SECTION IV

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IV. REGIONAL ENERGY SUPPLY AND CONSUMPTION

To understand what strategies the region needs to implement to achieve state energy goals, it is important to understand the region's current energy supply and energy consumption. Using federal, state, and regional data, the NRPC has estimated regional energy consumption for space heating, transportation, and electric uses. The regional energy supply for heating and transportation has also been estimated. Regional information regarding electricity supply has been compiled using data available from public utilities servicing the Northwest region.

Where possible, space heating, transportation, and electric uses have been broken down into subsectors (residential, commercial, industrial, institutional) to provide a more refined understanding of the data. All energy data in this section is expressed in British thermal units (BTUs) (Figure 4.1). The data in this section provides some context for the changes that will need to occur in the future to achieve state and regional energy goals.

FIGURE 4.1 BRITISH THERMAL UNITS (BTUs)

British thermal units (BTUs) are the standard of measurement used in this plan. Using BTUs allows for comparisons between different types of energy inputs (e.g., electricity vs. cord wood). Here are some example conversions:

Common Measurement	BTU
1 gallon of gasoline	120,404
1 gallon of diesel fuel	137,571
1 gallon of heating oil	137,571
1 gallon of liquid propane	84,738
1 cord of wood	20,000,000
1 kWh of electricity	3,412

FIGURE 4.2 AMERICAN COMMUNITY SURVEY (ACS)

Much of the information used in this section is derived from the American Community Survey (ACS), which is conducted by the U.S. Census Bureau. This is because the U.S. Census no longer collects a considerable amount of data that it previously compiled.

The main difference between the ACS and the U.S. Census is that the ACS is based on surveys of random households within a community during a five-year period (e.g., 2009–2013). It is not a "count" like the census. The ACS is collected via mail.

According to the U.S. Census Bureau, approximately 295,000 surveys are mailed per month to randomly selected addresses in the United States. Follow-up phone calls or personal visits by U.S. Census workers are made to households that do not respond to the mailed survey.

Since the Northwest region has a relatively small population, and since the ACS is a survey and not a census, regional data from the ACS has a margin of error. This should be kept in mind while reading this report. Regardless, the ACS is the best available source for a variety of data points used in this plan.

More information about the ACS can be found at www.census.gov/acs/www/.

A. SPACE HEATING

RESIDENTIAL HEATING SOURCES

Estimates for residential space heating fuel use by household are available from the American Community Survey (ACS). The primary heating sources in the region are fuel oil (including kerosene), electricity, liquid propane (LP), utility gas (such as natural gas), and wood (cord wood & pellets). Utility gas is available in the region, but only in western Franklin County and in the vicinity of Enosburg Falls (see Appendix C for map of service area). Fuel oil is the most common residential heating source in the region (37%), followed by utility gas (23%) and propane (17%). Use of utility natural gas and propane has increased somewhat since 2013.

The use of electrical heat pumps has increased significantly from 2013 to 2021, although it still represents a small number of total households. Approximately 10 times as many households have installed heat pumps in 2021 than had installed heat pumps in 2016.

Based on NRPC's estimates, the region currently uses approximately 2.25 trillion BTUs to heat residential units each year. Despite increased use of heat pumps, increased efficiency of new heating systems and increased weatherization, total thermal energy use has increased slightly since 2013, likely due to increased population in the region.

Figure 4.3 shows estimated residential heating use and costs.[2] Regional households who use propane or fuel oil spend more on energy than those using natural gas, wood or electric heat pumps. Wood costs may be lower than projected, as many residents in the region use cord wood harvested on their property and may not actually pay for wood. Cost information may vary considerably year to year based on global and regional fuel market price, particularly for unregulated fuels such as fuel oil and propane. While electricity has lower average costs than fuel oil and propane, the initial investment in transitioning to this heating source can be cost-prohibitive for many households.

FIGURE 4.3 REGIONAL RESIDENTIAL THERMAL ENERGY USE - 2021

Fuel Source	Regional Households (ACS 2016-2021)	% of Households	BTU (in billions)	Change Since 2013	% of the Total Costs
Natural Gas	5,082	23%	561.22	29%	13%
Propane	3,774	17%	440.72	21%	26%
Electricity	1,123	5%	108.69	168%	4%
Fuel Oil	8,216	37%	946.72	-14%	44%
Coal	14	0%	1.78	6%	n/a
Wood	3,273	15%	404.13	-16%	13%
Solar	62	0%	7.87	-	n/a
Other	427	2%	46.53	-2%	n/a
No Fuel	40	0%	3.63	-24%	n/a
Total	**22,011**	**100%**	**2,521.28**	**2%**	**100%**

Source: *Vermont Comprehensive Energy Plan*

There are approximately 22,011 households in the region. Roughly 80% of regional households are owner-occupied households, and 20% are renter-occupied households. It is important to note that renter-occupied households often have little to no control over the heating source used in their housing unit because renters cannot lawfully change their heating source. In addition, landlords often have little incentive to upgrade to more efficient heating sources when the tenant is paying for heat.

COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL HEATING SOURCES

Estimating space heating sources and costs for non-residential structures is more difficult than for residential structures given the lack of available information about structure square footage. There isn't enough existing data to provide an accurate estimate regarding heating sources and costs for non-residential uses in the state and the region.

Statewide, roughly 40% of all thermal energy consumption is from industrial and commercial sources (2021 CEP). If this trend is similar for the Northwest Region, regional thermal energy use for commercial and industrial uses may be around 1680.85 billion BTUs. However, this data should not be assumed to be accurate due to lack of region-specific information. There is no regional or statewide breakdown of source of thermal energy for commercial, industrial and institutional uses.

[2]Unit costs were calculated as follows: Estimated fuel costs from the 2021 Vermont CEP. Wood heating cost is the average of costs for pellet boilers & wood stoves. Electrical costs are assumed to be from heat pumps.

WEATHERIZATION

Weatherization of existing structures is critical to reduce thermal energy use and increase the efficacy of cold climate heat pumps. According to data from Efficiency Vermont (EVT), an average of 35 residential units per year were weatherized between 2016-2021, this is a 36% increase compared to the average yearly weatherization in 2011-2015.
However, this is far below the previous plan's goal of weatherizing 5,400 residential units by 2020.

Weatherization of existing structures in the region may be completed by various parties: individual homeowners, businesspersons, or institutions. Several public and private organizations in the region can help residential, commercial, and industrial customers weatherize their structures.

Data from public organizations regarding their weatherization efforts in the region is available. The Champlain Valley Office of Economic Opportunity (CVOEO), Efficiency Vermont, and VGS, formerly Vermont Gas Systems, are three prominent organizations operating within the region that provide weatherization-related services to individuals and businesses. Many private businesses also specialize in helping individuals and businesses weatherize. NRPC has chosen to highlight these three organizations because they are public utilities and/or provide services that are publicly funded.

Champlain Valley Office of Economic Opportunity

The Champlain Valley Office of Economic Opportunity (CVOEO) is the state-appointed community action agency serving the Northwest region. The organization administers a variety of programs focused on combating poverty and enabling individuals to reach self-sufficiency. One program operated by CVOEO is the low-income weatherization program in the region. This program is available to homeowners and renters that make less than 80% of the average income in Chittenden, Franklin Grand Isle counties (between $64,792-
$122,179 depending on household size). CVOEO prioritizes serving households with the greatest need. Many of the program's grantees are also eligible for other state programs focused on making heating more affordable, including the Fuel Assistance Program.

VGS

VGS is the natural gas utility serving the region. The organization offers several weatherization programs to its customers. Specific programs for residential customers, both renters and homeowners, include the Retrofit Program and the New Construction Program. Each program allows the customer to install significant building improvements to increase thermal efficiency. The Retrofit Program includes a free energy audit and low-interest financing options. VGS also provides comparable programs to its commercial customers. The most popular program for both residential and commercial customers provide rebates or other financial incentives to install high-efficiency equipment such as furnaces and water heaters.

Efficiency Vermont

Efficiency Vermont is the statewide Energy Efficiency Utility (EEU) appointed by the Public Service Board. It manages a broad array of programs that are focused on conservation efforts through providing education, services, and incentives to Vermont homeowners and businesses. This includes providing financing and technical support to homeowners and businesses seeking to complete energy-saving improvements and administering rebate programs for a variety of appliances and equipment.

CVOEO and Efficiency Vermont have recognized that occasionally their efforts may duplicate, especially with regard to weatherizing multi-family housing because property owners may be eligible for programs through each organization. There may also be some overlap with VGS programs. However, this circumstance is the exception, not the rule. The above cited data from Efficiency Vermont excludes projects completed that overlap VGS or CVOEO programs.

B. TRANSPORTATION

Transportation contributes a considerable amount to the region's total energy use. This is due to several factors: reliance upon the automobile for transportation, land use patterns, and fuel costs.

AUTOMOBILE RELIANCE

Data regarding vehicle use and vehicle miles traveled is available from both state and federal sources, and it provides a clear picture of auto reliance in the state and the region (Figure 4.4).

FIGURE 4.4 GAS VEHICLE ENERGY USE

	2013	2021
Est. # of Gas Vehicles	42,471	39,564
Average Miles Traveled (Vermont)	11,356	12,274
Transportation BTUs (Thousand MMBTU)	3,121	3,029
Gasoline Cost	$59,883,119	$95,863,654

Source: *US Census 2016-2021 ACS, 2021 VTrans Vermont Transportation Energy Profile*

From 2013-2021, estimated gasoline energy usage is down 2.9%. This is largely due to fewer gasoline vehicles estimated to be on the road, as well as a small increase in average vehicle fuel efficiency. However, average miles traveled is increasing in the state, which reduces fuel savings. This data is also likely impacted by COVID-19 and the prevalence of work from home arrangements during and after the pandemic.

ELECTRIC VEHICLES

Electric vehicles use energy more efficiently than gas powered vehicles and allow for the use of renewable energy to power our vehicles. From 2013-2021, the region has made significant progress in increasing the number of electric vehicles. While the total increase has been large, electric vehicles still make up just 2% of all vehicles in the region, so impacts to total gasoline energy use have been limited. As electric vehicles grow in popularity, so does the range of prices, mileage ranges, and sizes of electric vehicles on the market. The more electric vehicles replace gas vehicles in Vermont, the lower the carbon emissions from transportation and this will help to achieve state and regional energy goals. Incentives and advancements in technologies are aimed at increasing the rate of adoption for electric vehicles.

FIGURE 4.5 ELECTRIC VEHICLE TOTAL REGISTRATIONS

	2013	2021	% Change
Battery Electric Vehicle	5	316	6,220%
Plug-In Hybrid Vehicle	6	536	8,833%
Total	**11**	**852**	**7,645%**

Source: *Efficiency Vermont, Electric Vehicle Registrations from Vermont DMV*

Consistent with the statewide trend of increased vehicle miles traveled, fewer regional commuters appear to be carpooling than in 2013 but work from home has increased.
Data for other modes of transit is difficult to interpret due to the margin of error. Public health measures encouraged during the COVID-19 pandemic from 2020-2022 may explain the reduction in carpooling and increase in work from home.

FIGURE 4.6 COMMUTER CHARACTERISTICS

	2013	2021	% Change
Car, alone	77.3%	79.8%	3.2%
Carpooling	12.8%	9.0%	-30.1%
Public Transit*	0.5%	0.0%	-92.8%
Walking & Biking	3.0%	1.8%	-38.5%
Work from Home	5.3%	8.7%	64.1%
Other	0.8%	0.6%	-32.2%

Source: *US Census American Community Survey*
**Likely impacted by COVID-19*

LAND USE PATTERNS

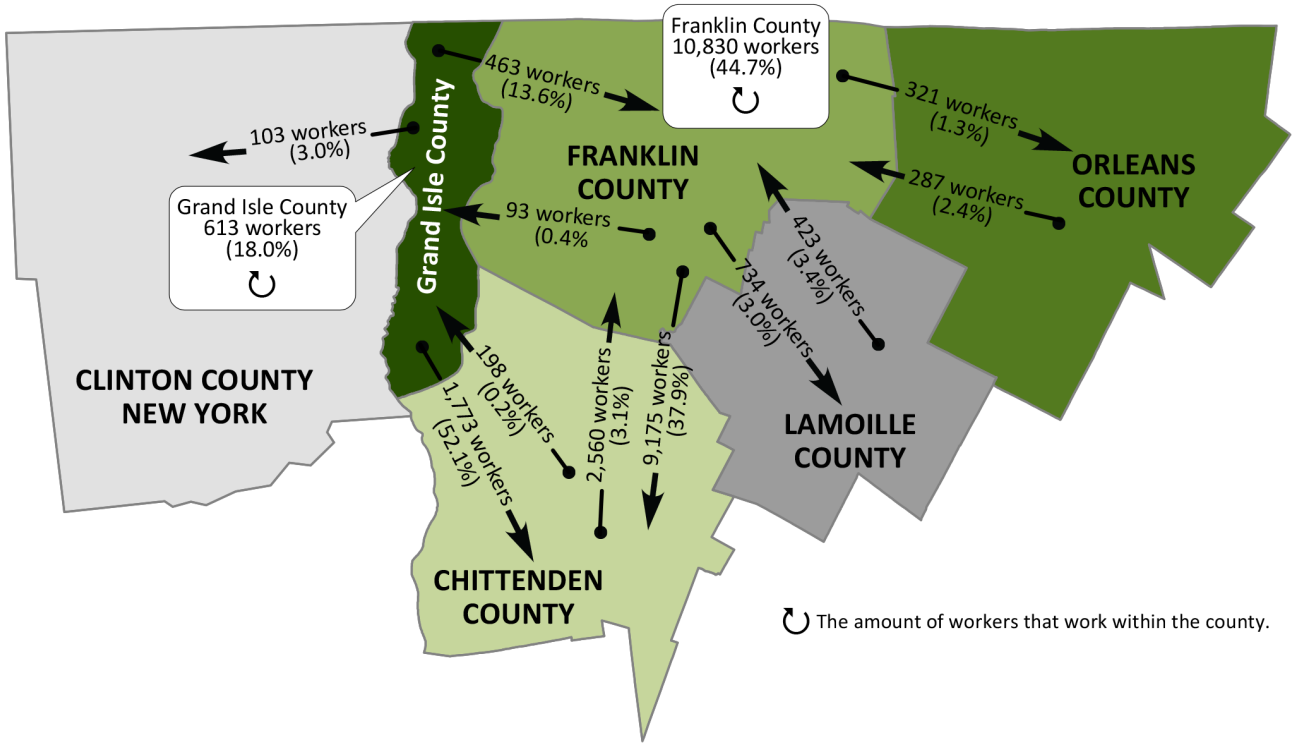
The transportation choices made by regional residents are influenced significantly by

regional land use patterns. Land use in the region has historically been characterized as compact development (downtowns and villages) surrounded by working landscape (agriculture and forestry). This model of development is still supported by the Northwest Regional Plan because it promotes concentrated economic development, walkability, and viability of public transportation, and it limits threats to the region's working landscape. It also decreases transportation costs.

With the development of the Interstate Highway System, land use patterns in the region began to change. Access to less expensive rural land and cheap fuel as well as the region's proximity to Chittenden County, the economic center of Vermont, have altered the way the region has developed over the past 60 years. The result is the loss of working landscape in the region (notably agricultural lands), increased commute times, and increased vehicle miles travelled (VMT). The highway system has also contributed negatively to environmental quality and greenhouse gas emissions and has led to changed commuting patterns (Figure 4.7).

FIGURE 4.7 REGIONAL COMMUTING PATTERNS

- Roughly 38% of workers who reside in Franklin County commute to Chittenden County for work. About 45% of workers commute within Franklin County.
- Approximately 82% of Grand Isle County workers commute to jobs outside the county, including a total of 52% of all workers who commute to Chittenden County.



Source: *US Census – Longitudinal Employer-Household Dynamics (2022) - https://lehd.ces.census.gov/*

FUEL USE

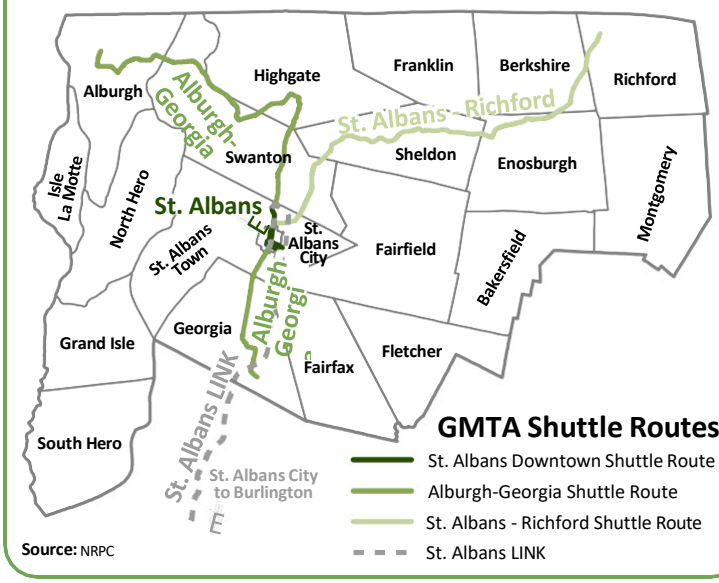
Current land use and commuting patterns have led to heightened transportation costs for individuals and a comprehensive reliance on increasingly expensive fossil fuels. Transportation fuel use and costs for individuals in the region can be estimated using data from the ACS and VTrans. Using the average fuel cost in 2023, individuals in the region spend approximately $95 million per year in transportation fuel costs. This figure is even higher when vehicles owned by regional businesses are considered. In addition, much of this money leaves the local economy.

PUBLIC TRANSIT

As previously noted, few regional residents use public transportation during their commute to work. However, public transit will be a key component to reducing transportation costs and meeting state and regional energy goals.

Green Mountain Transit (GMT) provides public transportation to the Northwest region and operates four routes in the region: the Alburgh–Georgia Shuttle, the St. Albans–Richford Shuttle, the St. Albans Downtown Shuttle, and the St. Albans LINK which provides access to Burlington (Figure 4.8). The former two routes terminate in two of the region's industrial parks. However, most of Grand Isle County and eastern Franklin County are without public transportation services. GMT also provides special transportation services to residents with disabilities and those over 65 years old. In addition, GMT serves as the fiscal agent for its partner agency, Champlain Islanders Developing Essential Resources (C.I.D.E.R.), which provides transportation to residents with disabilities and those over 65 years old in Grand Isle County. All buses in the region currently run on gasoline.

FIGURE 4.8 GMT SHUTTLE ROUTES



Source: NRPC

Amtrak serves St. Albans City via the Vermonter Line. According to Amtrak, in 2022, there was 3,621 riders from the St. Albans stop. Rail trips from the St. Albans station decreased somewhat compared to 2016. There is no commuter rail service within the region.

The financial costs and environmental impact of moving goods in and through the region are substantial. Currently, trucks move approximately 84% of goods by weight statewide, according to the 2021 Vermont Freight Plan. St. Albans is home to a private railyard owned by New England Central Railroad. Information about freight capacity and current traffic through the railyard is private and unavailable. Information about freight capacity and current traffic through the railyard is private and unavailable. While rail is an efficient and less carbon intensive way to transport goods, any plans to expand railroads must consider the economic, social, and environmental value of the rail trails that currently inhabit many rail beds.

C. ELECTRICITY

ELECTRICITY USE

According to Efficiency Vermont, 504,569,387 kwH of electricity were used in the region in 2021, representing roughly 10% of the state's energy use. Residential energy use has increased roughly 10% since 2013, while commercial and industrial use has stayed relatively consistent.

FIGURE 4.9 ELECTRICAL ENERGY USE (in Billions BTUs)

	2013	2021	% Change
Residential	664.0681448	730.384048	10.0%
Commercial & Industrial	983.145859	991.27734	0.8%

***Source:** Efficiency Vermont*

As discussed in the next section, electricity use must continue to grow through 2050 in order to meet the CAP Mitigation Scenario. It is difficult to interpret how much of current increases in electricity use are the result of electrification efforts.

REGIONAL ELECTRICITY GENERATION

As of 2023, the Northwest region had the capacity to generate 91 MW of electricity through hydro, wind, solar, and biomass technologies, and it had 131 MW of total generation capacity from all sources, according to data available from the Community Energy Dashboard & the Vermont Distributed Generation Survey. The 91 MW of renewable generation in the region is a "raw" number that does not take "capacity factors, renewable energy credits sold, or ownership of the systems" into consideration.

Hydro

The region has four dams with a total generation capacity of approximately 43.5 MW of electricity. Three of the dams are located on the lower portions of the Missisquoi River. A privately owned dam in Sheldon Springs has a generation capacity of approximately 26 MW of electricity; it is the largest dam both on the Missisquoi and in the region. The two other dams on the Missisquoi are located in Highgate and Enosburgh, and they are owned by public electric utilities in Swanton Village and Enosburg Falls, respectively. The fourth dam in the region is located on the Lamoille River in Fairfax and is owned by Green Mountain Power.

Wind

Georgia Mountain Community Wind is the only existing, large-scale wind project in the region. Two of the project's four turbines are located in Franklin County (Georgia), and the other two turbines are located in neighboring Chittenden County. The project generates approximately 10 MW in total (5 MW is estimated to be generated within the region). There are 18 small wind projects in the region.

Solar

There is an estimated 39.1 MW of solar generation in the region. The amount of solar generation has almost quadrupled in the last six years. Of this generation, roughly 27 MW comes from medium and large projects of 500 kW or more, while 12 MW is from smaller projects.

FIGURE 4.10 RENEWABLE GENERATION

	MW Capacity
Solar	39.1
Wind	5.2
Hydro	43.5
Biofuels	3.1
Solar & Wind Combined	0.1
Total	**91.0**

Source: Department of Public Service

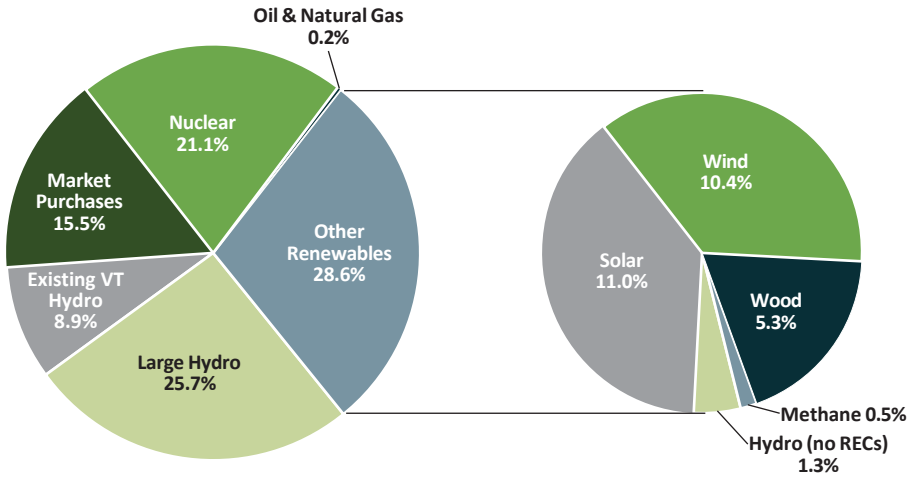
Biodigesters

3.1 MW of electricity is generation from anaerobic digesters, with 8 current biodigesters. Biodigester may also be used to produce renewable natural gas (RNG) for thermal use, although there are not currently any biodigesters in the region that produce RNG.

Non-Renewable Energy

There is one non-renewable energy generator in the region: Project 10. This facility, which is located in Swanton, is owned by the Vermont Public Power Supply Authority (VPPSA) and runs on fuel oil and/or biodiesel. The facility is a "peaking" plant that operates only during peak electric loads, which, according to the project's Certificate of Public Good, equals approximately 600 hours per year. The facility can be converted to use natural gas as a fuel and is located near a natural gas line.

FIGURE 4.11 GMP ENERGY PURCHASES BY FUEL - 2021

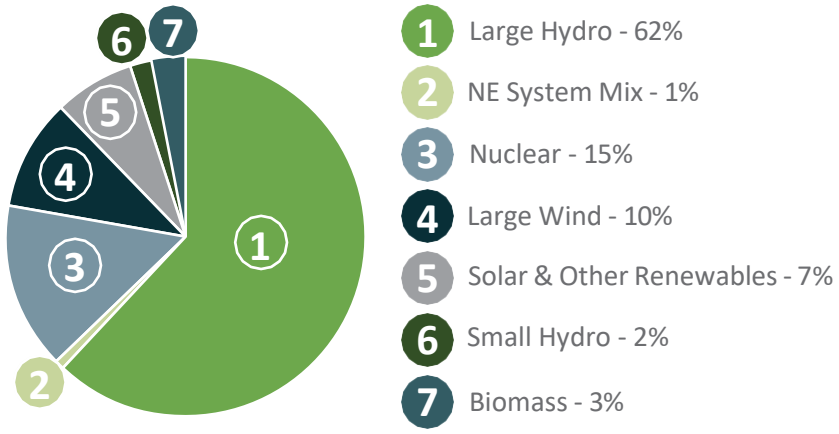


Source: Green Mountain Power

PUBLIC UTILITY ENERGY SOURCES AND IMPORTED ELECTRICITY

Four public utility companies in the Northwest region supply electricity (see Appendix C). Two of these utilities are operated by municipalities: Swanton Village and Enosburg Falls. Both of these utilities are part of Vermont Public Power Supply Authority (VPPSA), an organization that represents 12 municipal electric utilities in Vermont. The other electric utilities servicing the region are Green Mountain Power and Vermont Electric Cooperative (VEC).

FIGURE 4.12 VEC ENERGY PURCHASES BY FUEL - 2021



Source: Vermont Electric Cooperative

Green Mountain Power

Green Mountain Power generally services the southern and western parts of Franklin County. Figure 4.11 shows sources of electricity distributed by GMP in 2021 (before the sale of renewable energy credits (RECs)). The electricity comes from primarily outside the region with the exception of distributed solar generation and the GMP-owned dam at Fairfax Falls. GMP owns several generation facilities. It also enters into power purchasing agreements with individual power suppliers and purchases power on the open market ("System" power) (Figure 4.11).

FIGURE 4.13 VILLAGE OF ENOSBURG FALLS ELECTRICITY SOURCES

Type of Power	Generator
Hydro	Enosburgh Dam, NY Power Authority, Hydro Quebec, VEPPI
Farm Methane/ Solar/Small Wind	Chester Solar (Chester, MA), Standard Offer
Landfill Gas	Fitchburg Landfill (Fitchburg, MA)
Fuel Oil or Biodiesel	Project 10 (Swanton, VT)
Natural Gas or Oil	System Power (source of supply not identified)
Biomass	McNeil (Burlington, VT), Ryegate (Ryegate, VT), VEPPI

Vermont Electric Cooperative

VEC's territory includes all of Grand Isle County and most of the northern and eastern parts of Franklin County. VEC does not own any electric-generating facilities; it instead has power purchasing agreements with individual electric suppliers and purchases power on the open market. Figure 4.12 shows VEC's energy sources by type of resource (before sale of RECs). Generally, electricity distributed by VEC comes from primarily outside the region with the exception of distributed solar generation and electricity generated from methane on regional farms.

FIGURE 4.14 SWANTON VILLAGE ELECTRIC DEPT.

Type of Power	Generator
Hydro	Highgate Dam, NY Power Authority, VEPPI
Farm Methane/Solar/ Small Wind	Standard Offer
Landfill Gas	Fitchburg Landfill (Fitchburg, MA)
Fuel Oil or Biodiesel	Project 10 (Swanton, VT)
Natural Gas or Oil	System Power (source of supply not identified), Stonybrook (MA)
Biomass	McNeil (Burlington, VT), Ryegate (Ryegate, VT), VEPPI

Enosburg Falls Village and Swanton Village Electric Departments

Despite their small service territories, both the Enosburg Falls Electric Department and Swanton Village Electric Department distribute electricity that is generated from a variety of facilities. Both utilities have dams located in the region (Enosburgh and Highgate, respectively). Both also rely, to some extent, on importing electricity from outside the region.

Enosburg Falls' dam supplied approximately 14% of the power distributed by the Enosburg Falls Electric Department in 2019. The remainder of electricity come from a mixture of hydro, wood, nuclear landfill gas and solar sources.

The Swanton Dam supplied 64% of the electricity distributed by Swanton Village Electric Department in 2019. The McNeil Generating Station in Burlington contributed an additional 17% of the electricity distributed.