricity demand is to be expected in the commercial and industrial sectors as well—they are also undergoing a process of electrification—businesses must also be mindful of unchecked demand for electricity. Fortunately, businesses have a powerful motivation to keep electricity demand as low as feasible: firm profitability. While the Region's businesses will need to invest more in improved energy

conservation and efficiency if the Region is to achieve its future targets, the ACRPC is optimistic that these businesses will mind their bottom line by adopting further electricity-oriented, cost-saving measures as appropriate.

Section 3—Generation and Infrastructure

Infrastructure such as electricity distribution lines, gas pipelines and sewer systems can lead to new or intensified development. Development is easier, less expensive and therefore more likely to occur in places served by infrastructure. So, decisions regarding infrastructure extensions or improvements should consider the impacts on growth and development patterns in the area. For example, in the Region, there are areas, especially in the mountain towns, that do not currently have access to electric lines. As with roads, whenever a distribution line is extended into a place that previously did not have service, additional development is more likely to occur along the length of the line over time.

In the Region, energy is accessed by residents and businesses through delivery of fuels like oil and propane, the Vermont Gas natural gas pipeline, and the electric grid. The grid consists of transmission infrastructure feeding or passing through the Region, electric distribution infrastructure providing service to businesses and residents and a variety of generation facilities within the Region

Delivered Fuels

There are a number of companies in the Region delivering propane and fuel oil to retail, commercial and industrial customers, used primarily for space heating and cooking. Most of these fuels are shipped into the region by truck. There is also a rail facility located in Leicester Junction where fuel is delivered and stored. Retail distribution of these fuels is available throughout the Region. This plan supports phasing out the use of these fuels within the Region. However, it also recognizes that these businesses have been a very necessary part of the community for a long time. This Plan supports a just transition for these businesses and those that they serve.

Natural Gas

Vermont Gas has a 41-mile natural gas pipeline extension into the Region and continues to build out secondary distribution. The line serves or will serve commercial or residential customers in up to 7 communities in the Region, including two of the three regional employment centers—Vergennes and Middlebury—and the village areas in Monkton, New Haven and portions of Weybridge and Ferrisburgh. This pipeline has been a contentious issue for the Region. When proposed, the cost of other fuels was significantly higher. However, many in the community objected to investment in new, long-term infrastructure for fossil fuel. After significant debate, the Addison County Regional Planning Commission supported the project with conditions. Those conditions were included in an MOU it executed with Vermont Gas. Conditions included provisions like service to the villages that the pipeline passed through to provide infrastructure to support planned, denser growth within those villages, training for the Region's first responders and working to incorporate renewable natural gas from composting agricultural waste—mainly cow manure and/or food waste into its fuel mix. Vermont Gas is working to make this opportunity available to the Region's farmers and food manufacturers.

Although conventional natural gas was intended to serve as a short-term fuel for the Region, the comparatively lower cost fuel has generated significant interest in communities with access to the VGS network, which has reduced energy burden in the short-run. As such, the ACRPC will continue to work with VGS to promote sustainable economic development in our region and also explore intermediate to long-term solutions for creating an energy system that does not contribute to climate change or other social and environmental problems.

Electric Transmission

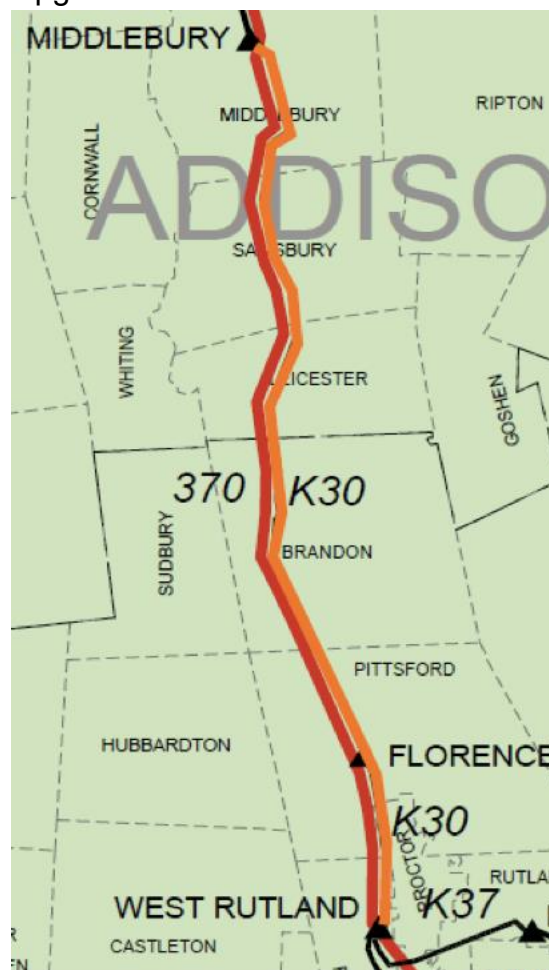
The Vermont Electric Power Company, Inc. (VELCO) manages the safe, reliable, cost-effective transmission of electric power throughout Vermont and as part of the integrated New England regional network. VELCO updates its Long-Range Transmission Plan every 3 years. The [2024 Long Range Transmission Plan](#) highlights that peak demand is forecast to grow due to accelerating electrification of the heating and transportation sectors. While the transmission system has sufficient capacity to serve expected future demand for the first 10 years of the 20-year planning horizon, load management is necessary to serve high electrification loads consistent with Vermont's energy and emissions goals in the 20-year planning horizon.

In addition to load growth, there are sub-transmission-scale reliability issues (categorized as causing high or low voltage, or a thermal overload in which equipment exceeds its rated temperature) anticipated within the 10-year planning horizon. This is a particular issue in Addison County where the Middlebury transformer is anticipated to fail between 2029 and 2033 depending on load growth. The transmission solution is to increase the capacity of the West Rutland to Middlebury 115kV line shown in orange on the map to the right. The cost estimate for the project is \$215M.

One alternative solution would be to aim to reduce the projected load growth by 2033 by about 80 MW to allow the current infrastructure to continue to function in the short-term. The projected increase in electricity demand can be reduced via weatherization and energy efficiency. Offsetting the increasing electric demand via weatherization and energy efficiency—which can be significantly boosted via storage and flexible load management—is a key piece of this puzzle. Additionally, the ACRPC supports experimentation with alternative organizational models that can support additional, niche infrastructure investments.

Currently, distributed generation (DG) projects—such as solar and wind farms—are reviewed on a project-by-project basis without regard to transmission system impact. This too should change. To prevent further stressing transmission and distribution systems, carefully coordinated, statewide

Figure 8—Regional Transmission Upgrades



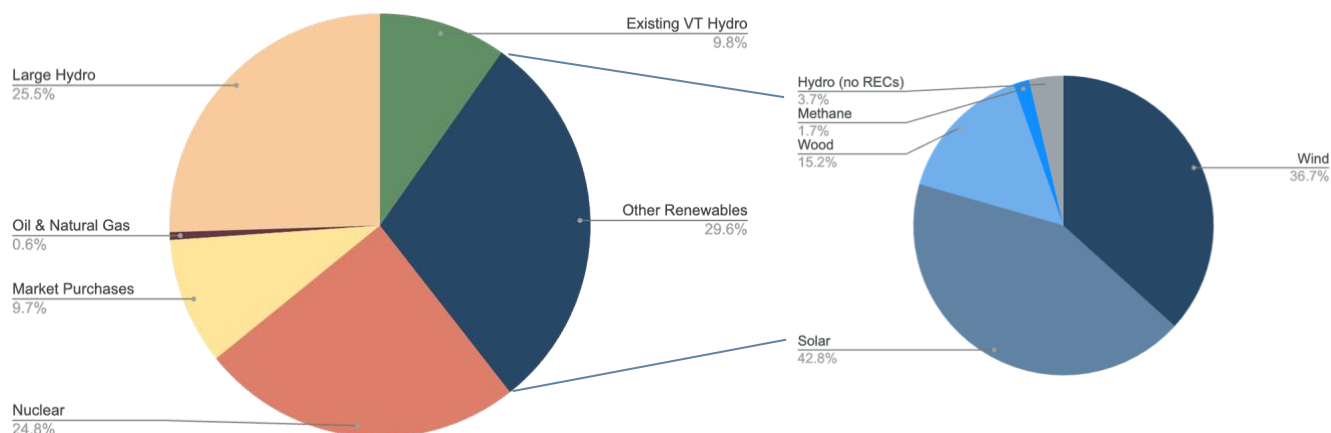
transmission system modernization will be required to successfully integrate future distributed generation and storage. As the grid is asked to take on more interconnection of distributed energy projects, coordination between VELCO, DG developers, the region, and municipalities will be increasingly necessary to ensure that Vermont and its stakeholders can meet projected goals. It is important that we do so in a manner that minimizes negative impacts to our landscapes and natural resources and maximizes benefits to all Vermonters-especially those who have been disproportionately burdened by energy costs and reliability issues.

Electric Distribution

In 2021, Vermont distribution utilities purchased over 5.8 million MWh of electricity. 64% came from renewable resources and 18% from carbon free resources. Also in 2021, Vermont distribution utilities retired just over 4 million renewable energy certificates⁷ (representing just over 4 million MWh of electricity) to meet their obligations under Vermont’s Renewable Energy Standards. of which 72% of the electricity Vermont accounted for was renewable; including nuclear 90% of it was low-carbon.⁸

Green Mountain Power (GMP) serves a majority of Addison County except for a portion of Starksboro that is served by the Vermont Electric Co-op. Figure 8 shows sources of electricity distributed by GMP in 2021 (before the sale of renewable energy credits (RECs)⁹. GMP owns several generation facilities, enters into power purchasing agreements with individual power suppliers, and it also purchases power from the wholesale electricity market, ISO-NE¹⁰.

Figure 9—Green Mountain Power Energy Mix, pre-REC purchases



⁷ Renewable energy credits (RECs) are the accounting system used to track all renewable electricity generation in or sold into ISO New England’s regional electric system (ISO= Independent System Operator). These certificates ensure no two entities claim credit for that electricity, and provides a mechanism to buy and retire (aka take credit) for renewable energy generation regardless of their own production and use (or rather to compensate for it).

⁸ See 3 one-page resources for more info: [Where does Vermont’s electricity come from](https://publicservice.vermont.gov/renewables), for Regional Event Series provided by <https://publicservice.vermont.gov/renewables>

⁹ <https://greenmountainpower.com/energy-mix/>

¹⁰ <https://www.ferc.gov/industries-data/electric/electric-power-markets/iso-ne>

The Region’s energy supply is largely consistent with statewide patterns. This includes a number of alternative energy installations that tap local energy resources. The Region was historically developed with hydropower. The Middlebury River, New Haven River and Otter Creek powered the first mills in Middlebury, Bristol and Vergennes respectively. Several of these hydropower sites still exist and are discussed in the sub-section later in this chapter dealing with Hydropower. More recently, the relatively flat and open topography of the Champlain Valley in portions of the Region has attracted several large-scale solar developments. Also, a growing number of homes have photovoltaic systems that supply a portion of their electrical energy. Finally, community members, either lacking good solar orientation or interested in a community system for other reasons, have created community energy systems where they have pooled resources with other like-minded citizens to develop an offsite community energy project.

Local Generation

As of October 2024, roughly 2,055 sites generate 225,428 MWh of solar, wind, hydro and bio-methane power annually within the Region (Table 7)¹¹. The discussion below encompasses the types of renewable generation potentially available to the Region’s residents and how they might harness it to meet statewide generation targets for the community. A map existing renewable generation with a name plate capacity that is above 15 KW in the Region can be found in the Appendix (Figure 12).

Table 7: Regional Renewable Generation

Technology	Capacity (MW)	Annual Generation (MWh)
Farm Methane	1.58	10,380.60
Hydro	22.50	98,545.62
Solar	58.53	76,903.14
Wind	0.89	1,758.80
Biomass	0.15	919.80
Grand Total	85.17	188,507.96

Hydropower

Hydropower has been used as an energy resource in the Region since colonial settlers built the first mills along the region’s streams. Throughout the 1800s most of the region’s industrial activity was focused on locations with access to hydropower, such as the Marble Works in Middlebury. Some of those same locations are still being used to generate power today. There are seven hydropower generation facilities operating in the Region, five of which are located on Otter Creek. One other facility is powered by Sucker Brook from the Sugar Hill Reservoir in Leicester and the Goshen Dam in the town of Goshen. In Salisbury, there is a facility that generates hydropower from the Leicester River. All of these facilities are owned by Green Mountain Power. The size of these facilities ranges from the Sucker Brook facility (or Silver Lake Project), which produces less than 7,000 MWh annually to Huntington Falls, which generates more than 22,000 MWh. Altogether the region’s hydro plants

¹¹ Existing renewable generation data was provided by the Public Service department distributed generation list as well as the large generation and The Low Impact Hydropower Institute (2024).

currently produce close to 85,000 megawatt hours of electricity annually. That figure represents approximately 33 percent of the electricity consumed in the Region annually.

The environmental impacts associated with hydropower, the Region’s main source of electricity generation, can be significant. The physical character of a power-producing stream is usually markedly changed upstream, downstream and at the dam location. Water chemistry and biology are also altered. Even run-of-river plants can still cause impacts on the riverine system. At a minimum there is often a dam limiting the mobility of fish and blocking passage to spawning areas. The level of water in the reservoirs used in ponding systems can fluctuate greatly, causing shoreline erosion and degrading plant communities and animal habitat. Further, drought from climate change can impact the availability of water for both run-of-river and reservoir-based hydropower systems, which could reduce the capacity of this resource to continue to supply the region with renewable energy in the future. However, when they are properly designed and managed effectively, hydropower systems can contribute to flood control—reducing this climate threats—and they also present fewer negative environmental impacts relative to carbon-based energy sources.

Solar

Photovoltaic systems currently provide about one third of the generation capacity in the region. The majority of PV systems in the region have a name plate capacity that is below 15 kW. Further, the RPC expects solar generation to grow to meet future generation targets for the region. Doing so would improve the Region’s resilience to climate change as well as enhance its energy security: however, like all forms of development, more solar generation for the region will likely result in land-use changes that could have impacts on social and environmental considerations like rural lifeways or habitat connectivity, respectively. As can be seen in Figure 9—Comparison of PV Sites by Facility Type, the land-use needs of commercial-scale and utility-scale solar can be substantial.

Figure 10—Comparison of PV Sites by Facility Type



As such, careful consideration of such impacts is viewed to be essential for undergoing a just energy transition in the region. Thankfully, project design and development practices for solar PV projects that both enhance ecosystem function and also enable continued agricultural use of the land do exist. Referred to by some as “eco-voltaics,” the development of ecologically informed solar facilities on current agricultural land has been found to be capable of supporting energy development, habitat needs, as well as agricultural policy goals in rural settings.¹² Consequently, it is the position of the Region that new solar

developments should—to the greatest extent that is possible—use eco-voltaic best practices when designing projects for our communities. Failure to do so could be viewed as a form of disorderly development because it would undermine the social and ecological functionality of the land upon which such a development is sited.

¹² <https://www.pnas.org/doi/10.1073/pnas.2501605122#sec-1>

Photovoltaics represent only one of several useful ways to harvest solar energy. The simplest use of sunlight is passive use for lighting and heating. Many of Vermont's one-room schoolhouses provide historic examples of how buildings can be oriented, and windows can be used to take advantage of passive solar energy for lighting and heating. Properly insulated buildings oriented so that their long axis is within 30 degrees of true south with unobstructed south facing windows can offset their space heating costs by 15 to 50 percent.¹³ Taking this one step further, floors and walls can be built of materials that will capture and store warmth from the sun. In many cases, passive solar buildings can be constructed at little or no extra cost, providing free heat and light – and substantial energy cost savings – for the life of the building. Solar water heating is another alternative solar application for buildings in the Region. Water heating is one of the largest energy costs for the Region's households. A water heating system that utilizes solar energy can reduce energy costs by up to 65 percent.

Wind

Wind represents less than 1MW of generation capacity in the region and a majority of that production coming from systems providing less than 15kW. This is reflective of the available wind resources identified by the National Renewable Energy Laboratory indicating that most of the Region has average winds in the Class 1 category (speeds below 12 miles per hour) which is unsuitable for commercial-scale wind power. This Plan supports small residential scale wind development, provided the applicant provides sufficient setbacks to property lines and sites the facilities pursuant to the guidelines contained in the Public Service Department's handbook for residential wind siting, "Siting a Wind Turbine on Your Property"¹⁴.

A small portion of the Region appears to have class 3 winds and above (around 12 miles/hour at 100 meters above the ground), considered marginally suitable for large-scale wind installations. Ridgelines provide the best location for wind generation facilities, with elevations between 2,000 and 3,500 feet above sea level being ideal for maximum power production. In the Region, locations primarily in the towns of Starksboro, Lincoln and Ripton, were identified as having a Wind Power Class of 3 or greater, making large-scale generation feasible. However, much of the land in this area lies in the Green Mountain National Forest, and a significant portion of that has been designated as Wilderness area. This Plan opposes any commercial development within the "Known Constrained" areas located on Map 4, including the wilderness area discussed above. This Plan does not set any further restrictions with regard to commercial or industrial scale wind generation, and will support the wind policies of its member municipalities as contained within their plans.

Biomass

Biomass resources that can be used to produce renewable natural gas or "Farm Methane" as these projects are described in the State database, include manure, food waste, cheese whey, slaughterhouse waste and brewery residuals. These projects require significant upfront investment, which is reflected in the small number of operations in Addison County. However, they offer several co-benefits such as reducing the amount of waste that is sent to the landfill, and producing valuable materials that can be used as fertilizer in addition to generating methane for energy production. Finally,

¹³ Information from the *1997 Vermont Comprehensive Energy Plan*, prepared by the Vermont Department of Public Service.

¹⁴ https://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/Resources/Wind/psb_wind_siting_handbook.pdf

these systems produce waste heat that can be captured and used to offset heating needs in nearby buildings through a thermal energy network.

Energy Storage

Addison County currently hosts about 4.5 mega-watts of battery storage capacity. More than 60 percent of that comes from two large GMP projects, located in Ferrisburgh and Panton, with the rest relatively evenly distributed across the other member municipalities. While lithium-ion batteries are the most common form of modern renewable energy storage, other options are also available. Alternative energy storage solutions include thermal energy storage that stores heat energy in materials like molten salts or water, which can later be converted back into electricity or used directly for heating or cooling. Pumped Hydro Storage uses excess energy to pump water to a higher elevation, storing gravitational potential energy that can be released by letting the water flow back through turbines. Solid-state Batteries are a next-generation battery technology that replaces liquid electrolytes with solid materials, potentially increasing energy density and safety. These storage options and many more are currently available and each come with their own drawbacks and benefits.¹⁵ However, they all provide a resource available to address the critical issue of peak energy demand periods, and transmission capacity limitations on the grid.

As additional commercial or industrial scale generation is sited within its jurisdiction, the Region strongly supports the inclusion of associated storage facilities to improve short-term, local energy system resiliency and also to replace expensive peak power purchases. Battery storage, while expensive, is rapidly decreasing in price, both at the industrial and the consumer level, and can provide similar benefits at both. At the homeowner level, offerings such as the Tesla Powerwall have made an appearance. In fact, GMP has a program that offers a Powerwall and operating software to homeowners with an agreement to let GMP draw power from the unit during peak demand periods. In the event of an outage, the homeowner has backup power capable of several hours of typical use. The ACRPC supports this program and similarly designed programs to address the high up-front cost of storage and to share the benefits and costs of storage more fairly.

Thermal Networks

Investing in infrastructure choices that maximize co-benefits and energy efficiency in complementary infrastructure such as capturing waste heat and/or creating thermal energy networks will reduce demand on existing electric infrastructure and further support cost and emissions reductions. A thermal network captures existing waste heat from building ventilation or wastewater and puts it to use to heat or cool buildings in the network with the help of air to water heat pumps that are far more efficient than the more common, air-to-air source heat pump. ACRPC is developing a pilot thermal energy planning map to support the consideration of thermal energy networks in future development (See Figure 17 in the Appendix). Integrating waste heat recovery into planned wastewater system upgrades is one-way communities can benefit from these technologies by recovering heat from wastewater to make potable hot water and to heat and cool buildings. Wastewater is a continuous and existing source of thermal energy; the average residential wastewater temperature is 70°F while commercial and industrial wastewater can be up to 140°F or higher. Heat recovery systems are simple, low maintenance, offer

¹⁵ <https://www.irena.org/publications/2017/Oct/Electricity-storage-and-renewables-costs-and-markets>

lower, predictable customer heating and cooling bills, and are scalable from one building/facility to much larger community or district thermal energy networks.¹⁶

Emerging Technology

The energy resource and storage landscape is rapidly evolving. As new technologies become viable, ACRPC will continue to analyze and distribute information on the appropriate use of those resources for orderly economic development and land-use in our region.

Municipal Generation

Table 8 displays the renewable generation capacity in the Region by municipality as of January 2024. The data below comes from several sources and should be considered an estimate as new renewable generation sites may emerge and existing sites may expand or close.

Table 8—Renewable Energy Generation Capacity, by Municipality, by Generation Type

Municipality	Farm Gas (MW) ¹⁷	Hydro (MW)	Solar (MW)	Wind (MW)	Biomass (MW)
Addison	0.45		1.77	0.11	
Bridport	0.68		3.21	0.20	
Bristol	0.45		2.57		
Cornwall			1.21	0.06	
Ferrisburgh			10.76	0.19	
Goshen			0.11	0.001	
Leicester		2.20	0.47	0.02	
Lincoln			0.80	0.01	
Middlebury		2.25	12.16	0.03	
Monkton			1.66		
New Haven		5.85	8.76	0.01	
Orwell			1.17	0.02	
Panton			6.20		
Ripton			0.41	0.01	
Salisbury		1.30	0.81		
Shoreham			1.78		
Starksboro			0.94	0.01	
Vergennes		2.40	1.92	0.22	
Waltham			0.57	0.01	
Weybridge		8.50	0.51	0.004	0.15
Whiting			0.76		
Region Total	1.58	22.50	58.53	0.89	0.15

¹⁶ Visit Vermont Community Thermal Network for toolkits and more information. <https://www.vctn.org/the-basics>

¹⁷ This data only includes biomass used for electric generation or combined heat and power, for commercial or industrial use. It does not include biomass used solely for heat or electricity in individual homes or businesses.

Section 4—Targets

While Section 2 and Section 3 focus on cataloging the region’s current energy demand and generation capacity, Section 4 creates targets for regional energy conservation, use and generation. The targets will guide the region toward achieving the state and regional energy goals. Achieving these energy goals will be challenging. Intensive conservation methods will need to be employed throughout the region in all sectors. Increased electrification of transportation and space heating will also be needed (combined with the subsequent decrease in fossil fuel use). But perhaps most importantly, total energy demand in the region will need to decrease despite population growth. Appendix B contains a comprehensive list of regional energy targets. Appendix D provides the methodology for how regional and municipal targets were developed. Total regional energy demand targets can be viewed in Table 9 below.

Table 9: ACRPC total energy demand reduction targets, MMBtu

	Current	2025	2035	2050	Change
Residential	1713	1,332	946	731	(982)
Commercial	990	832	735	727	(263)
Industrial	1057	1,068	1,101	1217	160
Total	3760	3,232	2,782	2675	(1,085)

Building Targets

Building targets for the Region include a reduction in total energy demand across the residential, commercial, and industrial sectors. PSD’s modeling estimates that the Region’s overall energy demand will need to decrease to meet state goals by 2050. The largest contributors to this deduction will be from conservation and efficiency improvements. Thermal conservation and more efficient equipment is projected to shrink the amount of energy the Region uses by about one third (1/3rd). This change is represented by the white space in Figure 3 above (See Section B for the projected targets and actions to improve thermal efficiency). VEIC’s model projects that fossil fuel use in the Region will significantly decrease by 2050 (The orange, green and beige bars). Fossil fuels will be replaced by increases in the use of biomass, wood chips and pellets (purple and pink bars) for heating commercial and industrial spaces, biodiesel (blue bar) for use in heavy equipment and electricity (yellow bar) in residential space heating and light vehicles.

Thermal Targets

To achieve the energy goals, according to the LEAP model, the amount of energy used for space heating demand is expected to fall regionally between the present and 2050 due to electrification with the rise of heat pumps. It is also due to increasing energy savings gained through weatherization

retrofits of existing structures and through the construction of new buildings that are compliant with the state’s building energy standards.¹⁸

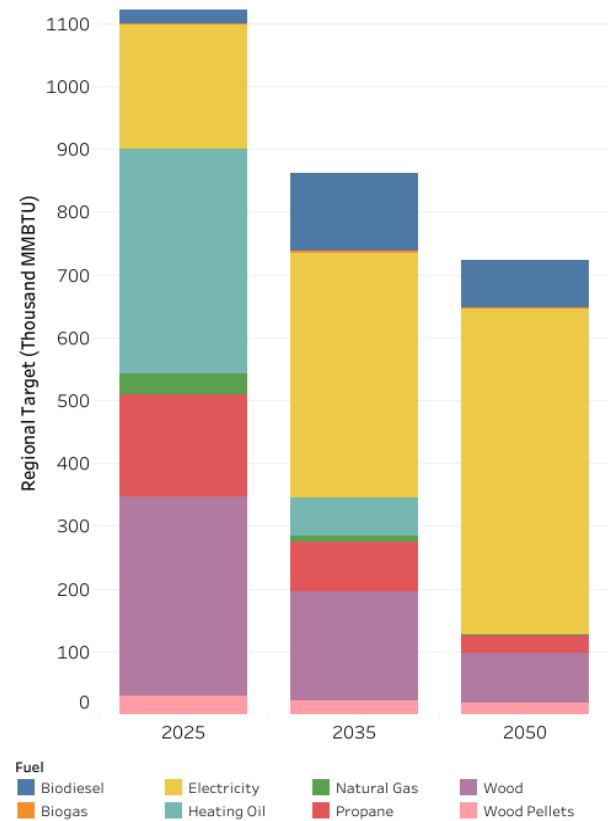
Table 10—Regional Thermal Energy Project Targets

		2025	2035	2050
Commercial	New Cold Climate Heat Pumps	2,336	7,064	9,034
Residential	New Cold Climate Heat Pump	4,637	12,468	18,374
	New Heat Pump Water Heaters	3,048	10,151	13,928
	New Weatherization Retrofits	3,356	7,253	11,734

heating sources by 2050. Liquid propane and natural gas use are projected to drop substantially during the model time frame. In contrast, electricity demand will increase as heat pumps replace other systems. Heat pumps are most effective when residential properties are fully weatherized, therefore the rate of weatherization should dramatically increase as well, although this version of the model does not provide a specific target. Industrial and commercial space heating demand is also estimated in the LEAP modeling.

Due to the lack of existing data on commercial energy heating, it is difficult to accurately determine the scale of change necessary. However, it is clear that industrial and commercial uses will need to

Figure 11—Residential fuel demand change



transition from fossil fuels to electricity to meet energy goals, including nearly eliminating natural gas usage. To support this transition, there will need to be a large increase in the number of commercial cold climate heat pumps.

Electricity Targets

As with the thermal targets, the Region will need to focus on efficiency and conservation to minimize the amount of electricity that it uses. Since electrical consumption in the Region is split almost evenly between residents (48%) and commercial and industrial entities (52%), the targets will require both individual homeowners and commercial and industrial users to participate.

However, even with significant efficiency steps taken by businesses and residents, the Region’s electrical usage will likely increase. This is because many of the new technologies needed to reduce fossil fuel consumption, like heat pumps and electric cars, replace fossil fuels with electricity. Importantly, this strategy of switching away from fossil fuels only works to reduce greenhouse gases if the electricity is generated renewably. Table B shows that the Region

¹⁸ <https://publicservice.vermont.gov/efficiency/building-energy-standards>

must increase its efficiency and conservation by about 52,000 MWh by 2050 to meet the proposed targets. This target is based on efficiencies available to residents and businesses today. Future technological advances, such as better fuels or motor efficiencies may help drive this change. However, the Region and its residents will also need to make significant capital investments in new technologies and efficiencies to meet the targets.

Table 11: Regional Program Achievable Electric Energy Efficiency Savings (MWh)

Energy Efficiency Source and Type		2025	2030	2035	2040	2050
Residential	Incremental Annual	1,428	1,500	1,627	1,572	1,748
Residential	Cumulative Annual	2,823	9,620	16,197	20,410	29,880
Non-Residential	Incremental Annual	2,532	2,300	2,303	2,270	2,640
Non-Residential	Cumulative Annual	5,075	16,614	25,489	24,914	22,984
Total	Incremental Annual	3,961	3,800	3,929	3,842	4,388
Total	Cumulative Annual	7,898	26,234	41,686	45,324	52,865

[Efficiency Vermont](#) is a statewide energy efficiency utility, the first of its kind in the nation. Efficiency Vermont helps consumers reduce energy costs by making homes and businesses more energy efficient. It provides technical assistance and financial incentives to help Vermonters identify and pay for cost-effective approaches to energy-efficient building design, construction, renovation, equipment, lighting and appliances. Efficiency Vermont is funded by an energy efficiency surcharge on electric bills.

Transportation Targets

Transportation Energy demand is a major contributor to the regional energy and greenhouse gas emissions. Therefore, ACRPC proposes that regional targets for an overall reduction in the fossil fuel usage of all vehicle classes must be met to obtain our goal of climate change resilience. Further, a reduction in demand for most of these non-domestically produced transportation fuels will also enhance energy security by making the region less dependent on fuel imports. Projections of the necessary reductions in demand by fuel type, by vehicle type can be seen in Table 12—Transportation Fuel Demand Targets, thousand MMBtu.

Table 12: Transportation Fuel Demand Targets, thousand MMBtu

Fuel	Passenger Car			Light Truck			Medium Duty			Heavy Duty		
	2025	2035	2050	2025	2035	2050	2025	2035	2050	2025	2035	2050
Electricity	11	93	192	14	167	295	20	165	352	10	81	147
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Gasoline	416	202	26	1,050	477	64	147	98	26	0	0	0
Diesel	2	1	0	20	12	1	190	108	22	283	91	9
LPG				-	-	-	2	1	0	-	-	-
Ethanol	35	21	3	90	50	7	13	10	3	0	0	0
CNG	-	-	-	-	-	-	-	-	-	-	-	-
Biodiesel	0	0	0	1	1	0	13	14	5	20	12	2
Total	465	317	222	1,176	707	368	384	396	408	312	183	159

Much of the transition described above is related to the transition from fossil fuel powered vehicles to electricity powered vehicles. As EV use grows, this should lead to a decline in demand for gasoline, diesel and ethanol. Targets for EV adoption can be viewed in Table 13—CAP Regional EV and PHEV Targets. Meeting these EV and PHEV targets, in addition to shifting single traveler, single destination travel to public options, should help to substantially reduce the demand for fossil fuels and their additives for road transportation.

Table 13—CAP Regional EV and PHEV Targets

Vehicle Type		2025	2035	2050
Passenger Vehicle EV and PHEV Stock	Battery Electric	606	6,250	14,719
	Plug In Hybrid	115	88	20
	Total	721	6,338	14,739
Light Duty Truck EV and PHEV Stock	Battery Electric	622	8,705	17,753
	Plug In Hybrid	65	86	21
	Total	687	8,792	17,775

Note. Units are number of vehicles.

Road vehicles are not the only sources of fossil fuel-based, transportation fuel demand in the Region, however. Reducing demand for fossil fuels from non-road vehicles is also a long-term priority to improve energy security and climate change resilience in Addison County. As can be seen in Table 14—CAP Regional, Non-Road Energy Demand, the primary goal for reducing fossil fuel demand for non-road vehicles is to encourage fuel switching from traditional jet kerosene to sustainable aviation fuels (SAF).

Table 14—CAP Regional, Non-Road Energy Demand

Fuel	2015	2025	2035	2050
Diesel	64	61	61	62
Biodiesel	2	4	8	14
Avgas	2	3	3	3
Jet Kerosene	83	82	69	48
Sustainable Aviation Fuel	-	1	16	37
Gasoline	22	20	21	21
Ethanol	2	2	2	3
Lubricants	18	14	14	14
Natural Gas	-	-	-	-
Total	193	187	192	202

Note. Units are Thousand MMBTUs.

Generation Targets

The PSD’s “determination standards”, or the standards to achieve “enhanced energy plans”, require that regional plans establish 2025, 2035 and 2050 targets for renewable energy production. ACRPC

worked with PSD guidelines and the provided Generation Scenarios Tool to produce municipal and regional targets for new renewable generation. These targets are listed in Table 14 below.

Table 14—New Generation Targets

Municipality	Current Generation		Generation (MWh) Targets	
	2023	2025	2035	2050
Addison	5,598	4,456.02 (126%)	6,598.67 (85%)	8,608.90 (65%)
Bridport	3,781	3,804.07 (99%)	5,633.24 (67%)	7,349.35 (51%)
Bristol	7,061	8,039.83 (88%)	11,905.74 (59%)	15,532.72 (45%)
Cornwall	1,500	2,709.33 (55%)	4,012.10 (37%)	5,234.35 (29%)
Ferrisburgh	14,514	7,866.97 (184%)	11,649.76 (125%)	15,198.76 (95%)
Goshen	67	864.34 (8%)	1,279.96 (5%)	1,669.89 (4%)
Leicester	626	2,148.68 (29%)	3,181.86 (20%)	4,151.19 (15%)
Lincoln	1,084	3,306.97 (33%)	4,897.11 (22%)	6,388.98 (17%)
Middlebury	11,155	25,457.57 (44%)	37,698.70 (30%)	49,183.28 (23%)
Monkton	1,593	3,888.50 (41%)	5,758.26 (28%)	7,512.47 (21%)
New Haven	38,125	7,338.18 (520%)	10,866.70 (351%)	14,177.14 (269%)
Orwell	1,912	3,504.19 (55%)	5,189.16 (37%)	6,770.00 (28%)
Panton	8,138	2,422.10 (336%)	3,586.76 (277%)	4,679.43 (174%)
Ripton	547	2,613.57 (21%)	3,870.29 (14%)	5,049.33 (11%)
Salisbury	1,116	2,999.63 (37%)	4,441.99 (25%)	5,795.20 (19%)
Shoreham	2,367	3,989.79 (50%)	5,908.26 (40%)	7,708.15 (31%)
Starksboro	1,429	3,800.06 (38%)	5,627.30 (25%)	7,341.61 (19%)
Vergennes	3,381	5,787.90 (68%)	8,570.98 (39%)	11,182.05 (30%)
Waltham	1,461	988.97 (148%)	1,464.51 (100%)	1,910.66 (76%)
Weybridge	25,691	3,741.03 (687%)	5,539.88 (464%)	7,227.55 (355%)
Whiting	1,211	1,115.48 (109%)	1,651.86 (73%)	2,155.08 (56%)
Total	132,356	100,843.20 (131%)	149,333.09 (89%)	194,826.08 (68%)

These generation targets represent only one possible pathway to derive 90% total energy from renewable sources by 2050. The purpose of these targets is only to provide an idea for planning the future electricity generation in our Region based on our estimated demand.

Other potential electricity generation combinations exist and could be better suited for our Region. For instance, this model represents a generation mix which almost certainly would require industrial scale wind. Depending on individual municipalities' planning, this may not be practical, and a model with more solar and less wind generation might be more appropriate.

The targets analysis conducted using the generation scenarios tool found that annual generation from local renewable energy sources must reach 100,843.20 MWhs, 149,33.09 MWhs, and 194,826.08 MWhs, by 2025, 2035, and 2050 respectively. As summarized previously, on page 21-25 of this Plan and explained in more detail in Table 7 on page 21, the Region has a name plate generation capacity of 85.17 MWs and it produces about 188,507.96 MWh of electricity annually from renewable generation as of April of 2024. As such, The Region is found to have exceeded its 2025 and 2035 generation targets early and is less than 7,000 MWhs away from meeting its 2050 renewable generation target.

Some have suggested that the Region's demand may increase somewhat—perhaps significantly—over current demand levels by 2035 and 2050, and it is highly likely that the generation data and targets will change over the coming decades. If the reduction of industrial electrical demand were to prove overly optimistic for example, then additional generation might well be needed. If energy efficiency improvements produce less demand reduction for direct use electricity or heating, and substantial EV uptake takes place as well, then this could also impact the generation needs for the Region. Additional housing developments in the area will also likely increase demand and the need for new generation. Conversely, technological developments in the energy sector are progressing rapidly and new electric, heating, and transportation technologies may require less energy to operate than we currently perceive. As such, the projections produced for this plan are best viewed as educated estimates of what will need to be done to usher in the energy future of the Region and to meet state standards. ACRPC supports further expansion the Region's renewable generation capacity, and it will continue to evaluate the impacts of new generation to determine both the feasibility of the targets, how they relate to the Region's demand.

Habitat Blocks, Renewable Energy Generation Targets, and Climate Change Resilience

Conserving large, contiguous blocks of habitat in Addison County is viewed to be essential for maintaining the regions ecological functioning. Connected and healthy habitats are good places to work and play, provide the spaces within which wildlife can live, and support our local food systems. They also directly contribute to the climate change mitigation goals of the region and the state. Intact habitats support biodiversity, facilitate species migration, and sustain ecosystem services such as carbon sequestration, flood attenuation, wind buffering, drought resistance—services that are increasingly critical to preventing changing climatic conditions and responding to them. Conserving these areas also reduces landscape disruptions that which can amplify greenhouse gas emissions through increased soil disruption and the need for expanded infrastructure. In this way, habitat conservation and strategic energy planning are complementary components of a regional energy plan that seeks to increase the climate change resilience of the region.

To evaluate how renewable energy development could proceed without compromising high-value habitat blocks, a GIS-based spatial analysis was conducted. This analysis relied on data from the Vermont Agency of Natural Resources (ANR), Vermont Center for Geographic Information (VCGI), and the Department of Public Service. First, the technical potential for solar and wind energy was assessed across the county using land cover data, slope thresholds, and proximity to transmission infrastructure. Next, the land was screened for compatibility with both land conservation priorities and renewable energy siting requirements, with further filters applied to remove hydric soils, wetlands, and steep slopes. Finally, core habitat blocks were identified, and these areas were then excluded from the developable land base. This approach was adopted to examine whether the remaining land area available for renewable energy development was sufficient to meet the regions renewable energy targets while also advancing climate pollution reduction objectives. The results of this analysis can be viewed below in Table 15 below and in Figures 22 and 23 in the Appendix.

Table 15—Regional Ground-based Solar and Wind Potential, Controlling for Habitat Blocks

	Prime sites, no constraint	Prime sites, no constraint, no habitat blocks	Preferred sites	Preferred sites, no habitat blocks
Solar				
MW	1,424.20	847.32	854.70	494.52
MWh	1,871,403.49	1,113,383.63	1,123,075.99	649,800.86
Wind				
MW	579.98	495.71	149.57	86.54
MWh	1,143,140.92	977,053.47	294,807.45	170,572.72

The results of the analysis demonstrate that Addison County has more than sufficient land available to meet its renewable electricity generation targets without encroaching upon core conservation blocks. Both the 2050 generation target of 194,826.08 MWhs of domestic, renewable energy generation as well as an even more aspirational target of 100% of current demand—275,079 MWhs—are well within reach. Even after excluding all high-value ecological areas from the more restrictive “preferred sites” locations, there remains a substantial amount of technically suitable land for distributed, utility-scale solar and wind projects. The Region’s future generation potential is even greater when considering the role that future rooftop solar will play in our energy transition. This finding underscores the feasibility of decoupling renewable energy development from habitat loss in our communities and reinforces the County’s commitment to climate resilient energy planning. By pursuing energy development goals through conservation-aware siting, Addison County can preserve its local biodiversity, protect the ecological assets that are foundational to long-term climate adaptation and community well-being, and pursue orderly energy development.

Section 5—Plan Pathways, Policies, Actions, and Impact

Section 5 of the Regional Energy plan is primarily composed of Table 16, which contains energy policy suggestions for the Region and tangible actions for implementing those suggestions. It does not intend to serve as an exhaustive or exclusive list of proposals for facilitating the region’s energy goals. However, it is indicative of the types of proposals that the RPC supports, adoption of which the RPC would welcome. Additionally, Table 16 also identifies the ways in which the proposed actions may impact the three primary energy goals of this plan: the energy justice, climate change resilience, and energy security of the Region. Finally, Table 16 also identifies which planning standards the proposed policies and actions are meant to align with.

Table 16—ACRPC 2024 Draft Goals, Policies, and Actions

Policy	Action	Impact on Plan Priorities	Standard
Cross-Cutting Pathways		Energy Justice (EJ) Climate Change Resilience (CCR) Energy Security (ES)	
P1: Educate consumers regarding efficiency and energy conservation;	1. Regularly host a regional energy fair.	- EJ: Accessibility-centered programing presented - CCR: Low to no carbon technologies presented - ES: Local generation technologies presented	6.A
	2. Promote “button up” and similar winterization events.	- CCR: Reduced Demand for fossil heating fuels - ES: Reduced demand for non-domestic energy	6.A
P2: Expand targeted ACRPC energy services for municipalities.	1. Support the development of a regional or sub-regional staff position that is focused on developing municipal energy projects and code enforcement.	- EJ: Planning capacity less dependent on local taxbase - CCR: Planning support for low to no GhG projects - ES: Planning support of domestic energy projects	
	2. Develop questionnaire for annual mailing to learn what types of energy projects are needed in each town and provide targeted outreach	- EJ: Planning capacity less dependent on local taxbase - ES: Planning support of domestic energy projects	
	3. Promote the Residential Building Energy Standard (RBES) and the Commercial Building Energy Standard (CBES) codes and assist municipalities with their implementation.	- EJ: Living and working conditions in region’s building stock improves over time - CCR: Improved energy efficiency of building stock reduces demand for heating fuels, some of which generate GHGs	8.A

		• ES: Reduced energy demand reduces dependence on non-domestic energy sources	
Buildings Pathways			
Goal A:			
P1: Demonstrate leadership by promoting energy efficiency in the Region's municipal buildings:	1. Work with towns to further develop and plan for the recommended projects in the Municipal Energy Resilience Program energy assessments.	• EJ: Reducing municipal energy costs reduces the communal energy burden in ways that benefit local taxpayers • CCR: Reducing municipal energy demand for fossil heating fuels by fuel switching and weatherization reduces GHG pollution. • ES: Fuel switching and weatherization reduces non-domestic fuel dependence	6.B
	2. Support towns in accessing grant funding to complete projects and facilitate group purchasing of common materials and equipment to reduce costs for all towns.	• EJ: Identifying and accessing external funding and resources reduces local cost for their access • CCR: Funds and resources can be used to reduce GHG pollution and harden existing infrastructure	6.B
	3. Advocate for a state-wide, municipal utility tracking software to support ongoing evaluation of the costs and benefits of these projects.	• EJ: Addresses information gap between more and less well funded municipalities • CCR: Data on MERP efficacy will help identify progress and room for further reductions.	
Goal B: Increase the Region's thermal energy efficiency and self-sufficiency by reducing both its energy use and carbon footprint to meet local and State targets of 90% renewable energy by 2050.			
P2: Encourage and promote local and sustainably harvested wood and efficient wood heating:	1. Promote EPA III approved energy efficient wood stoves through education and outreach.	• EJ: Advanced wood stoves have less impact on indoor and outdoor air quality, which reduces the likelihood of disparate impact • CCR: Advanced wood stoves contribute far less GHGs from heating due greater system efficiency and ability to cyclically store carbon in the fuel • ES: Fuel sources is more readily available domestically	6.C
	2. Promote the management and use of town forests for sustainably harvested cordwood for low-income citizens;	• EJ: Sustainable use of public forests to attend to the needs lower income Vermonters reduces energy burden. • CCR: Cord wood, as a heating fuel, produces substantially less GHG pollution than fossil fuels. • ES: Domestically sourced fuel	6.C

		reduces dependency on fuel imports	
P3: Encourage and support the Region's resident's efforts to weatherize their homes:	1. Coordinate with CVOEO, Neighbor works of Western Vermont, Efficiency Vermont, VEEP, and other weatherization service providers to encourage the Region's residents to participate in weatherization programs.	• EJ: Low to moderate income programs offered by these organizations make the energy transition more accessible • CCR: weatherization programs reduce demand for fossil fuels in buildings that use them • ES: weatherization results in reduced demand for imported fuels	6.A
	2. Continue supporting CEAC and their Energy Navigator program including: - Event and Campaign Support - Grant Technical Assistance - Advisory Capacity - Collaborate on Education and Outreach	• EJ: CEAC works extensively with low to moderate income Vermonters to improve access to public energy assistance programs • CCR: Increasing access to fuel switching and weatherization programs reduces demand for GHG polluting fuels and enhances comfort and safety of homes to more variable weather conditions • ES: Increasing access to fuel switching and weatherization programs reduces demand for imported fuels	6.A
P4: Encourage proposed development to optimize design features and energy systems that conserve energy and use renewable sources:	1. Promote the installation of air source and geothermal heat pumps;	• EJ: Reduction in fossil fuel heating improves air quality, and reduces the risk of disparate impact • CCR: Fuel switching from fossil to electricity powered heating systems reduces GHG pollution • ES: Fuel switching from fossil to electricity powered heating systems reduces demand for non-local fuels	6.C
	2. Continue partnership with Thermal Energy Network organizations to encourage planning, zoning, and implementation of thermal network projects.	• EJ: Connecting low-income housing to heating networks could reduce and stabilize heating costs • CCR: Use of waste heat from industrial processes and geothermal reduces demand for GHG producing heating fuels • ES: Use of waste heat from industrial processes and geothermal reduces demand for imported fuels	6.C
	3. Encourage municipalities, businesses, organizations and homeowners to build to higher energy standards to increase efficiency and use renewable resources as heating or cooling sources (e.g. the Energy Star Home	• EJ: Improved heating code implementation will ensure that rental and ownership model housing, including that which	6.B

	Program, the “Stretch Code” or passive solar homes such as PassivHaus);	targets low-income Vermonters, will meet standards that reduce energy costs and improve building comfort and safety. • CCR: Improved heating code implementation will reduce GHG pollution from heating fuels used by the residential, commercial, and industrial buildings • ES: Implementation of updated heating codes and standards will also reduce demand for non-domestically produced heating fuels	
	4. Work with local planning commissions to incorporate additional energy standards into municipal plans and zoning regulations;	• EJ: Energy planning assistance reduces the cost of implementing heating recommendations for municipalities, which can assist with the resource gaps between regions. • CCR: Implementation assistance will also increase the likelihood of success for GHG pollution reduction recommendations • ES: Implementation assistance can help with locally sourcing heat energy solutions in more efficient and less disruptive ways.	6.B
P5: Support energy conservation efforts and the efficient use of energy by installing efficient electric equipment:	1. Discourage the use of “always on” lighting in parking lots and other indoor and outdoor lighting in public places. Encourage the use of technology like motion sensors to light areas when needed;	• ES: Less electricity demand during non-solar producing hours will reduce dependence on non-domestic sources of electricity	
	2. Advocate for the availability of smart meter technology to help consumers understand and regulate their electricity usage.	• EJ: Increased access to energy use information can help reduce energy burden by giving consumers tools for safely managing their use • ES: Reduced demand for electricity during non-solar producing hours will reduce dependence on non-domestic sources of electricity	
P6: Promote energy efficiency in all buildings, including retrofits and new construction:	1. Promote improved compliance with the residential and commercial building energy standards by distributing code information to permit applicants and working closely with the Region’s Zoning Administrators:	• EJ: Living and working conditions in region’s building stock improves over time • CCR: Improved energy efficiency of building stock reduces demand for heating fuels, some of which generate GHGs • ES: Reduced energy demand reduces dependence on non-domestic energy sources	
	2. Encourage municipalities to consider requiring new	• EJ: Living and working conditions	

	construction to comply with the “ stretch energy code .”	in region’s building stock improves over time • CCR: Improved energy efficiency of building stock reduces demand for heating fuels, some of which generate GHGs • ES: Reduced energy demand reduces dependence on non-domestic energy sources	
P7: Work with municipalities, electric utilities and community groups to lead and support the transition:	1. Help the Regions municipalities investigate and install, or purchase, cost-effective municipal solar and /or wind net-metered facilities to power municipal energy use;	• EJ: Reducing municipal energy costs reduces the communal energy burden in ways that benefit local taxpayers • CCR: Reducing municipal energy demand for fossil heating fuels by fuel switching and weatherization reduces GHG pollution. • ES: Fuel switching and weatherization reduces non-domestic fuel dependence	
	2. Work with utilities serving the Region to ensure that during the transition to distributed electric generation and increasing consumer reliance on electricity for power, that the distribution and transmission grid improves regularly to continue to provide cost effective, reliable service and opportunity for growth to all communities in the Region;	• CCR: Modernization of the grid to support distributed power will reduce the impact of severe weather events on the grid, and support energy generation that prevents climate change • ES: A modernized grid supports local energy generation development	
	3. Support utilities globalizing the cost of improving local distribution and substation infrastructure necessary to support residential-scale distributed generation;	• EJ: Projects that advance state-wide goals should receive state-wide financial support to avoid unduly burdening one community with the costs of advance the needs of another • CCR: Residential scale, distributed generation can reduce demand for fossil fuels and can also reduce the impact of climate change threats to local energy systems • ES: Additional deployment of residential scale, distributed generation reduces demand for imported fuels	
	4. Advocate for the retention of the current State policy that requires commercial and industrial generators to fund the cost of improvements to the distribution system necessary to accommodate their proposed projects;	• EJ: Projects that contribute more substantially to the capital, operations, and maintenance costs of distribution should cover those costs to avoid undue funding burden for local systems • CCR: Funded improvements to the distribution system will yield a	

		modernized grid that supports climate friendly generation and hardened supply of it • ES: An adequately funded distribution network, one that supports distributed generation, will support domestic energy supply	
	5. Share info with VELCO, GMP and VECOOP to ensure that targets for renewable generation in the Region and across the state are optimized to enhance the cost effectiveness of the transmission and distribution system for the State of Vermont;	• EJ: Economic efficiency can produce lower energy costs for Vermonters, which should reduce energy burden • CCR: Preventing and adapting to climate change will be costly and the efficient use of resources will help us do more prevention and adaptation. • ES: Decreasing the cost of domestically generated electricity will make it cheaper and more price stable than imported electricity.	
	6. Strongly encourage the Region's electric utilities to adopt the new standards for digital substations from the National Electrical Manufacturers Association;	• EJ: Digital substations, which are able to actively balance the supply and demand of electricity based on a variety of factors, may be able to keep electricity prices from spiking during periods of high demand or low supply, which benefits LMI Vermonters substantially by energy price burden and uncertainty • CCR: The new digital sub-station standards provide guidance for the development of local distribution systems that are better designed for no-carbon, renewable energy generation and that are also better able to handle events that would interrupt service from traditional, analogue substations • ES: These new digital substation standards, because they are more suitable for the types of energy generation that take place within the region, will also improve the Addison's energy security	
	7. Suggest that new renewable energy projects in the region be designed in such a way so that they are "storage ready," or capable of being connected to onsite or nearby storage projects without significant retrofitting; and	• EJ: storage of electricity generated from renewable sources can keep electricity prices more stable, and designing a project from the beginning to be compatible with storage should reduce retrofit	

		costs and also avoid locking in less efficient—more costly—storage technologies before they are mature • CCR: Storage ready renewables adoption will, ultimately, reduce demand for other forms of baseload—greenhouse gas producing—power by making new renewable generation ready to address intermittency related challenges and will also, eventually improve the Region’s ability to withstand system shocks that disconnect energy supply from demand • ES: Storage ready renewables will also improve energy security by enabling, when feasible, the improved functioning of energy technologies that can be deployed within the Region	
	8. Require systems 500 kW or greater to follow the IEEE1547 standard, as updated in 2020, for connection to the grid.	• CCR: the adoption of modern interconnection standards will make the deployment of additional, low to no greenhouse gas producing technologies to take place without endangering the functioning of the electric grid itself • ES: modernized grid interconnection standards will improve the functioning of utility-scale renewables and enable them to more safely contribute to the domestic generation mix	
P8: Create infrastructure and policies supporting electric vehicle use within the Region:	1. Plan for and install electric vehicle charging infrastructure on municipal property;	• EJ: Public EV Charging can expand charging access to people who are not able to afford or install chargers of their own. • CCR: More public chargers will increase the speed of the transition to non-fossil fuel consuming vehicles by reducing range anxiety • ES: Increasing the number of public chargers will improve the ability of the region’s vehicles to use domestically produced fuel.	7.B
	2. Incorporate EV ready standards into building code. (This can be as simple as requiring 220v outlets in garages);	• EJ: Building EV Ready reduces the make ready costs for homeowners and renters, some of whom may not be able to	7.B

		afford the upfront costs required for an EV. • CCR: Building EV Ready increases the ease of transitioning to non-fossil fueled vehicles • ES: Building EV Ready increases the ease of transitioning to vehicles that are fueled by domestically generated electricity	
	3. Encourage major employers in the Region, to install (additional) EV charging stations for employees;	• EJ: Expands access to the EV charging infrastructure to those who cannot afford to or otherwise cannot install EV residentially • CCR: Expedites the transition to non-fossil fuel powered vehicles by incorporating their use into people's commutes • ES: Reduces the Region's demand for imported fuels to commute to work.	7.B
	4. Develop an EV Readiness report that includes strategic infrastructure improvement recommendations as well as assessments of municipal fleets;	• CCR: Provides further information about additional progress that can be made in adopting non-fossil fuel powered vehicles in the Region as well as barriers to that progress • ES: Additionally, will support progress toward transitioning transportation infrastructure from imported fuels	7.B
	5. Promote the Drive Electric Vermont website and resources;	• EJ: Decreases information asymmetry between EV program managers and those that would benefit from their programs • CCR: Supplies additional information about decarbonizing transportation for the Region • ES: Provides information about obtaining and using transportation that does not use imported fuels	7.B
P9: Support regional efforts to increase access to safe, daily walking and cycling within and across municipal borders:	1. Review municipal road standards to ensure that they reflect all "complete streets" principles applicable to our rural roads;	• EJ: Expands access to alternative forms of transportation within population dense areas, many of which are more affordable than owning and operating a personal light-duty vehicle • CCR: Transportation alternatives that are enabled by complete streets are often low to no greenhouse gas producing	7.A

		- options • ES: Complete streets alternatives like biking and walking require no fuel use.	
	2. Provide walking and biking paths connecting population densities with critical infrastructure, like in and between villages and elementary schools;	• EJ: Increased walking and biking infrastructure reduces the cost of transportation as well as air pollution from avoided light-duty vehicle travel which can have undue impacts on vulnerable communities • CCR: Better walking and biking infrastructure between major community centers reduces the need for fossil fuel consuming travel methods to and between those centers • ES: Similarly, pedestrian travel that replaces light-duty vehicle travel will reduce the Region's dependence on imported transportation fuels	7.A
	3. Promote municipal membership on the Walk-Bike Council of Addison County to foster safe and accessible opportunities for walking and cycling as an alternative to SOVs;	• EJ: Greater participation by municipal leadership in pedestrian planning will help ensure that the needs of vulnerable populations in their areas considered in the process • CCR: Increased municipal ownership over pedestrian planning will demonstrate local commitment to preventing climate change • ES: Municipal contributions to pedestrian planning for the Region will also demonstrate municipal commitment to reducing demand for imported fuels	7.A 7.C
	4. Help municipalities find and apply for funding sources for building walk/bike infrastructure;	• EJ: Identification of funding sources to implement the transformation of the transportation sector will reduce the costs of that transition—and its burden—on financially constrained municipalities • CCR: Identifying and securing external funding for non-GHG producing transportation projects will accelerate climate change prevention strategies in the Region • ES: An accelerated transition away from fossil fuels for transportation will make the Region's transportation less dependent on non-domestic fuel	7.C

		sources	
	5. Help the Walk-Bicycle Council of Addison County work with municipal road foremen and select boards to plan for incremental development of critical bicycle infrastructure within their municipalities as road work is completed annually.	• EJ: Assisting with the incremental adoption of pedestrian friendly infrastructure will improve transportation affordability overtime at a minimized upfront cost to municipal finances • CCR: Incremental improvements to pedestrian travel infrastructure will reduce demand for fossil fuels gradually • ES: The incremental improvement of municipal road infrastructure so that it is more pedestrian friendly will reduce demand for imported fossil fuels.	7.C
P10: Support public transportation programs serving the Region. Bus routes, car and vanpools, and elderly and disabled services all fall under the umbrella of public transit:	1. Work with ACTR (TVT) to explore creative approaches to expanding service in rural areas of the Region, including small capacity ride-share, ZipCar style micro-leases, and even self-driving EVs for a connecting service between small villages via major intra-regional transportation corridors;	• EJ: This expands access to alternative forms of transportation within population dense areas, many of which are more affordable than owning and operating a personal light-duty vehicle • CCR: Ride sharing, Hybrid and EV Zipcar use, and greater EV deployment in the Region should reduce demand for fossil fuel powered transportation • ES: Reduced demand for fossil fuels from this approach will reduce demand for imported transportation fuels	7.A
	2. Encourage additional municipal representatives on the Tri-Valley Transit ("TVT) Board and the Addison County Transit Resources Regional Operating Committee ("AROC") to bring issues facing smaller, more isolated towns to the table;	• EJ: Greater participation by municipal leadership in regional public transit planning will help ensure that the needs of vulnerable populations in their areas considered in the process • CCR: Increased municipal ownership over public transit planning will demonstrate local commitment to preventing climate change • ES: Municipal contributions to public transportation planning for the Region will also demonstrate municipal commitment to reducing demand for imported fuels	7.A
	3. Support the use of a Park and Ride in the Region and encourage the Region's residents to consider ride-sharing programs;	• EJ: Ride sharing and commuting programs expand access to lower cost forms of intra- and inter-regional travel • CCR: Reduced single person, single destination travel will	7.A

		address the Region's goal of reducing greenhouse gas pollution from transportation • ES: Greater use of commuting and ride share programs will also reduce the demand for non-domestically produced, fossil fuel demand	
	4. Plan and advocate for enhanced access to public transit, particularly during relevant Act 250 proceedings;	• EJ: Increased access to public transit will improve the affordability of intra- and inter-regional travel and reduce air pollution that could have a disparate impact • CCR: Expanded access to and use of public transit reduces the need for single occupant vehicle travel, which reduces the demand for fossil fuel-based transportation fuels • ES: Public transit use reduces the amount of fuel demanded for light duty, passenger vehicles which is imported to the Region.	7.A
	5. Work with (TVT) to create better connectivity between public transit and park- and-ride locations;	• EJ: Better connectivity between park and ride locations and public transit systems will provide more affordable options and greater variety to non-light-duty vehicle users for intra- and inter-regional travel • CCR: Increased connectivity will also reduce fossil fuel demand as a greater share of travelers can meet their travel needs without single user, single trip travel • ES: Greater usage, due to expanded access and convenience, of public transit and ride-share services will reduce the demand for transportation fuel imports	7.A
	6. Support employer programs to encourage telecommuting, carpooling, vanpooling, for employees' commute trips.	• EJ: Increased support for telecommuting, carpooling, and other employer-led transportation solutions will reduce the energy burden on rural and extended commute employees • CCR: Successful implementation of employer-led transportation solutions will also reduce individual employee demand for fossil fuel-based transportation fuels • ES: These employer-led programs should also reduce individual employee demand for	

		fuels that are not produced domestically	
P11: Support improvements to the Western Rail Corridor that improve safety and the ability of the corridor to carry additional freight and passengers:	1. Promote the use of rail transportation, including the expansion of regular, local and regional service on the Ethan Allen Express line to population centers in the Region.	• EJ: Increased access to passenger rail in the Region will provide its residents with additional, lower cost options for longer range travel in the county and beyond • CCR: Passenger rail use could reduce intra- and inter-regional light-duty vehicle travel, which would reduce demand for greenhouse gas producing fossil fuels • ES: Increased passenger rail use will reduce regional, per passenger demand for fuels that are not produced within the region	7.A
	2. Encourage businesses in the region to explore using railway freight for their shipping needs.	• CCR: Due to the fuel efficiency advantage of rail shipping, the expanded use of freight rail, where feasible, would reduce the demand for greenhouse gas producing, heavy duty vehicle fuels in the Region • ES: Shipping by rail will also reduce the regional demand for heavy-duty vehicle fuel that is imported into the Region	7.A
P12: Encourage options for cleaner fuel availability:	1. Work with Clean Cities Coalition to encourage large vehicle fleets to switch to conventional natural gas use in situations where switching to EVs or renewable natural gas is not feasible.	• EJ: converting fleet vehicles—particularly heavy duty vehicles with centralized refueling—from diesel to conventional or renewable natural gas can provide air quality improvements over diesel and provide substantial sound pollution improvements as well • CCR: vehicles that use conventional natural gas tend to produce less greenhouse gas pollution than gasoline and diesel fueled vehicles, and it has been suggested that renewable natural gas produces even less	7.B
P13: Lead by	1. Analyze the feasibility and support the installation of	• EJ: Additional adoption of	

example. Encourage the use and generation of renewable energy by town buildings, schools and residences:	additional municipal solar and/or wind net-metering facilities that are compliant with the standards enumerated in this plan to off-set municipal electric use.	renewables by municipalities will reduce and stabilize their energy bills which can relieve the energy related tax burden experienced by residents • CCR: Increased municipal generation, when paired with electrification, can reduce the impact to the climate from their heating and cooling systems and will also harden the energy infrastructure of buildings that frequently function as emergency shelters and command centers • ES: Further adoption of renewable, distributed generation at municipally owned sites will also reduce communal reliance on imported fuels	
P14: Support the development and siting of renewable energy resources in the Region that conform with the goals, strategies, and mapping outlined in this Plan.	1. Support responsibly sited and responsibly developed renewable energy projects, which shall include solar panels, wind turbines and all associated supporting infrastructure;	• EJ: Socially and environmentally responsible siting of renewable energy projects ensures that particular communities are not unfairly impacted by development related to the energy transition • CCR: responsible development can reduce opposition to clean energy projects, which will assist with the timely adoption of climate friendly energy generation • ES: responsible energy development will also reduce opposition to projects that generate energy domestically	
	2. Work closely with the Municipal Planning Commissions and Select boards from municipalities impacted by proposed energy development projects within the Region;	• EJ: Cooperation with local decision-makers on renewable energy development can reduce frequency and severity of instances in which particular communities become over-burdened by development • CCR: Partnering with municipal decision makers can increase support for—and reduce opposition of—climate friendly energy development • ES: Local decisionmaker buy-in to energy development in their backyard will reduce regional reliance on imported energy	
	3. Expand regional and local energy storage and promote local microgrids to improve energy system reliability and resiliency;	• EJ: Rural community members experience longer and more frequent disruptions to their energy systems than urban members, which the adoption of	

		storage and microgrids can address • CCR: Increased storage and microgrid capacity enables better supply/demand balancing for non-GHG producing energy generation, replacing the need for fossil fuels for balancing, and can make energy systems less vulnerable to interruptions from extreme weather events • ES: Local storage and microgrid development will improve the functionality of domestically produced energy	
	4. Support local on-farm or residential scale renewable distributed generation projects;	• EJ: energy development in already developed spaces can reduce new instances undue burden; however, communities should be careful to avoid replicating existing unfair distributions of burden and benefit • CCR: On-farm and residential renewable development will reduce demand for fuels that make climate change worse, and also make the energy systems of the places that adopt them less vulnerable to climate change influenced extreme weather • ES: Increased farm and residential renewable energy generation will reduce the Region's dependence on electricity and fossil fuel imports	
	5. Favor the development of generation utilities in identified preferred locations over the development on other sites.	• EJ: Siting new renewable energy development in preferred locations is viewed as less likely to cause undue burden on the communities within which that development takes place • CCR: Siting in preferred locations is less likely to undermine other climate change policy goals, such as increased regenerative forestry	
P15: Encourage settlement patterns that reduce travel requirements for work, services, and recreation by helping member	1. Allow infilling of existing large-lot development where higher density development is desirable and appropriate;	• EJ: Housing and economic development that promotes shorter travel distances can reduce the energy burden from transportation costs • CCR: Shorter average travel distances will reduce the demand for fossil fuel-based	8.A

municipalities to create plans and zoning that:		- transportation fuels - ES: Reduced travel times attributable to concentrated development will reduce demand for non-domestically produced transportation fuels	
	2. Support continued improvements in broadband connectivity and encourage telecommuting;	- EJ: decoupling economic activity from travel will increase economic opportunity for those live rurally or further away from development centers - CCR: reduced travel for work will reduce the demand for transportation specific fossil fuels - ES: a reduction in the demand for non-domestically produced transportation fuels is also possible by reducing the distance that folks have to travel for work	8.B
	3. Facilitate the exploration of water and sewage solutions that enable compact development.	- EJ: Advanced wastewater and sewage solutions can reduce the impact that these systems already have on local communities - CCR: reductions in the consumption of water and energy from more efficient systems, as well as the development of energy networks that use waste heat from these systems will lessen their impact on the climate - ES: use of waste heat from advanced water treatment and distribution systems will also reduce demand for imported heating fuels	8.B
	4. Encourage applications to State Designated Downtown, Village Center and New Neighborhood programs to support infill growth and economic development.	- EJ: orderly economic development can reduce instances of disparate impact - CCR: infill growth in the Region's communities will reduce the distance that residents will have to travel to access economic and recreation opportunities - ES: Reducing the travel distances required to access places to work and play will reduce dependence on imported transportation fuels	8.B
P16: Conserve forest land as a renewable energy resource and promote the responsible and efficient use of	1. Discourage the conversion of forest blocks and other important ecosystems into exclusively energy generating sites.	EJ: protecting important ecosystems is crucial for maintaining the social and environmental services that they provide to our communities, and is more respectful of the spaces within which our communities are	

wood for biomass energy production.		located • CCR: conserving forest blocks will reduce the atmospheric concentration of CO₂ and can serve as buffer against extreme weather events like heavy rains and winds	
	2. Promote the sustainable harvest of timber for use in forest products like wood pellets for advanced wood-fired stoves for heat and electricity generation.	• EJ: Advanced pellet stoves have less of an impact on local air quality than older wood stoves and fossil fuel powered heating • CCR: the sustainable harvest of timber from forests in Vermont could replace some of the fossil fuel demand from heating in the state, which would reduce greenhouse gas emissions • ES: local forests in Vermont could serve as a domestic source of wood for the creation of wood pellets for advanced wood stoves, which would reduce the demand for fuel imports	
	3. Partner with a variety of regional and state experts and practitioners to identify best practices for the development of a regenerative forestry economy for the region.	• EJ: the development of a regenerative forest economy in rural places ensures that the benefits of the energy transition are shared more fairly and doing so in a socially responsible way ensures that particular communities will not be adversely impacted • CCR: promoting regenerative forestry in the Region will help to decarbonize the local economy and could shorten commutes as economic opportunities emerge that closer to home • ES: the development of a local, regenerative forest economy will lead to increased production of goods, including heating fuels, locally within the Region	

Appendix A: Energy Units and Conversions

This plan uses multiple units of measurement to describe current and future energy use. Definitions and conversions for those units are described below³.

Table 17—Unit Conversions

Power and Energy Unit Definitions	
Btu	A British thermal unit (Btu) is a measure of the heat content of fuels or energy sources.
MMBtu	One million British thermal units (MMBtu).
KW	A kilowatt (kW) is a unit for measuring power that is equivalent to one thousand watts. It is often used to describe generation capacity.
KWh	A kilowatt- hour (kWh) is a measure of power usage as a function of time. For example, one kilowatt-hour is one hour of using electricity at a rate of 1,000 watts.
MW	A megawatt (MW) is a unit for measuring power that is equivalent to one thousand kilowatts. It is often used to describe generation capacity.
MWh	A megawatt- hour (MWh) is a measure of power usage as a function of time. For example, one megawatt-hour is one hour of using electricity at a rate of 1,000 kilowatts.
GW	A gigawatt (GW) is a unit for measuring power that is equivalent to one million kilowatts. It is often used to describe generation capacity.
GWh	A gigawatt-hour (GWh) is a measure of power usage as a function of time. For example, one gigawatt-hour is one hour of using electricity at a rate of one million kilowatts.
Energy Unit Conversions	
1 kWh of electricity	3,412 BTUs
1 MWh	1,000 kWh
1 MW	1,000 kW
1 GWh	1,000 MWh
1 trillion BTUs	10^{12} BTUs
1 gallon of heating oil	138,500 BTUs
1 cord of wood	20,000,000 BTUs

Appendix B: Comprehensive Energy Targets List

LEAP Targets

Total Energy Fuel Switching Targets

Table 18: Total Energy Demand Reduction Targets by Sector

Target Energy Demand Targets (Thousand MMBTU)				
	2025	2035	2050	Change
Residential	1,332	946	731	(982)
Commercial	832	735	727	(263)
Industrial	1,068	1,101	1217	160
Total	3,232	2,782	2675	(1,085)

Table 19: Residential total fuel switching target

CAP Mitigation Total Regional Residential Sector Final Energy Demand (Thousand MMBTUs)				
Fuel	2015	2025	2035	2050
Electricity	345	311	413	482
Wood	394	317	173	79
Propane	302	225	107	40
Wood Pellets	98	30	22	18
Biodiesel	-	24	145	110
Heating Oil	525	389	71	-
Biogas	-	2	4	2
Natural Gas	50	35	11	1
Total	1,713	1,332	946	731

Table 20: Commercial total energy fuel switching target

CAP Mitigation Total Regional Commercial Sector Final Energy Demand (Thousand MMBTUs)				
Fuel	2015	2025	2035	2050
Electricity	317	335	396	409
Gasoline	31	34	36	38
Kerosene	0	0	0	-
Wood	76	80	90	108
Ethanol	2	2	2	3
Solar	8	20	21	23
Heat	-	-	24	39
Propane	194	106	30	1
Residual Fuel Oil	5	2	2	2
Wood Pellets	-	4	12	19
Biodiesel	-	6	46	64
Heating Oil	220	105	23	-
Biogas	-	9	13	16
Natural Gas	138	127	40	6
Total	990	832	735	727

Table 21: Industrial total energy fuel switching target

CAP Mitigation Total Regional Industrial Sector Final Energy Demand (Thousand MMBTUs)				
Fuel	2015	2025	2035	2050
Electricity	260	253	237	251
Natural Gas	302	339	270	95
Gasoline	26	24	25	27
Kerosene	1	1	1	1
Diesel	161	128	44	-
LPG	16	16	15	14
Wood	19	11	11	12
Biogas	-	38	150	411
Ethanol	2	2	3	3
Lubricants	9	6	7	7
Biodiesel	-	62	144	188
Residual Fuel Oil	9	6	6	6
Wood Waste Solids	5	1	1	1
Asphalt and Road Oil	248	181	189	200
Total	1,057	1,068	1,101	1,217

Thermal Efficiency & Fuel Switching Targets

Table 22—CAP Mitigation Regional Residential New Cold Climate Heat Pumps

Technology	2025	2035	2050
ASHP 2 Head	1,103	2,957	4,366
ASHP Central	1,715	4,631	6,804
ASHP HE	1,619	4,343	6,412
GSHP HE	200	537	792
Total	4,637	12,468	18,374

Table 23—Regional Residential New Retrofits (Number of Housing Units)

Scenario	2025	2035	2050
Baseline Scenario	1,232	2,378	4,178
CAP Mitigation	3,356	7,253	11,734

Table 24—Regional Residential New Heat Pump Water Heaters (Number of Units)

Scenario	2025	2035	2050
Baseline Scenario	246	250	257
CAP Mitigation	3,048	10,151	13,928

Commercial

Table 25—CAP Mitigation Regional Commercial New Cold Climate Heat Pumps

	2025	2035	2050
New CCHP	2,336	7,064	9,034

Transportation Targets

Table 26—CAP Mitigation Regional Final Energy Demand (Thousand MMBTUs)

	Passenger Car			Light Truck			Medium Duty			Heavy Duty		
Fuel	2025	2035	2050	2025	2035	2050	2025	2035	2050	2025	2035	2050
Electricity	11	93	192	14	167	295	20	165	352	10	81	147
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Gasoline	416	202	26	1,050	477	64	147	98	26	0	0	0
Diesel	2	1	0	20	12	1	190	108	22	283	91	9
LPG	-	-	-	-	-	-	2	1	0	-	-	-
Ethanol	35	21	3	90	50	7	13	10	3	0	0	0
CNG	-	-	-	-	-	-	-	-	-	-	-	-
Biodiesel	0	0	0	1	1	0	13	14	5	20	12	2
Total	465	317	222	1,176	707	368	384	396	408	312	183	159

Table 27—CAP Mitigation Regional Non-Road Final Energy Demand (Thousand MMBTUs)

Fuel	2015	2025	2035	2050
Diesel	64	61	61	62
Biodiesel	2	4	8	14
Avgas	2	3	3	3
Jet Kerosene	83	82	69	48
Sustainable Aviation Fuel	-	1	16	37
Gasoline	22	20	21	21
Ethanol	2	2	2	3
Lubricants	18	14	14	14
Natural Gas	-	-	-	-
Total	193	187	192	202

Table 28—CAP Mitigation Regional EV and PHEV Stock (Number of Vehicles)

Vehicle Type		2025	2035	2050
Passenger Vehicle EV and PHEV Stock	Battery Electric	606	6,250	14,719
	Plug In Hybrid	115	88	20
	Total	721	6,338	14,739
Light Duty Truck EV and PHEV Stock	Battery Electric	622	8,705	17,753
	Plug In Hybrid	65	86	21
	Total	687	8,792	17,775

Electric Efficiency Targets

Table 29 below represents total achievable EE savings through the implementation of improvements listed in tables 32 & 33. Tables 30+31 show the benefits of these efficiency measures on the peak demand pressure on the grid. The [Spreadsheet Linked Here](#) includes regional disaggregation and municipal disaggregation values and instructions.

Table 29—Municipal Program Achievable Electric Energy Efficiency Savings (MWh)		2025	2030	2035	2040	2050
Residential	Incremental Annual	76	79	86	83	93
Residential	Cumulative Annual	150	510	858	1,082	1,584
Non-Residential	Incremental Annual	76	69	69	68	79
Non-Residential	Cumulative Annual	152	498	765	747	690
Total	Incremental Annual	152	148	155	151	172
Total	Cumulative Annual	302	1,008	1,623	1,829	2,273

Table 30—Municipal Program Achievable Electric Energy Efficiency Summer Capacity Savings (MW)		2025	2030	2035	2040	2050
Residential	Incremental Annual	0.006	0.005	0.006	0.006	0.007
Residential	Cumulative Annual	0.013	0.037	0.057	0.065	0.068
Non-Residential	Incremental Annual	0.013	0.011	0.011	0.010	0.012
Non-Residential	Cumulative Annual	0.026	0.082	0.126	0.120	0.105
Total	Incremental Annual	0.019	0.016	0.017	0.016	0.019
Total	Cumulative Annual	0.039	0.120	0.183	0.184	0.173

Table 31—Municipal Program Achievable Electric Energy Efficiency Winter Capacity Savings (MW)		2025	2030	2035	2040	2050
Residential	Incremental Annual	0.02	0.02	0.02	0.02	0.02
Residential	Cumulative Annual	0.03	0.10	0.17	0.22	0.33
Non-Residential	Incremental Annual	0.01	0.01	0.01	0.01	0.01
Non-Residential	Cumulative Annual	0.02	0.07	0.11	0.11	0.10
Total	Incremental Annual	0.03	0.03	0.03	0.03	0.03
Total	Cumulative Annual	0.05	0.18	0.29	0.33	0.43

Table 32—Regional Residential Incremental Annual MWh- by End-Use	2025	2030	2035	2040	2050
Appliances	286	250	301	295	403
Hot Water	205	191	222	192	221
HVAC Equipment	615	832	853	865	905
HVAC Shell	25	29	23	16	6
Lighting	91	5	7	6	7
Misc. Loads	127	100	132	110	135
Motor	8	8	10	8	9
Whole Building	71	86	78	80	79

Table 33—Regional Non-residential Incremental Annual MWh- by End- Use	2025	2030	2035	2040	2050
Compressed Air	164	170	168	168	193
Plug Loads	36	60	65	63	74
Heating and Cooling	162	183	196	196	227
Ventilation And Circulation	152	189	216	229	261
Lighting	1,463	1,007	917	858	1,020
Refrigeration	268	306	328	341	389
Water Heat	83	110	117	110	130
Motors	75	73	72	72	83
Other	101	175	198	206	236

Appendix C: Energy Map Package

As part of its efforts to discover energy generation potential within the Region, ACRPC created a series of maps depicting generation resources and also potential constraints. These maps show data as required by the Department of Public Service Determination Standards and are a required element of enhanced energy planning. The maps show areas that are potentially appropriate or inappropriate locations for future renewable generation facilities. The maps are a planning tool only and may not precisely indicate locations where siting a facility is acceptable. When proposing a generation facility, applicants must verify the presence or absence of the natural resources and other specific characteristics of the site as a part of the application.

The following maps are included below:

1. **Rooftop Solar Potential:** This map summarizes the generation potential of rooftops by town due to the lack of granularity at the regional scale. Potential is based on the provided Act 174 Planning Atlas¹⁹ lidar data, which evaluates the solar aspect and size of visible rooftops.
2. **Wind Potential:** This map includes wind speed potential for the region as well as proximity to 3-phase power lines. Known constraint areas are excluded.
3. **Preferred Locations:** This map incorporates preferred locations for solar generation previously identified in Municipal Enhanced Energy Plans within the region (teal), rooftops in coordination with the State priority to develop generation in proximity to demand and avoid green fields (gradient scale).
4. **Known Constraints:** This map presents the established constraints on land development.
5. **Existing Generation Facilities:** This map presents existing generation facilities greater than 15kW in capacity as well as existing transmission lines and 3-phase power lines in the region.
6. **Transmission resources and constraints:** This map demonstrates a key challenge for Addison County energy generation and electrification efforts with a depiction of the constrained electric distribution network in the region. As discussed in Section 3, constraints at the transmission scale are also an issue for the area, however, map data of constrained lines are only provided by Green Mountain Power.
7. **Transportation Infrastructure:** This map includes resources to support the reduction of fossil fuel driven vehicles through public transportation lines, park and ride locations, bike trail infrastructure, and EV charger locations.
8. **Solar Potential:** This map includes prime and base solar potential for the region as well as proximity to 3-phase power lines. Known constraint areas are excluded.
9. **Potential Constraints:** suggests where conditions would likely require mitigation, and thus which may prove a site unsuitable for development after site-specific study, based on statewide or regional/local policies that are currently adopted or in effect.

¹⁹ <https://maps.vermont.gov/ACCD/Html5Viewer/index.html?viewer=PlanningAtlas&layerTheme=Act%20174%20-%20Energy%20Planning>

Table 34—Constraint Type Definitions

<u>Constraint</u>	<u>Description</u>	<u>Source</u>
Confirmed and unconfirmed vernal pools	There is a 600-foot buffer around confirmed or unconfirmed vernal pools.	ANR
State Significant Natural Communities and Rare, Threatened, and Endangered Species	Rankings S1 through S3 were used as constraints. These include all of the rare and uncommon rankings within the file. For more information on the specific rankings, explore the methodology for the shapefile.	VCGI
River corridors	Only mapped River Corridors were depicted. It does not include 50-foot buffer for streams with a drainage area less than 2 square miles.	VCGI
National wilderness areas	Parcels of Forest Service land congressionally designated as wilderness.	VCGI
FEMA Floodways	FEMA Floodways display the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.	VCGI/ ACRPC
Class 1 and Class 2 Wetlands	Vermont Significant Wetland Inventory (VSWI) identified class I or II wetlands. These wetlands provide significant functions and values that are protected by the Vermont Wetland Rules. Any activity within a Class I or II wetland or buffer zone which is not exempt or considered an “allowed use” under the Vermont Wetland Rules requires a permit.	VCGI

Figure 12—Addison Region Existing Generation Facilities

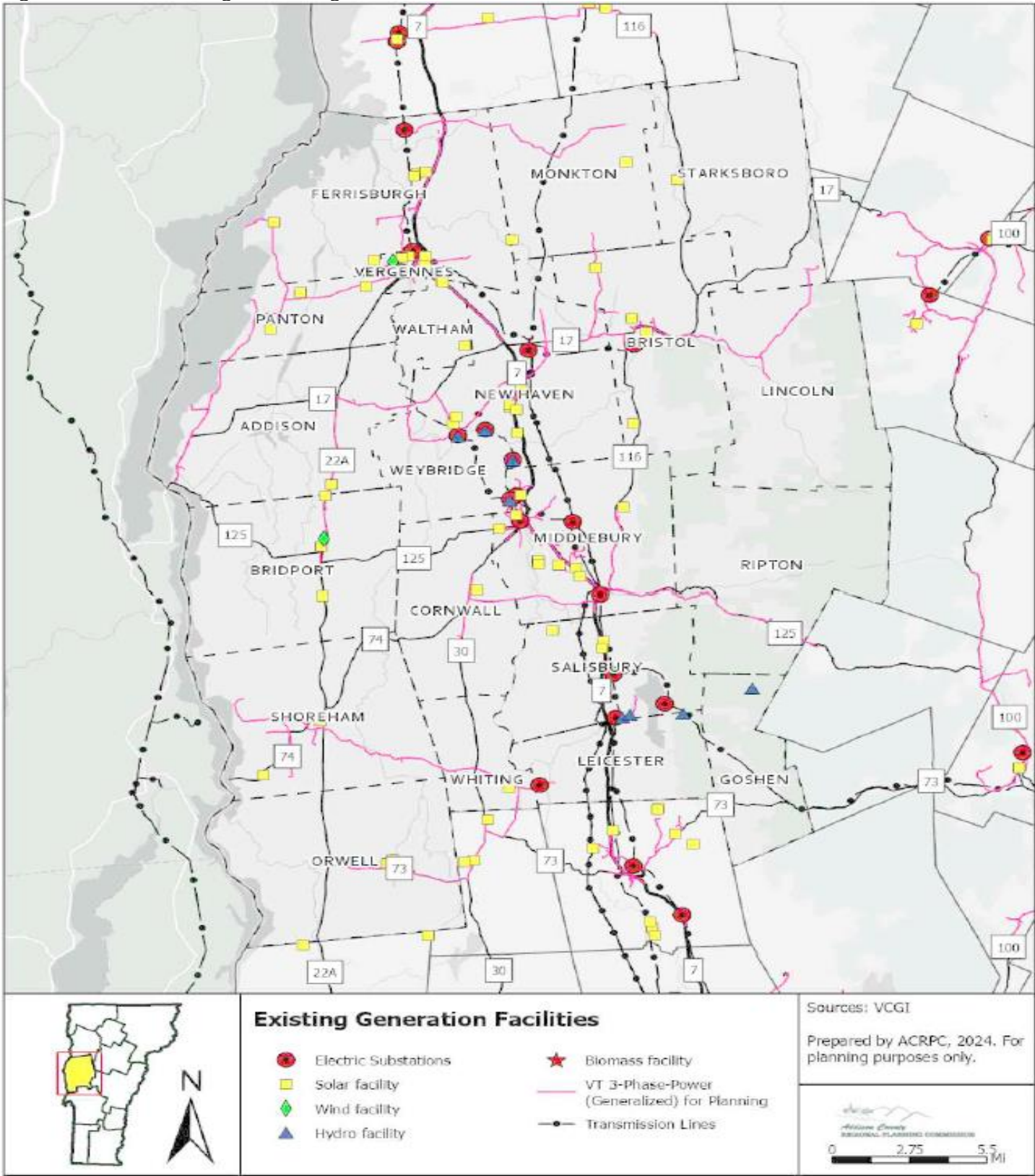


Figure 13—Addison Region Rooftop Solar Generation Potential

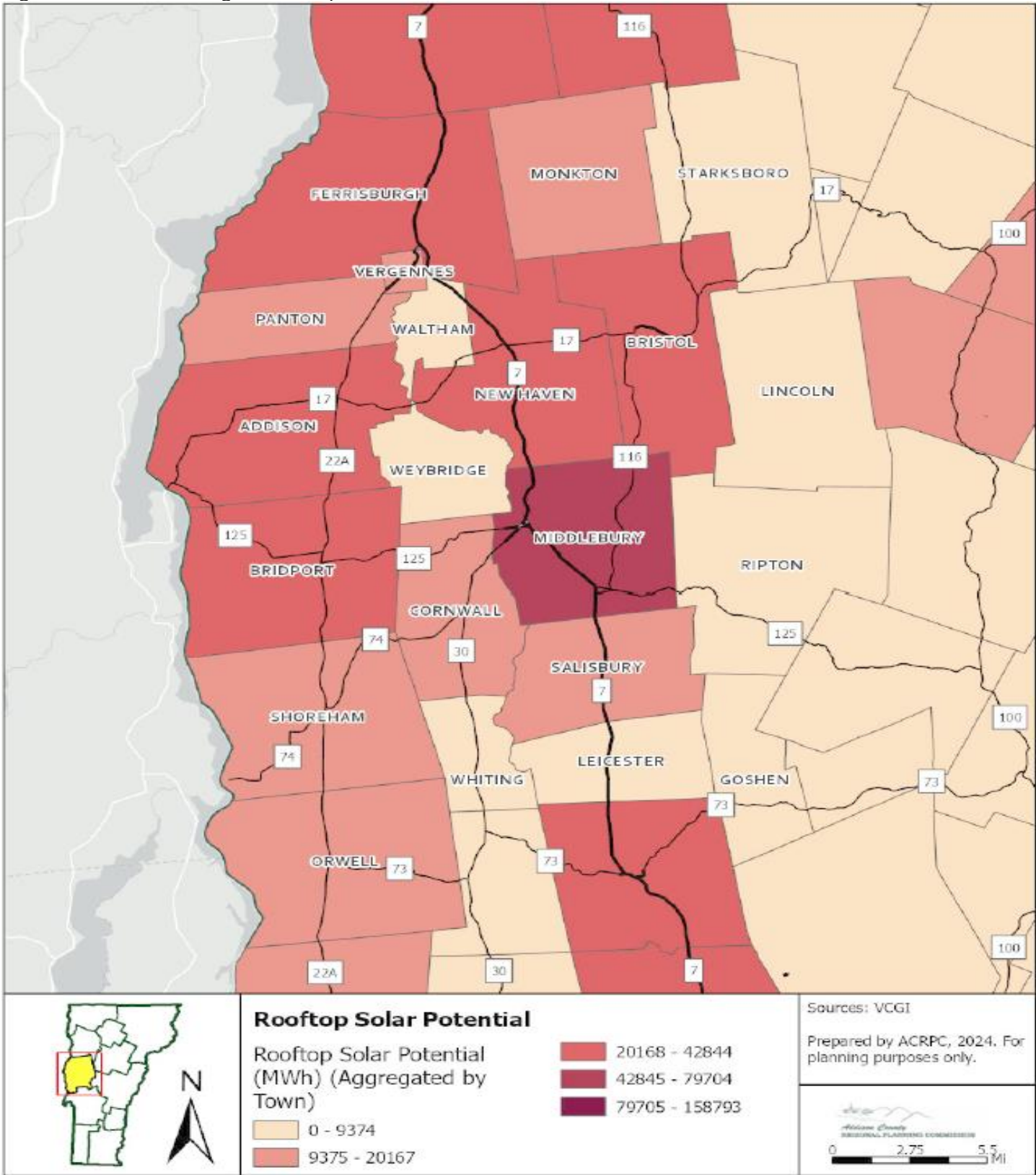


Figure 14—Addison Region Ground Mount Solar Potential

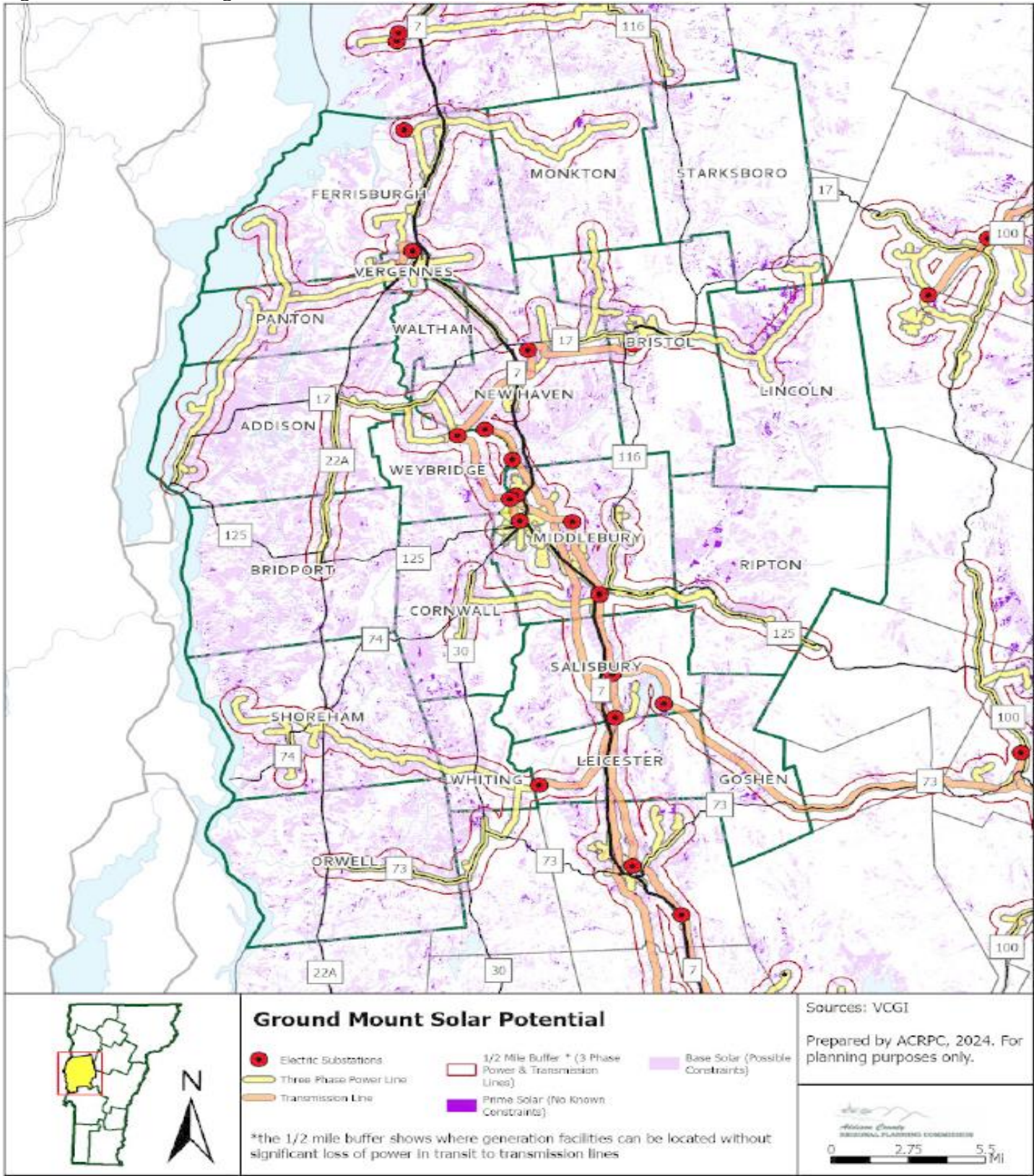


Figure 15—Addison Region Wind Generation Potential

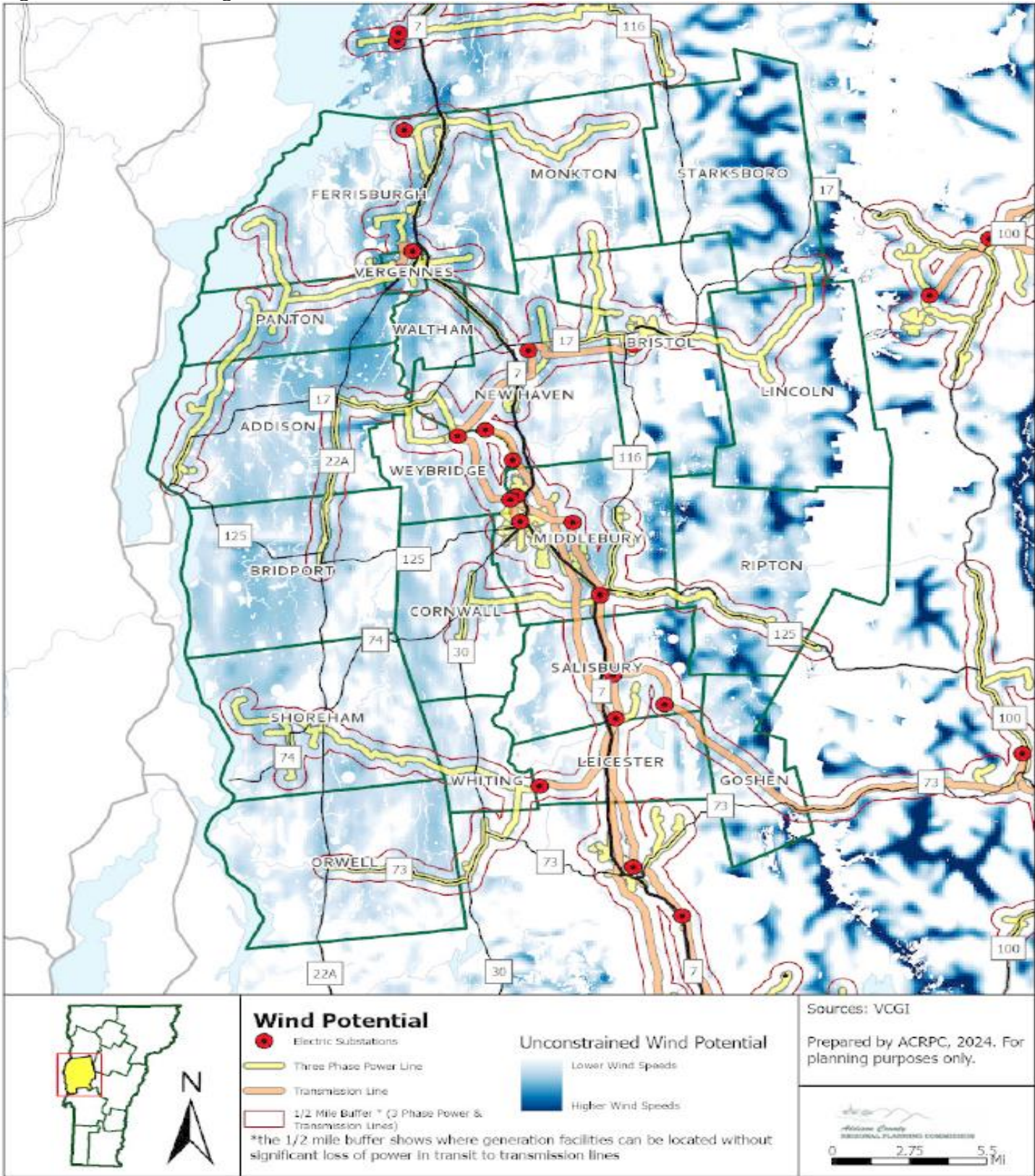


Figure 16—Addison Region Locations with “Known Constraints”

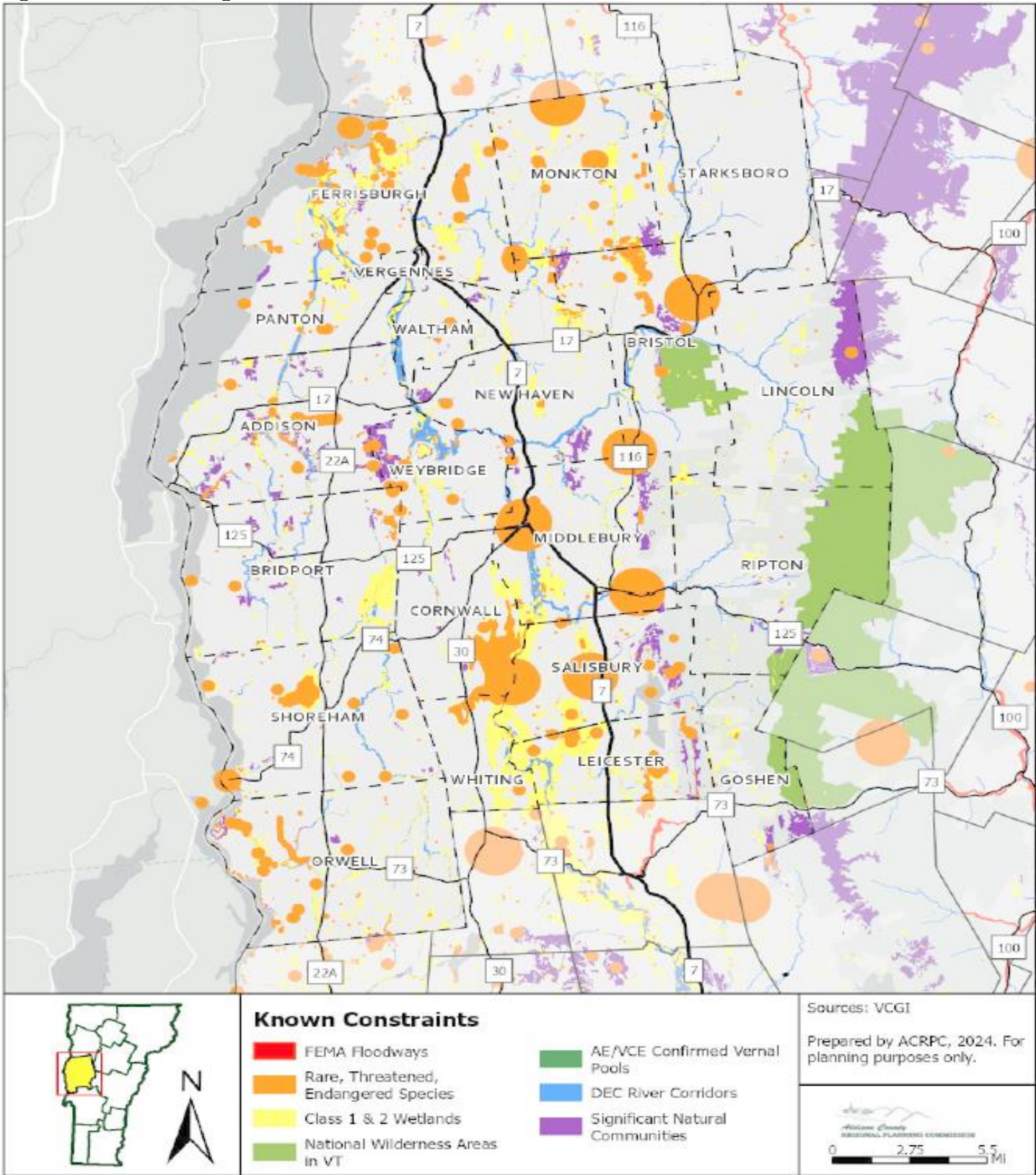


Figure 17—Addison Region “Possible Constraints”

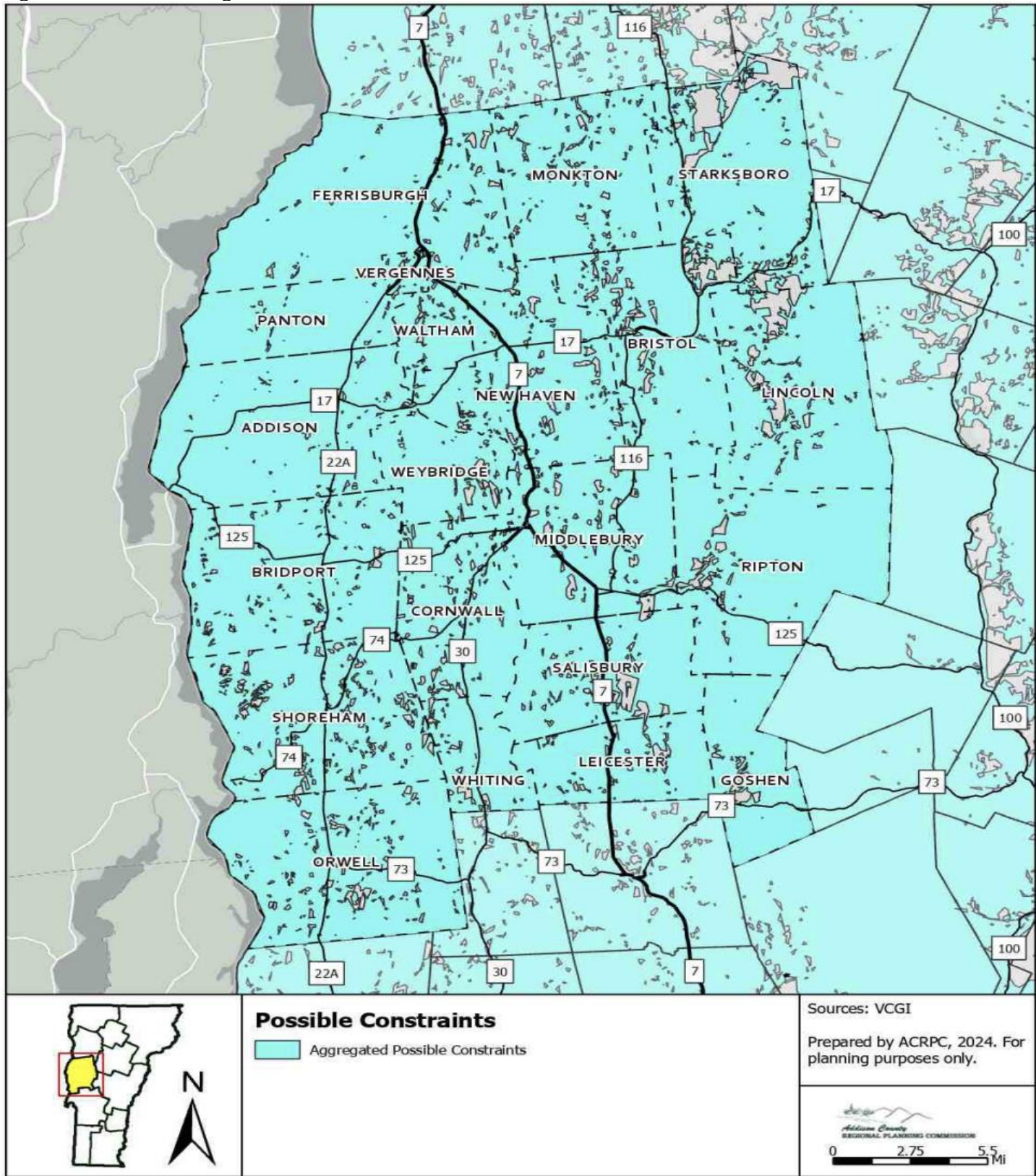


Figure 18—Addison Region Roof-top Locations for Solar Siting

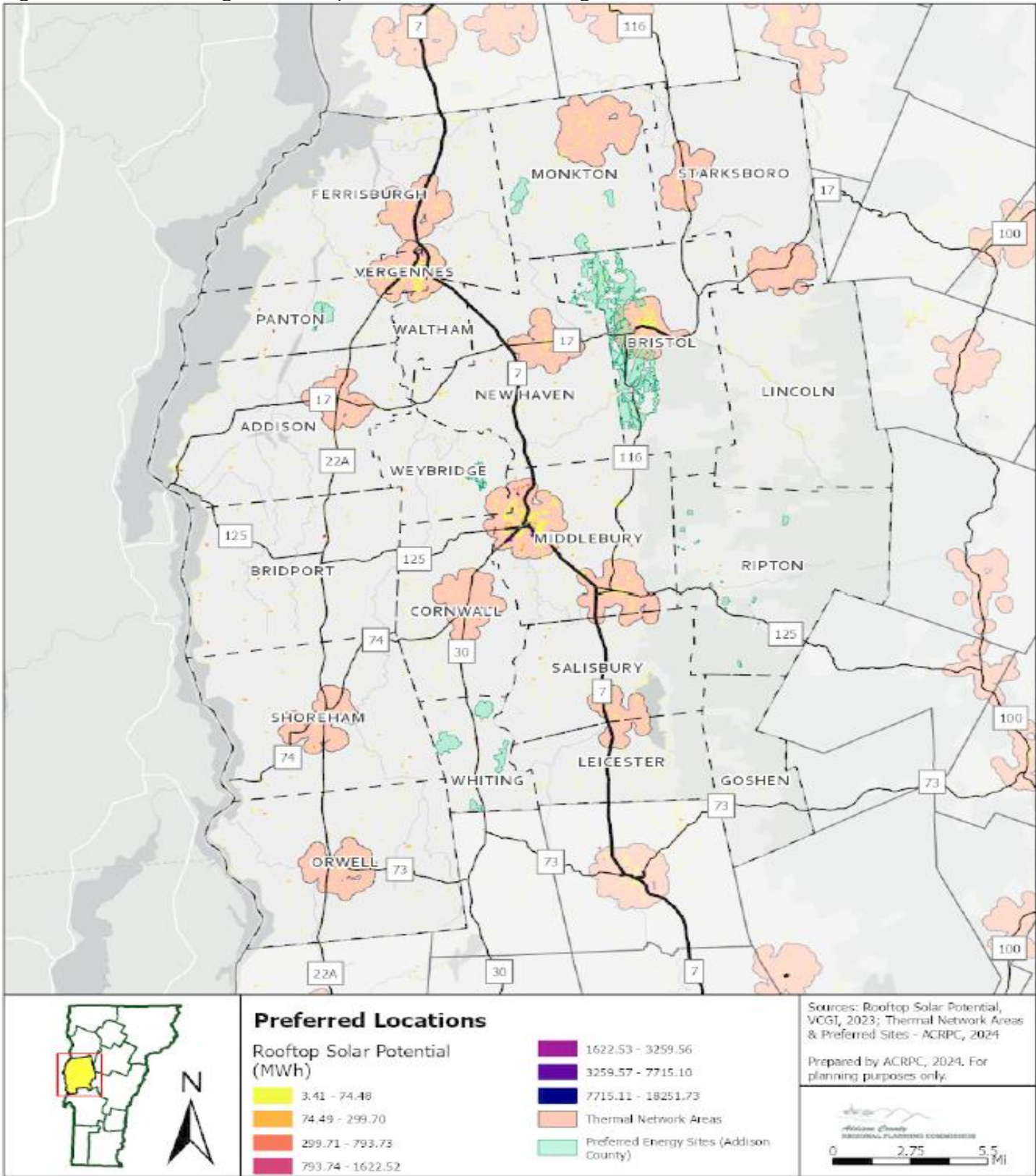


Figure 19—Potential Sites for Thermal Energy Networks in Addison County

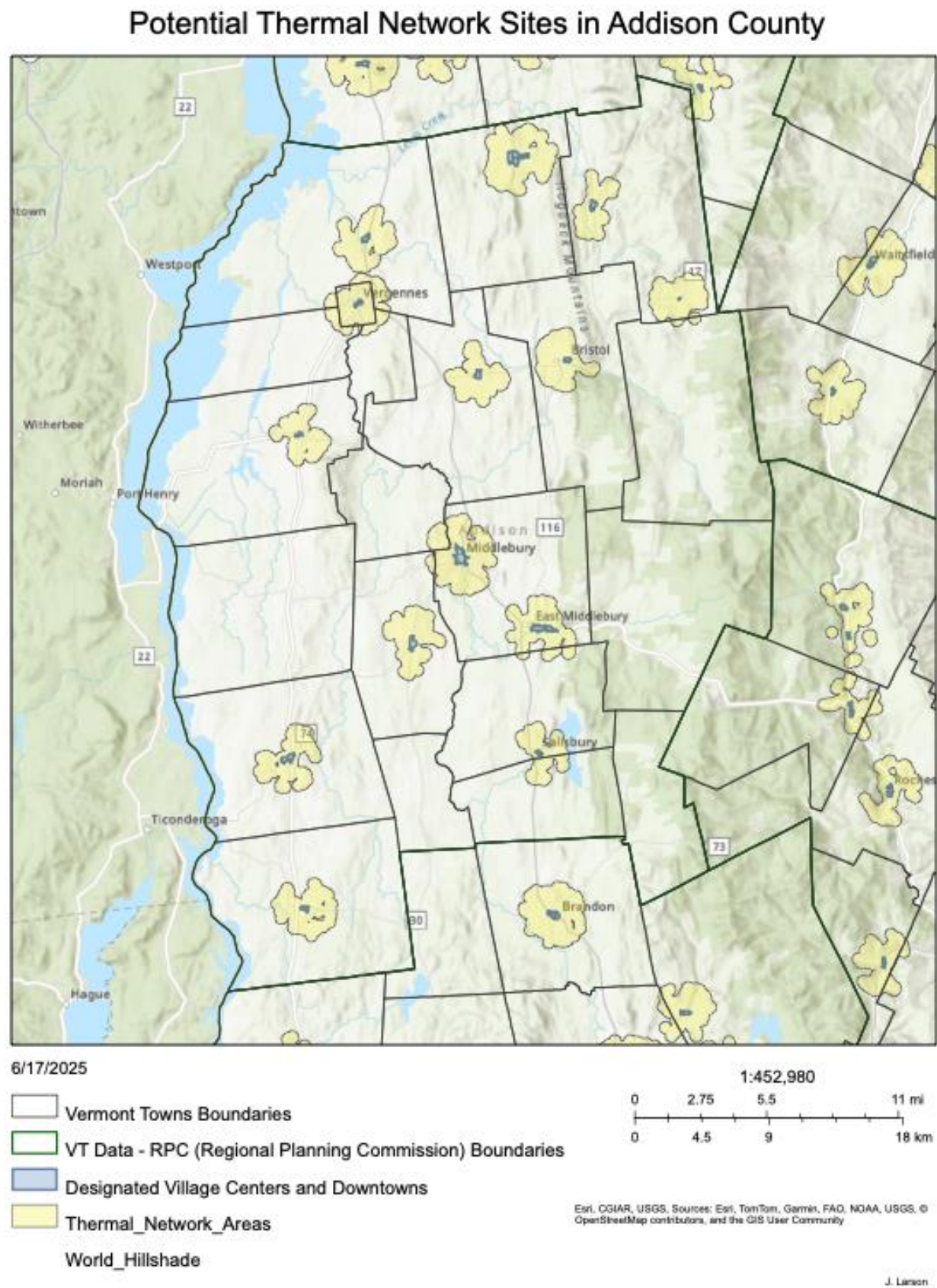


Figure 20—Addison Region Transmission, Substation, Transformer Capacity

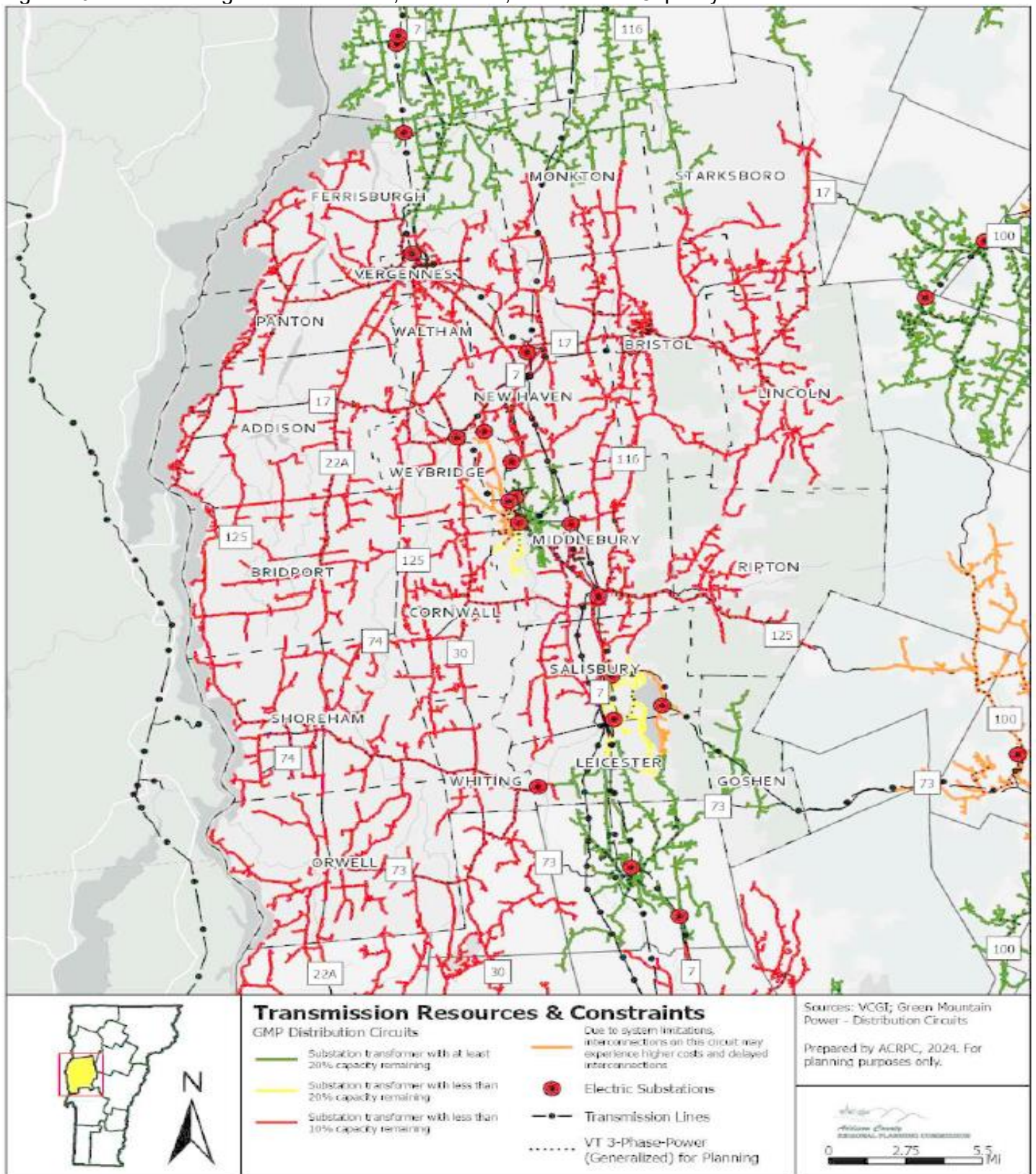


Figure 21—Addison Region Transportation Infrastructure

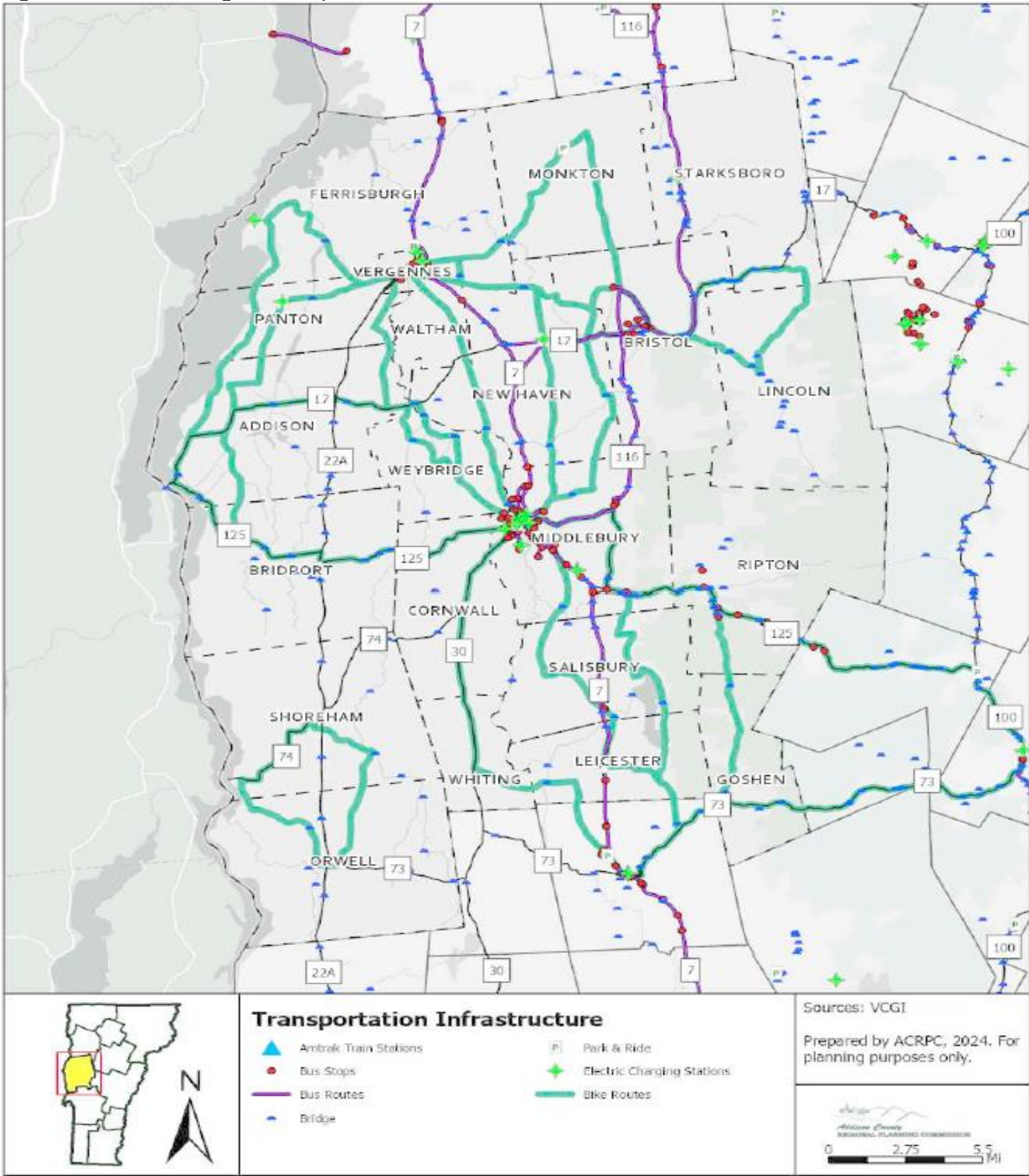


Figure 22—Prime Solar Sites and Habitat Blocks

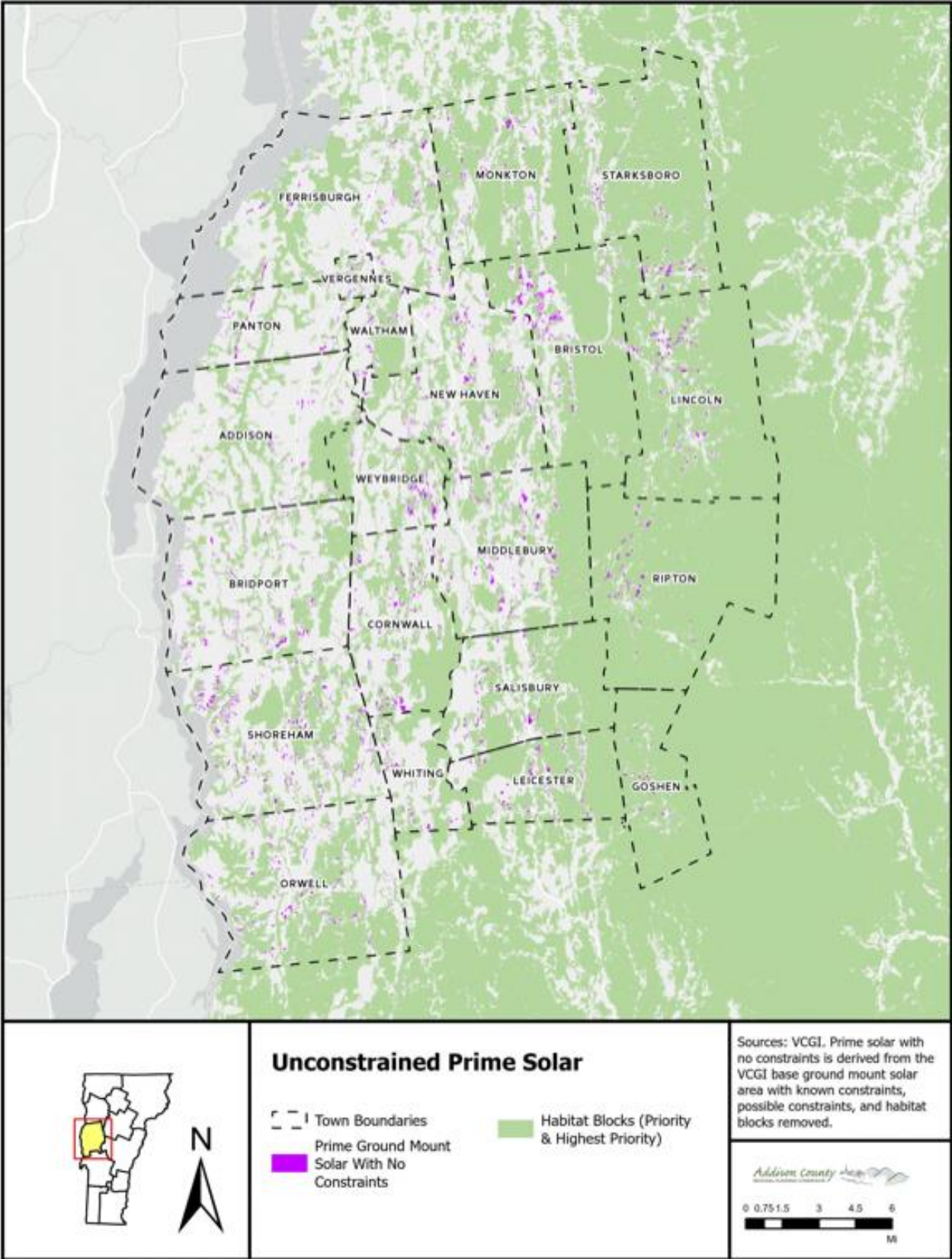
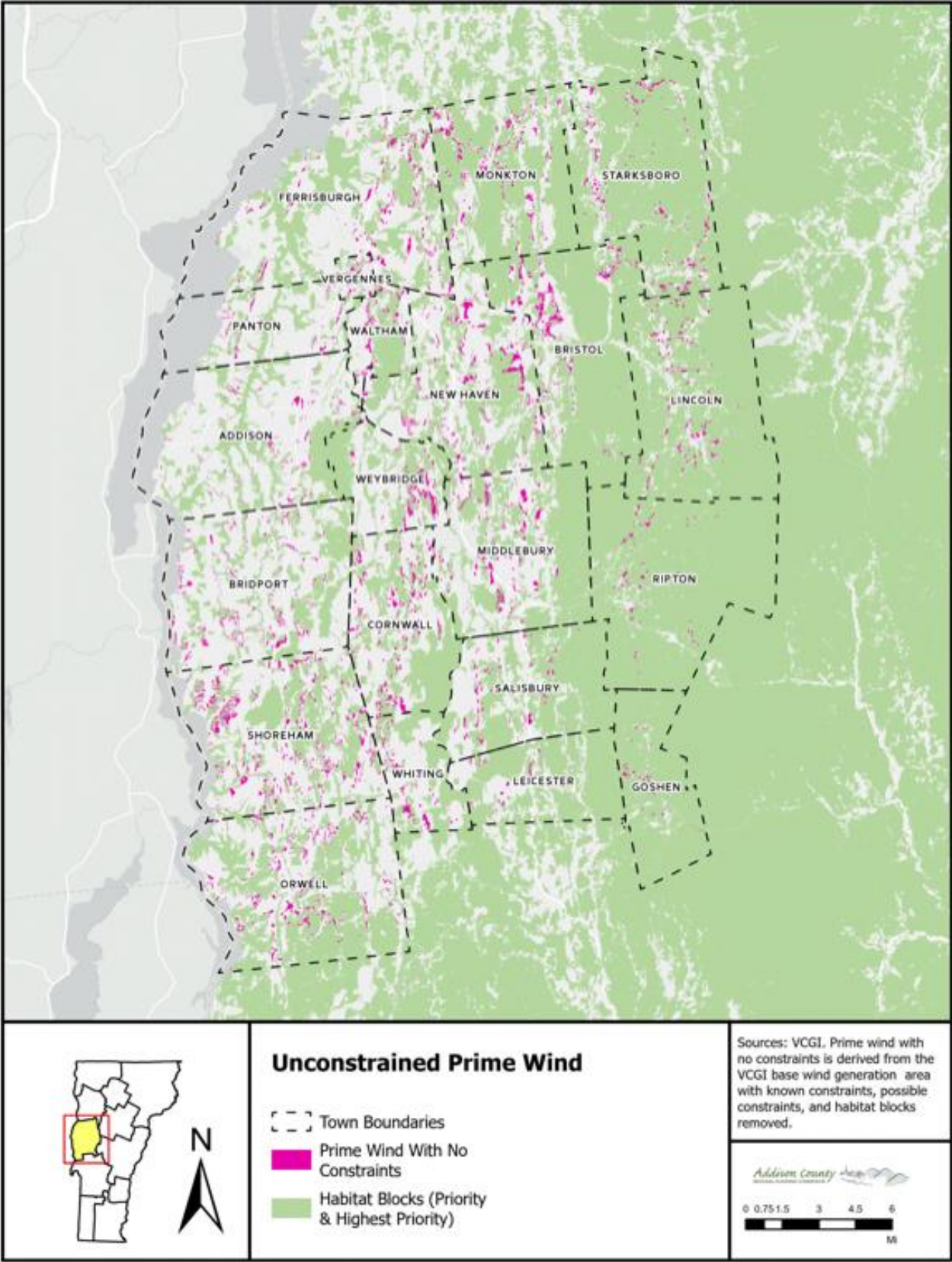


Figure 23—Prime Wind Sites and Habitat Blocks

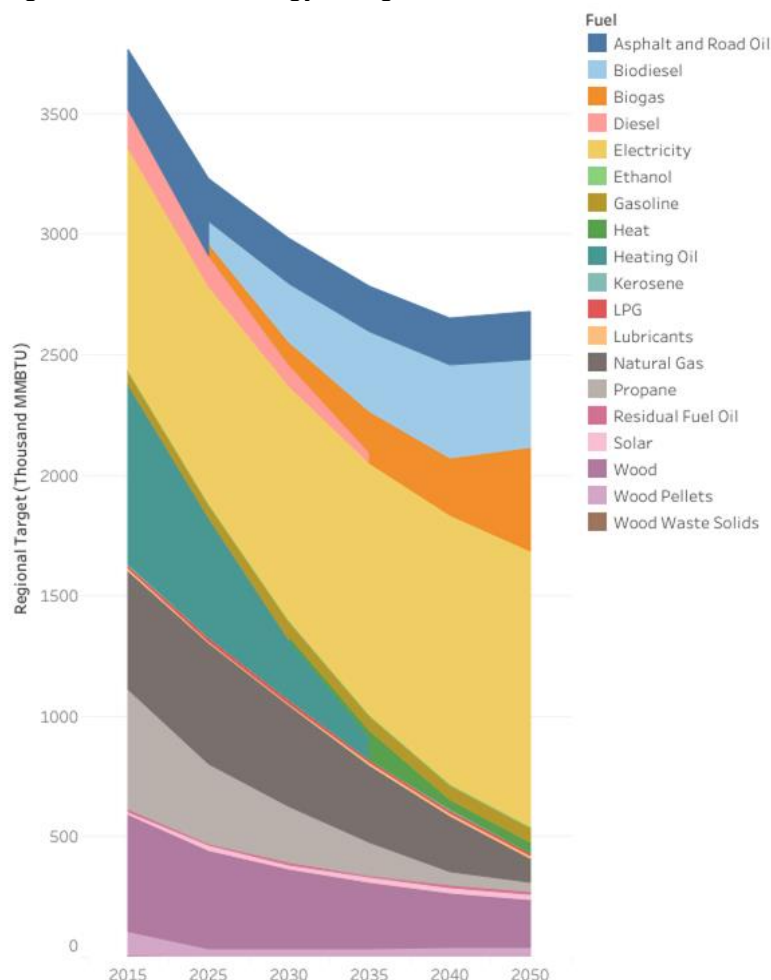


Appendix D: Target Generation Methodology

LEAP Model

Energy targets were created by the Department of Public Service using the LEAP (Long-range Energy Alternatives Planning) software to create a model of the demand for and supply of total energy usage in Vermont and the region. Full details of the LEAP Model methods, data sources and assumptions may be found as Appendix 103D to the 2022 Comprehensive Energy Plan. LEAP software is a system that allows users to create complex models of future energy use. The LEAP model does not identify specific costs that would be incurred in the future. Instead, it compares 2050 costs among various scenarios, in order to achieve the least-cost alternative to meet legislative goals. The LEAP model also includes impacts that do not result in out-of-pocket costs, such as impacts of pollution. Because of the model's complexity, it is difficult to explain comprehensively. The following scenarios provide some background on the methodology and the inputs used to create both statewide and regional models in

Figure 22—Total Energy Usage



LEAP. Appendix A presents the full model results for the region and the state as well as a more thorough explanation of the model assumptions and methodology. Targets for generation were developed by the Addison County Regional Planning Commission in partnership with the Department of Public Service.

The model created in LEAP actually contains two scenarios. The first scenario—the reference scenario—models what we will achieve based on current trends. The second scenario is designed to achieve the goal of meeting Vermont's greenhouse gas reduction obligations under the Global Warming Solutions Act (GWSA). This scenario, called the "CAP Mitigation" scenario, is adapted from the Vermont Total Energy Study (TES) Total Renewable Energy and Efficiency Standard (TREES) Local scenarios.²⁰ More information regarding the TES can be found on the Department of Public Service website.²¹

To meet the GWSA goals, total energy use will need to decline despite a growing population and economy. Electricity use will increase with the intensified use of heat

pumps as primary heating sources and the use of electric vehicles. Because those choices are powered by electricity, and electricity is three to four times more efficient compared to fossil fuels, overall energy

²⁰ Required by Act 170 of 2012 and by Act 89 of 2013, the intent of the TES according to the VT Public Service Dept. was "to identify the most promising policy and technology pathways to employ in order to reach Vermont's energy and greenhouse gas goals."

²¹ Vermont Total Energy Study: http://publicservice.vermont.gov/publications-resources/publications/total_energy_study

use will decrease both regionally and statewide. The difference in total energy demand between the reference scenario and the CAP Mitigation scenario is a key point. This difference represents the amount of total energy demand that will need to be eliminated to reach the state's and region's energy goals by 2050.

This LEAP model was developed for the state Comprehensive Energy Plan and disaggregated for each regional planning commission accounting for share in population, housing units, industries, commercial floorspace, number of vehicles and presence of natural gas pipelines. More information on the LEAP modeling inputs and assumptions can be found in Appendix D of the 2022 Vermont Comprehensive Energy Plan. This disaggregated "share" represents only one of the many paths the region may take to attain its energy goals and does not necessarily set a mandatory target for the region to achieve. The Regional Targets are further disaggregated to the municipal scale by ACRPC based on consumption in each sector.²²

Because different fuels are measured in different units (e.g., gallons, cords, pounds, cubic feet), the results of the LEAP model can be difficult to compare. To help make comparisons between fuel types easier, ACRPC has decided to report the scenario results in a standard unit: BTUs.

Please refer to the Department of Public Service's Act 174 Landing Page which has guidance for regions and municipalities and a host of tools used in the analyses that support this plan. This supplement provides additional, not comprehensive, methodological information so as not to duplicate that which is already laid out by the State.

Vermont's Regional Planning Commissions have been tasked with developing reasonable estimates for local consumption across the transportation, heating, and electric energy sectors. While these estimates use best available data, they should not be considered a unit-by-unit audit of energy use. Rather, they serve as a starting point for better understanding our region's current energy use patterns, the cost drivers, and what we need to do to achieve long-range energy goals. Note, estimates and targets are frequently given in British Thermal Units (BTUs) and millions of BTUs (MMBTUs) in order to allow for comparison between different energy types.

Current residential and commercial & industrial electricity usage data is provided by Efficiency Vermont (both municipal and regional totals - see supplement), transportation and thermal sector data is estimated via the Municipal Consumption Tool which pulls from a variety of sources including the Vermont Department of Public Service, American Community Survey, Vermont Department of Labor, the Vermont Department of Motor Vehicles, and DriveElectric (VEIC) (see supplement for specifics). Using the regionalized LEAP results provided by the Department of Public Service, targets are established to provide milestones for thermal efficiency; renewable energy use; and conversion of thermal and transportation energy from fossil fuel based to renewable resources. These milestones are intended to help the region measure progress towards the overall goals and are not identified as requirements. Regional LEAP targets were disaggregated using each municipality's share of current regional energy use, municipal disaggregation factors were calculated for transportation (Light Duty Vehicles), residential thermal, commercial thermal, residential electric, and commercial electric. Targets are established for the years 2025, 2035, and 2050 which coincide with the State Comprehensive Energy Plan (update 2022). Targets include both a "business as usual" baseline and the CAP (Climate Action Plan) mitigation scenario targets. While a summary of results is included below and referenced throughout this appendix, a walkthrough of the methods, data sources, and interim steps are included in the supplement and accompanying tools and supporting resources hosted by the Department of

²² The municipal disaggregation can be found on the ACRPC website

Public Service. Municipal analyses and targets are available on the [ACRPC website](#) and in the supplement.

Residential Heating Energy Use and Cost Estimates

The following explains the series of steps that ACRPC has taken to calculate estimates of Residential Heating Energy use, square footage, and costs for the Addison County region. According to the Department of Public Service, residences in New England use somewhere about 45,000 to 80,000 BTUs of heat energy per square foot annually, averaging statewide at about 110 MMBTUs per residence per year for space and water heating. Space heating is by far the biggest use, and older building stock can require significantly more energy to heat.

Caveats:

- ACS data is based on random sampling over a multi-year period with large margins of error especially for rural communities like many in the Addison County Region. As the writing of this plan, it remains the most consistent and comprehensive data available on residential heating.
- ACS data identifies only one primary source of heating. In reality, many residents use two or more resources.

Data (ACS 2022 5-Year Estimates used)

- a. B25117 Tenure by House Heating Fuel,
- b. B25010: Average Household Size of Occupied Units by Tenure,
- c. DP04 Selected Housing Characteristics,
- d. Total Housing Units.
- e. These data can be downloaded into an excel spreadsheet, CSV, or other file type. ACRPC did this by town and aggregated them in excel (Tables).

House heating fuel is categorized on the ACS questionnaire as follows:

Utility Gas: This category includes gas piped underground from a central system to serve the neighborhood. The only utility in Vermont that delivers gas in this manner (i.e. natural gas) is Vermont Gas, and its service area is well outside of our region. A small number of ACS respondents indicated that they heated with “utility gas.” It is most likely that they confused this source with bottled, tank or LP gas. We therefore made adjustments to account for this error.

Bottled, Tank, or LP Gas: This category includes liquid propane gas stored in bottles or tanks that are refilled or exchanged when empty. This is the second most dominant heat source for owner- and renter-occupied homes.

Electricity: This category includes electricity that is generally supplied by means of above or underground electric power lines. Census data does not distinguish between types of electric heat (e.g. resistance vs. heat pumps). We assume that additional homes in this category since the last plan and in the future are new heat pumps and not new resistance heat.

Fuel Oil, Kerosene, etc.: This category includes fuel oil, kerosene, gasoline, alcohol, and other combustible liquids. This category (oil) is the leading source of heat in the region overall, and for both owner- and renter-occupied homes. **Coal or coke:** This category includes coal or coke that is usually distributed by truck. Some households in our region use anthracite in stoves, furnaces, and boilers. There are very few of these, if any, still in the region, as the margin of error suggests potential to be zero.

Wood: This category includes purchased wood, wood cut by household members on their property or elsewhere, driftwood, sawmill or construction scraps, or the like. Wood is a close third largest source of heat in the region for owner-occupied homes, much of which is likely cordwood.

Solar Energy: This category includes heat provided by sunlight that is collected, stored, and actively distributed to most of the rooms. It is difficult to anticipate what residents mean when they select this option; consequently, we combined this estimate with the “other fuel” class.

Other Fuel: This category includes all other fuels not specified elsewhere. This category very likely consists of non-fossil fuel sources, but it is difficult to make further assumptions.

Commercial Estimates

A worksheet, Municipal Consumption, created by the Department of Public Service, which uses data from the Vermont Department of Labor’s Economic and Labor Market Information website: <http://www.vtlmi.info>. The worksheet determines the municipality’s share of the regional commercial building stock and applies assumptions from the Energy Information Institute’s Survey of Commercial Uses. The estimate does not include industrial uses, which are highly variable.

Transportation Estimates

This data was developed using the Department of Public Service’s Municipal Consumption worksheet. The total number of vehicles comes from American Community Survey (ACS) 5-Year Estimates. Average annual VMTs account for slightly longer-than-average commutes and more incidental trips in the rural and commuter parts of our region. Total vehicle miles traveled assumes an average fuel economy of 22 miles per gallon. Registered ICE vehicles are assumed to travel 12,000 miles per year which is the mid range of the provided estimate. Registered EVs were determined by the Vermont Energy Investment Corporation ([Drive Electric](#)) and use the low estimate provided by the Dept. of Public Service’s average of 9,000 VMTs per EV annually taking into account early trends in EV adoption including reducing trips in adverse weather and coincidence of alternative transportation modes as well as the high percentage of our region who is retired and thus without a daily commute.

Electricity Estimates

Efficiency Vermont provides an annual report with compiled data from the most recent three years, based on that provided by utilities serving the region. ACRPC has [compiled all of the annual reports from EVT](#) into a single report providing data between 2015 and 2023.

Thermal Efficiency & Fuel Switching Targets (Residential & Commercial)

Targets for thermal efficiency of residential and commercial structures are based on a methodology developed by the regional Long-range Energy Alternatives Planning (LEAP) analysis carried out by the Department of Public Service and then disaggregated using municipal share of regional energy use determined via the [Municipal Consumption Tool](#). See the Municipal Consumption Summary (live) tab in the Municipal Consumption Tool to see how each regional target was disaggregated to the municipal scale.

Table 35—Municipal consumption summary disaggregation

Town	Transportation Percent of Region (MMBtu)	Thermal Residential Percent of Region	Thermal Commercial Percent of Region	Electric Commercial Percent of Region	Electric Residential Percent of Region	Total Electric
Addison	4.2%	4.3%	4.3%	3.0%	5.3%	4.1%
Bridport	3.8%	3.6%	3.6%	2.1%	4.0%	3.1%
Bristol	10.8%	10.4%	10.4%	7.2%	9.4%	8.3%
Cornwall	3.1%	3.4%	3.4%	0.4%	4.2%	2.3%
Ferrisburgh	8.5%	9.0%	9.0%	5.1%	10.3%	7.7%
Goshen	0.6%	0.6%	0.6%	0.1%	0.5%	0.3%
Leicester	3.5%	4.2%	4.2%	0.3%	3.5%	1.9%
Lincoln	4.2%	3.8%	3.8%	0.4%	3.7%	2.1%
Middlebury	16.0%	19.5%	19.5%	57.6%	15.8%	36.7%
Monkton	6.2%	5.0%	5.0%	0.5%	5.9%	3.2%
New Haven	6.1%	4.5%	4.5%	4.1%	5.2%	4.6%
Orwell	3.2%	3.5%	3.5%	1.2%	3.8%	2.5%
Panton	2.1%	1.9%	1.9%	1.0%	2.9%	2.0%
Ripton	1.7%	1.9%	1.9%	0.9%	1.7%	1.3%
Salisbury	3.6%	4.0%	4.0%	1.5%	4.0%	2.7%
Shoreham	3.9%	3.6%	3.6%	3.2%	4.0%	3.6%
Starksboro	5.9%	5.0%	5.0%	0.7%	4.9%	2.8%
Vergennes	7.4%	7.0%	7.0%	9.7%	5.5%	7.6%
Waltham	1.5%	1.2%	1.2%	0.2%	1.3%	0.8%
Weybridge	2.3%	2.1%	2.1%	0.5%	2.9%	1.7%
Whiting	1.3%	1.3%	1.3%	0.2%	1.3%	0.8%

Electrical Efficiency Targets

Efficiency and conservation measures are integrated into the thermal sector targets. Electricity efficiencies were embedded into the 20-year load forecast used in the updated LEAP model, thus are not an output of their own (and why the Public Service Department removed the Electric Sector tab of the updated Analysis & Targets Tool). Therefore electric efficiency targets were provided separately in the [EEU Potential Study Data Sheet](#) and disaggregated to the Regional scale using the recommended methodology. Municipal disaggregation (Located in the Addison Co. Disaggregation (EVT) Dashboard tab) uses the Total Electric percentage which comes from the Municipal Consumption Tool Summary and is copied to the Information tab in the EEU Potential sheet.

Fuel Switching Transportation Targets

This table displays a target for switching from fossil fuel-based vehicles to EVs. This target is calculated using the Regional LEAP data and disaggregates the regional target based on the municipal share of current transportation consumption as estimated in the Municipal Consumption Sheet. The targets are cumulative.

Generation Targets

Existing Renewable Energy Generation

Significant effort was made to aggregate the most comprehensive list of existing renewable energy generation sites possible for the region. The Department of Public Service periodically provides an updated Distributed Generation Inventory which includes projects that have been submitted to the Public Utility Commission and are less than <5MW. Unfortunately, though hope was long held out, the Energy Action Dashboard was officially updated leaving aside the difficult task of updating and hosting the much-beloved and crowd-sourced Energy Atlas that is unfortunately 7+ years out of date. Data from the most recent data set provided in the dashboard were cross referenced with the DG data provided by the PSD.

Capacity Factor is the ratio of actual electrical energy output over a given period of time to the theoretical maximum over that same period (the theoretical maximum energy output of a given installation being continuous operation at full nameplate capacity over the relevant time period).

Table 36—Conversion Factors			
Resource	Acres/MW	Capacity Factor	MWh/MW
Solar	7	15.0%	1314
Rooftop Solar	1.5	14.5%	1270
Wind	40	22.5%	1971
Large Wind	10	30.0%	2628
Natural Gas	0.343	75.0%	6570
Biomass	6.375	70.0%	6132
Hydro	1	50.0%	4380

Ground-Mounted Solar Energy Potential

The methodology for estimating ground-mounted solar electricity potential is to divide the number of acres available as prime and base resources by 7 acres per MW for prime solar; 60 acres per MW is used for base solar to account for the presence of possible constraints that reduce the land usable for solar panels. The annual electricity production is then estimated using the formula below. Solar MWh of energy = (number of MW) * (8760 hours per year) * (0.15 capacity factor).

Rooftop Solar Energy Potential

Rooftop solar potential data is sourced from the Vermont Center for Geographic Information (VCGI) dataset named Town Rooftop Solar Potential – Act 174 2022. As explained in the release notes, these estimates use a geographic information system (GIS) model of building footprints to determine the total surface area of rooftops suitable for solar photovoltaic panels (accounting for amount of solar radiation, slope, aspect, shading of nearby objects, and minimum size of rooftop viable for solar panels). Using published data for solar radiation, the VCGI data also estimates an annual solar energy production potential for each suitable rooftop, summarized by municipality, applying a capacity factor of 13.76% as published by the U.S. Environmental Protection Agency. The total system capacity in megawatts is then estimated using the formula below. Rooftop MW of capacity = (number of annual MW) ÷ (0.145

capacity factor) * (8760 hours per year)). This was further curtailed by ACRPC to provide a conservative estimate as roof and condition could not be integrated at this point in analyses.

Wind Energy Potential

The methodology for estimating wind electricity potential is to divide the number of acres available as prime and base resources by 25 acres per MW. There is no reduced land factor for base wind since possible constraints have a lesser impact on actual equipment siting due to the vertical nature of wind turbines. Then to estimate the amount of production using the formula below. Wind MWh of energy = (number of MW) * (8760 hours per year) * (0.225 capacity factor).

Calculating Renewable Energy Generation Targets

Municipalization is based on a weighted average of the following factors agreed upon by ACRPC energy committee: **Land Area: 20%, Existing Generation: 10%, Demand: 50%, Population: 20%**. The target selected was the maximum available of 25% In-State Generation. All data used and targets generated can be found in the [ACRPC Generation Scenarios Tool](#).

State Known and Possible Constraint Definitions and Descriptions

The following is a list of the known, possible, and regional constraints that were used and referenced in the mapping section of this document. A definition of the constraint including source of the data is provided. As discussed in the report, RPCs supported a coordinated effort by the Department of Public Service, VCGI, and ANR to aggregate these layers which are now available via the Act 174 tab of the DHCD Planning Atlas (<https://vcgi.vermont.gov/data-release/act-174-statewide-energy-planning-data-updated-known-and-possible-constraints>).

Known Constraints Vernal Pools (confirmed and unconfirmed layers)

Source: Vermont Fish and Wildlife, 2009 - present Vernal pools are temporary pools of water that provide habitat for distinctive plants and animals. Data was collected remotely using color infrared aerial photo interpretation. "Potential" vernal pools were mapped and available for the purpose of confirming whether vernal pool habitat was present through site visits. This layer represents both those sites which have not yet been field-visited or verified as vernal pools, and those that have.

Department of Environmental Conservation (DEC) River Corridors

Source: DEC Watershed Management District Rivers Program, January 2015 River corridors are delineated to provide for the least erosive meandering and floodplain geometry toward which a river will evolve over time. River corridor maps guide State actions to protect, restore and maintain naturally stable meanders and riparian areas to minimize erosion hazards. Land within and immediately abutting a river corridor may be at higher risk to fluvial erosion during floods. River corridors encompass an area around and adjacent to the present channel where fluvial erosion, channel evolution and down-valley meander migration are most likely to occur. River corridor widths are calculated to represent the narrowest band of valley bottom and riparian land necessary to accommodate the least erosive channel and floodplain geometry that would be created and maintained naturally within a given valley setting.

Federal Emergency Management Agency (FEMA) Floodways

Source: FEMA Floodway included in Zones AE – FEMA Map Service Center These are areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. A

"Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

State-significant Natural Communities and Rare, Threatened, and Endangered Species

Source: Vermont Fish and Wildlife, National Heritage Inventory The Vermont Fish and Wildlife Department's Natural Heritage Inventory (NHI) maintains a database of rare, threatened and endangered species and natural (plant) communities in Vermont. The Element Occurrence (EO) records that form the core of the Natural Heritage Inventory database include information on the location, status, characteristics, numbers, condition, and distribution of elements of biological diversity using established Natural Heritage Methodology developed by NatureServe and The Nature Conservancy. An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation).

National Wilderness Areas

Source: United States Department of Agriculture Forest Service A parcel of Forest Service land congressionally designated as wilderness. Class 1 and Class 2

Wetlands

Source: Vermont Significant Wetland Inventory (VSWI) and advisory layers The State of Vermont protects wetlands which provide significant functions and values and also protects a buffer zone directly adjacent to significant wetlands. Wetlands in Vermont are classified as Class I, II, or III based on the significance of the functions and values they provide. Class I and Class II wetlands provide significant functions and values and are protected by the Vermont Wetland Rules. Any activity within a Class I or II wetland or buffer zone which is not exempt or considered an "allowed use" under the Vermont Wetland Rules requires a permit. Class I wetlands have been determined to be, based on their functions and values, exceptional or irreplaceable in its contribution to Vermont's natural heritage and, therefore, merits the highest level of protection. All wetlands contiguous to wetlands shown on the VSWI maps are presumed to be Class II wetlands, unless identified as Class I or III wetlands, or unless determined otherwise by the Secretary or Panel pursuant to Section 8 of the Vermont Wetland Rules.

Possible Constraints Agricultural Soils

Source: Natural Resources Conservation Service (NRCS) "Primary agricultural soils" are defined as "soil map units with the best combination of physical and chemical characteristics that have a potential for growing food, feed, and forage crops, have sufficient moisture and drainage, plant nutrients or responsiveness to fertilizers, few limitations for cultivation or limitations which may be easily overcome, and an average slope that does not exceed 15 percent. Present uses may be cropland, pasture, regenerating forests, forestland, or other agricultural or silvicultural uses. The soils must be of a size and location, relative to adjoining land uses, so that those soils will be capable, following removal of any identified limitations, of supporting or contributing to an economic or commercial agricultural operation. Unless contradicted by the qualifications stated above, primary agricultural soils include important farmland soils map units with a rating of prime, statewide, or local importance as defined by the Natural Resources Conservation Service of the United States Department of Agriculture.

FEMA Special Flood Hazard Areas

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA) on National Flood Insurance Program (NFIP) maps. The SFHA is the area where the NFIP's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

Protected Lands

State fee land and private conservation lands are considered protected lands. Other state level, nonprofit and regional entities also contribute to this dataset. The Vermont Protected Lands Database is based on an updated version of the original Protected Lands Coding Scheme reflecting decisions made by the Protected Lands Database Work Group to plan for a sustainable update process for this important geospatial data layer.

Act 250 Ag Mitigation Parcels

Source: Vermont Department of Agriculture All projects reducing the potential of primary agricultural soils on a project tract are required to provide "suitable mitigation," either "onsite or offsite," which is dependent on the location of the project. This constraint layer includes all parcels in the Act 250 Ag Mitigation Program as of 2006.

Deer Wintering Areas (DWA)

Source: Vermont Department of Fish and Wildlife Deer winter habitat is critical to the long-term survival of white-tailed deer (*Odocoileus virginianus*) in Vermont. Being near the northern extreme of the white-tailed deer's range, functional winter habitats are essential to maintain stable populations of deer in many years when and where yarding conditions occur. Consequently, deer wintering areas are considered under Act 250 and other local, state, and federal regulations that require the protection of important wildlife habitats. DWAs are generally characterized by rather dense softwood (conifer) cover, such as hemlock, balsam fir, red spruce, or white pine. Occasionally DWAs are found in mixed forest with a strong softwood component or even on found west facing hardwood slopes in conjunction with softwood cover. The DWA were mapped on mylar overlays on topographic maps and based on small scale aerial photos.

Vermont Conservation Design include the following Highest Priority Forest Blocks: Connectivity, Interior, and Physical Landscape Diversity – Source: Vermont Department of Fish and Wildlife The lands and waters identified in this constraint are the areas of the state that are of highest priority for maintaining ecological integrity. Together, these lands comprise a connected landscape of large and intact forested habitat, healthy aquatic and riparian systems, and a full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend. Hydric Soils – Source: Natural Resources Conservation Service A hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. This constraint layer includes soils that have hydric named components in the map unit.