10.0 ENERGY

10.1 Energy Planning in Village and State

Energy is a resource that must be considered in any comprehensive planning process. The Village of Manchester (Village) recognizes that as conventional fuel resources dwindle globally, the future resilience of its small community will require lowering dependence on imported, non-renewable fuels, tapping local energy sources for enhanced self-reliance, and improving efficiency.

Village of Manchester Energy Goals and Policies:

1. Use land use planning to reduce reliance on fossil fuels and imported energy sources.
2. Reduce overall energy consumption through conservation and efficiency.
3. Develop renewable energy resources locally.

The State of Vermont established markers through its Comprehensive Energy Plan (CEP updated 2016) to help guide communities to a sustainable future. A central goal of the plan is to attain 90% renewable energy by 2050. To achieve this goal, however, development of new renewable energy sources is insufficient on its own. Since renewable sources yield less energy per unit than their fossil fuel-based counterparts, a drastic reduction in overall energy consumption is critical to meeting this target.

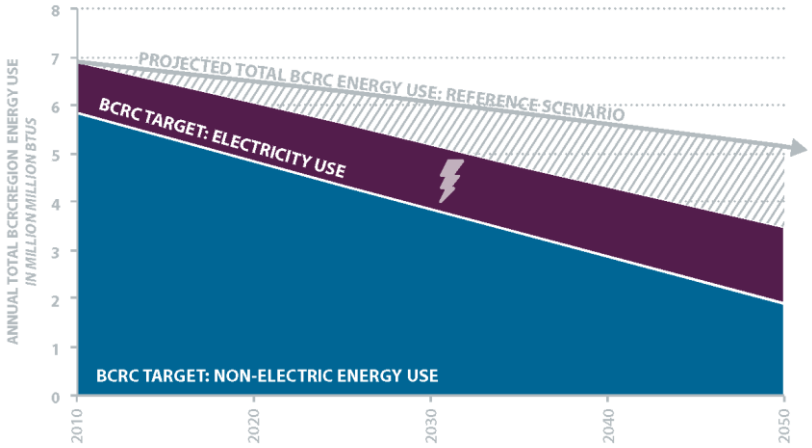


Figure 1: BCRC Region Energy Reduction Projections, 2010-2050

According to LEAP estimates (see below for more details), to achieve the 90X50 energy goal, the BCRC region will need to dramatically reduce energy use by increasing efficiency and relying on electricity for many more purposes. The 'Reference Scenario' above represents a business-as-usual scenario.

In the Village of Manchester, total energy consumption would have to be cut by more than half by 2050 to meet this goal. Energy conservation efforts combined with improved energy efficiency through technology upgrades and building weatherization will enable Vermont municipalities to reduce energy consumption.

Vermont Energy Goals and Policies (VT Comprehensive Energy Plan [CEP], 2016):

1. Obtaining 90% of energy for all uses from renewable sources by 2050.
2. Reducing greenhouse gas emissions to 50% below 1990 levels by 2028 and 75% by 2050.
3. Relying on in-state renewable energy sources to supply 25% of energy use by 2025.
4. Improving the energy efficiency of 25% of homes by 2025.
5. Meeting the Vermont Renewable Energy Standard through renewable generation and energy transformation.

A key aspect of improved efficiency will be a greater reliance on electricity. Since electricity can be generated from renewable resources, and electric-powered technologies such as heat pumps and electric vehicles are highly efficient, switching to electricity will help lower overall energy consumption even as lifestyles remain much the same as today. By 2050, nearly half of all energy will be supplied through electricity according to projections in the VT CEP.

Though this major shift in energy use is considerable, there are opportunities to lower costs and bolster the local economy through a transformation of the Energy Sector, which now costs the Bennington Region over $150 Million a year in imported fuels electricity costs (2014 estimates). Nearly all this money currently flows out the region and the state, so redirection of these funds to local energy businesses and jobs will better retain wealth in local communities.

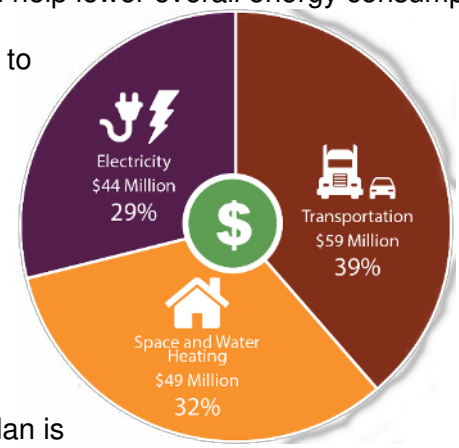


Figure 2: BCRC Region Energy Cost Estimates, 2014
Based on data from Census Bureau, VT Dept. of Motor Vehicles, and US Energy Information Administration.

The Energy Chapter of the Village of Manchester municipal plan is intended to provide the residents and local leadership of the Village with information and strategies needed to plan for an energy future that maintains a vibrant community, as the energy sector evolves to lower energy costs, to promote local renewable energy development, and to better protect the environment.

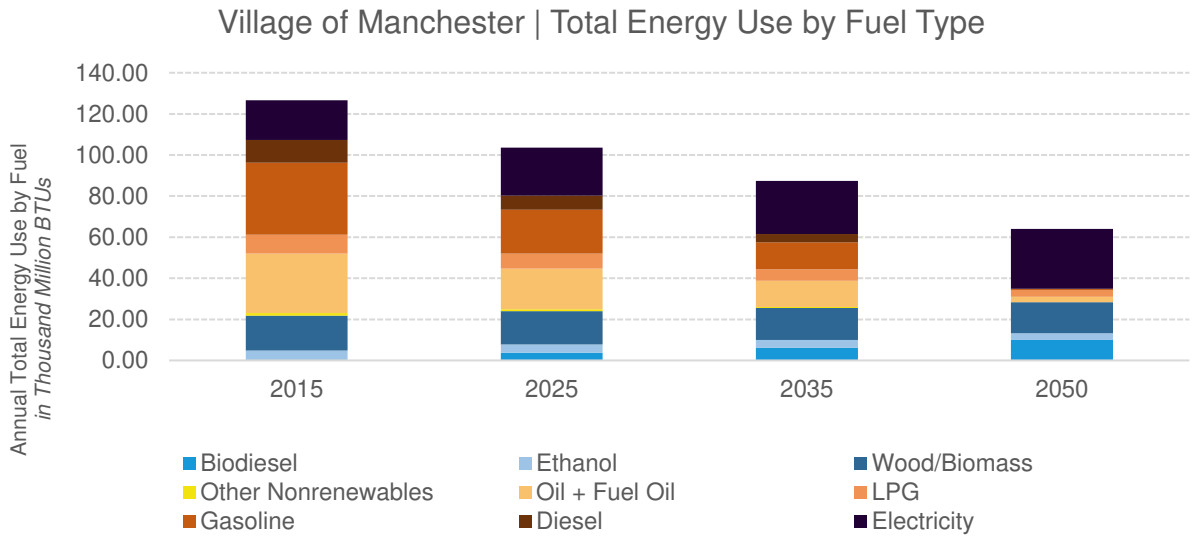
10.2 Current and Future Energy Use

As a village located in a rural context with 648 residents housed mostly in single family homes, the Village of Manchester consumes a considerable amount of energy every year to meet its transportation, space heating, and electricity needs. According to LEAP model projections (see BCRC Regional Energy Plan 2017, page 39, for more details), the Village of Manchester uses over 120,000 thousand million BTUs (British Thermal Units) per year.

The chart below illustrates one path the Village can pursue to achieve this target through gradual adaptation and fuel switching over the next several decades. With the year 2015 as a baseline, the Village has identified energy use targets by fuel/energy carrier for years 2025, 2035, and 2050:

Modify all notations of LPG to PROPANE

Figure 3: Village Total Energy Use by Fuel Type, 2015—2050. Based on LEAP projections.



According to LEAP projections, the Village of Manchester would phase out fossil fuels through electrification of the transportation and heating sectors, with biodiesel replacing some conventional diesel and oil fuels, and with widespread use of woody biomass for space heating. Over time, electricity will go

from meeting just 15% of total energy needs in 2015 to 46% of energy needs in 2050. More details on how specific technologies and strategies will achieve this energy reduction and fuel conversion are broken down by energy sector below.

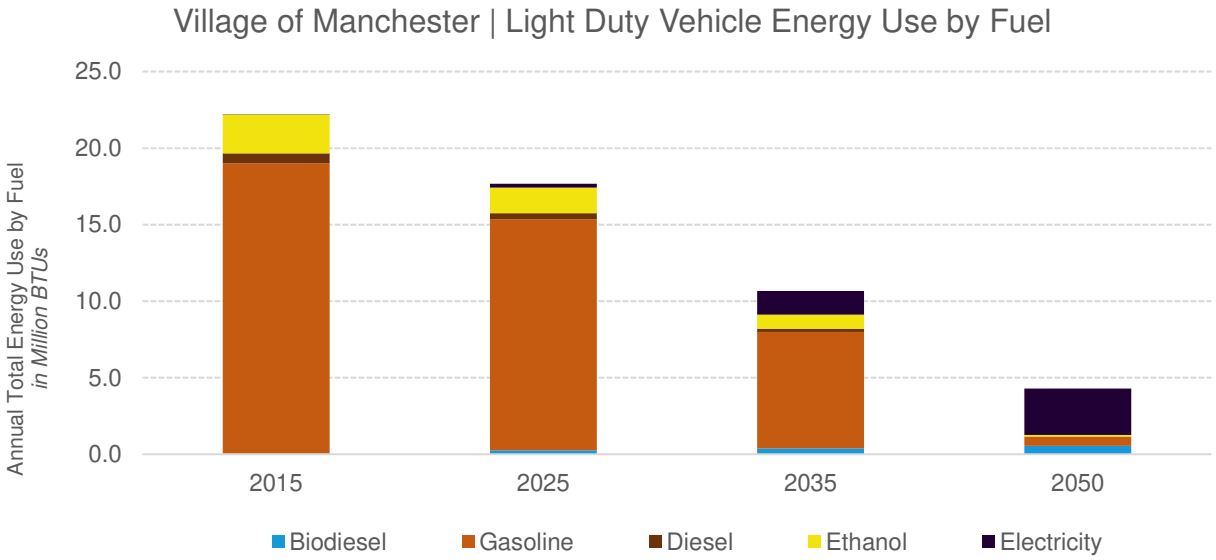
10.3 Residential Energy Use

Energy use can be grouped into 3 major sectors: transportation, thermal (heating and cooling), and electricity. The Village's more than 600 residents consume large amounts of energy for transportation, to heat space and water, and to power lights and appliances with electricity. By identifying technologies and practices capable of catalyzing the transformation of each energy sector, the Village of Manchester aims to provide its residents and municipal officials the tools necessary to realize the state's energy goals.

Transportation

In the Village, and across all Vermont, transportation consumes the most energy of any one sector. Due to the Village's largely rural location in southwestern Vermont, people and goods constantly travel long distances to move to and from the community. The light duty vehicle has made this independent mobility and the freedom and access that come with it possible, yet most vehicles rely on vast amounts of non-renewable fuel inputs to function. Given the dependence most households have developed on fossil fuel vehicles, transportation represents one of the greatest challenges to reducing overall energy use.

Figure 4: Village Light Duty Vehicle Energy Use by Fuel, 2015—2050. Based on LEAP projections.



Electric vehicle (EV) technologies have advanced significantly in recent years and these systems are projected to dominate the car industry in coming decades. By electrifying the light duty vehicle fleet, Village of Manchester residents have the opportunity to improve transportation efficiency and divert money currently spent on fossil fuels. Targets for gradually reducing energy consumption and converting to EV technologies are shown in the chart on the following page.

Over the next three decades, total energy for transportation would fall gradually to just 20%, or one fifth, of current levels by 2050. Electrification of 70% the light duty vehicle fleet would account for much of this reduction in energy use. The following EV vehicle count targets should guide adoption rates in the Village: by 2025, 26 EVs; by 2035, 179 EVs; and by 2050, 370 EVs (targets generated through LEAP analysis). A combination of biodiesel and gasoline fuels will power the remaining portion of light duty vehicles.

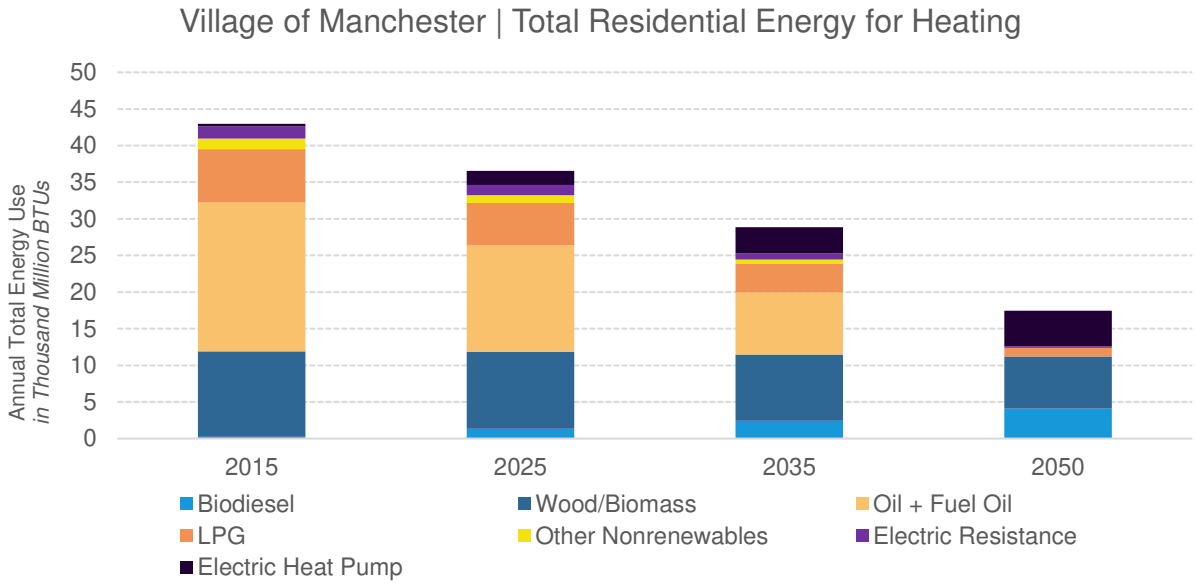
While EVs will play a major role in reducing energy use while allowing Village residents to continue to rely on some personal vehicle travel, efficiency gains from EVs alone will not account for all the energy reduction needed to meet future transportation energy targets. Conservation through behavior changes such as carpooling, transit use, and increased reliance on walking and biking will be critical to reaching 2050 energy targets. Policies that encourage dense land use development and implementation of

Complete Streets road design are necessary to shift the predominant transportation model from being vehicle-centric to multimodal and efficient-by-design.

Thermal

Close to half of Village of Manchester homes are heated throughout the 7-month heating season by oil. Though this fuel source has been inexpensive and widely accessible in the past, projected future shortages of fossil fuels suggest that the Village should mitigate reliance on this fuel source by switching to more efficient systems that can be powered by local resources. Woody biomass is one abundant local resource already used for space heating. Wood and pellet stoves currently heat 27% of Village residences, and this proportion is projected to increase to about 40% of Village homes by 2050. Though the number of homes heated by woody biomass will increase, the total energy consumed by these systems will lower from about 43 thousand million BTUs to 9 thousand million BTUs as aging stoves are replaced by newer, more efficient ones.

Figure 5: Total Residential Energy Use for Heating, 2015—2050. Based on LEAP projections.



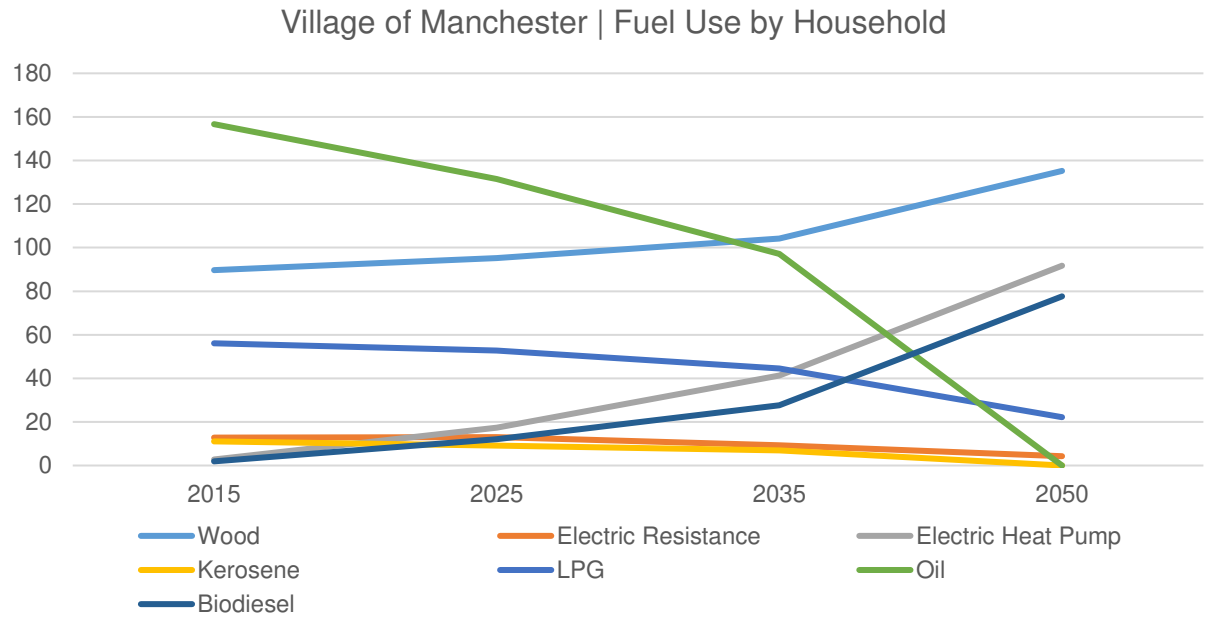
The Village of Manchester's energy use for residential heating would decline to just 40% of current use, or 17 thousand million BTUs, by 2050. Cold-climate electric heat pumps are another highly efficient technology that will play a major role in lowering overall energy consumption in the Village through electrification. By 2050, one in four homes would use an electric heat pump as its primary heating source. Cold-climate heat pump technology, based on the mechanism that cools refrigerators by extracting cold air from ambient space, has improved significantly in recent years. In addition to being more energy efficient than other heating technologies, heat pumps can cool one's home during the warmer months. To meet 2050 goals, electric heat pumps can be adopted in accordance with the following household target counts: by 2025, 17 households heated primarily by cold climate heat pump; by 2035, 41 households; and by 2050, 92 households (targets generated through LEAP analysis).

The overall shift in residential thermal energy use can also be shown by portion of households (see chart on following page). According to LEAP estimates, of the Village's more than 300 households, over 130 homes would rely for heating on woody biomass through high efficiency pellet and wood stoves, about 90 homes would use electric heat pumps, and almost 80 homes will use biodiesel-based systems. Some homes would continue to use liquid propane gas (LPG), but at a fraction of today's usage (about 22 homes in 2050).

Gradually switching thermal systems to more efficient electric options would do much to improve energy efficiency, but thermal conservation gains would rely on extensive weatherization of existing homes and incorporation of building codes for new construction. The following household weatherization count

targets can help guide efforts in the Village of Manchester: 23 households weatherized by 2025; 71 households by 2035; and 155 households by 2050 (targets generated through LEAP analysis).

Figure 6: Village Fuel Use for Heating by HH, 2015—2050. Based on LEAP projections.



By better sealing and insulating homes, total energy use will decrease drastically since it requires less energy to heat and cool a weatherized home. NeighborWorks of Western Vermont is a regional organization that offers technical assistance and financing options to make weatherization programs accessible.

Electricity

As mentioned previously, electricity use will expand greatly in the future since it is a reliable way to make renewable energy sources available for use. Electricity is a conductor of energy, not a source, but electricity is often mentioned as if it were an energy source since widespread adoption of appliances, vehicles, and thermal technologies powered by electricity are critical to achieving Vermont's energy goals.

As part of this process, total electricity use is expected to increase to 29.1 thousand million BTUs, more than doubling current usage, by 2050. This increase may seem contrary to energy use reduction goals, but since electricity is much more efficient than the fuels it will replace, total energy consumption will decline even as electricity use rises. More is said about local generation of electricity in a later section on *Local Renewable Energy Potential*.

10.4 Commercial and Industrial Energy Use

The Village of Manchester is home to several service-based and other business establishments that provide jobs and economic vitality to the Village community. About 38 establishments may be considered commercial (service producing) and 2 that may be considered industrial (goods producing) (data from Village of Manchester, October 2019). Industrial operations in the Village are limited to the Orvis Fly Rod Shop and small-scale cheese production at Hildene Farm. The industrial energy use levels shown below represent breakdowns of statewide trends, and it is likely that this sector is in fact less intensive in the Village than shown. Future updates to this section may attempt to estimate actual energy use levels of industrial operations.

Figure 7: Village Total Commercial Energy Use by Fuel, 2015—2050. Based on LEAP projections.

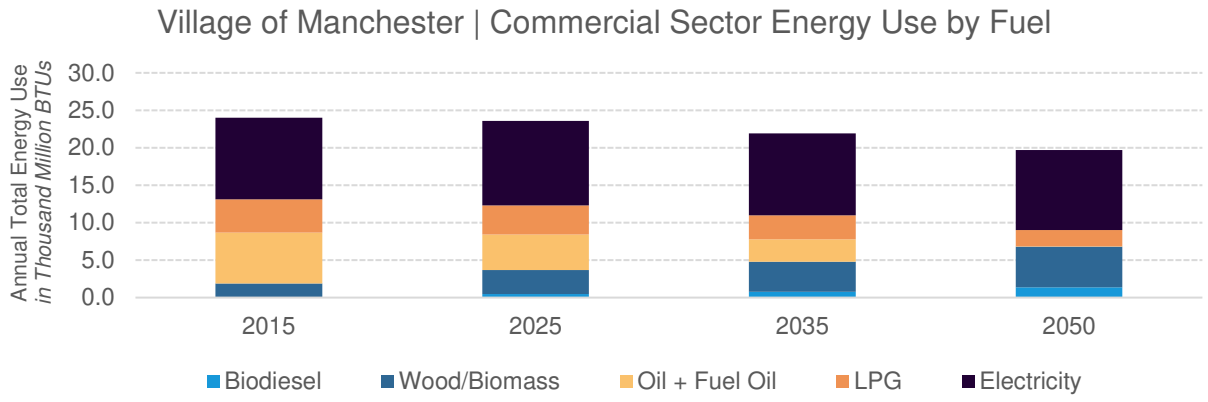
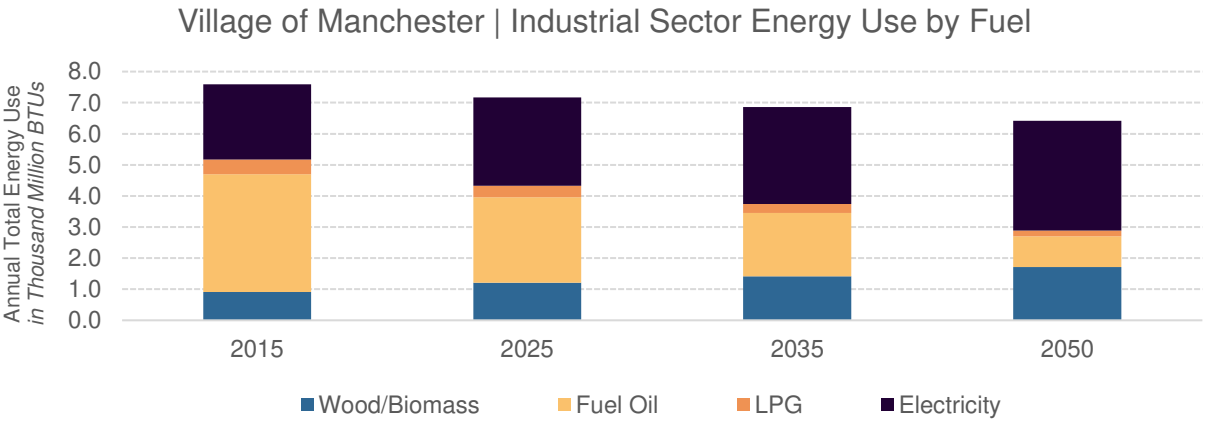


Figure 8: Village Total Industrial Energy Use by Fuel, 2015—2050. Based on LEAP projections.



It is clear at a comparative glance that overall energy use reduction at the Village of Manchester's businesses and industries is not projected to be as dramatic as for Village homes. This flexibility is intended to prevent energy reduction goals from threatening local establishments' viability over the next several decades. At the same time, policies and market forces still expect businesses to pursue energy reduction strategies appropriate to their ability.

Fuel oil use is projected to decrease to almost no use in the commercial sector and to 74% of current levels in the industrial sector by 2050. Businesses will need to plan for electrification, woody biomass combustion systems, and biodiesel use to replace this fuel over time. Most businesses can reduce energy consumption through straightforward conservation practices such as upgrading lightbulbs and appliances, powering down appliances and machinery when not in use (such as by using programmable timers), and adjusting thermal settings. Comprehensive energy audits are an excellent first step to identifying strategies that make the greatest impact on energy reduction and cost savings. Additionally, since many commercial and industrial operations involve sizeable building footprints, some sites may be well suited to accommodate rooftop solar arrays.

10.5 Municipal Energy Use

Local government and schools are significant consumers of energy, and the costs associated with energy use by those entities have a direct bearing on taxes. Energy conservation and use of alternative energy systems in this sector have the potential to produce significant savings for the community and to set a visible example of responsible energy use.

The Village Offices are located on the lower floor of the historic Bennington County Courthouse, which is owned by the Town of Manchester and officially ceased use as a courthouse in 2019. The Courthouse was originally built in 1822 and enlarged in 1849. It is a large brick structure with a slate gable roof. The Village Offices comprise about 1500 sq feet of the building. The offices are heated by oil and are not air

conditioned. The offices were constructed in 2010 with modern building components. Office lighting is provided by fluorescent lights. Here follows an estimate of annual energy use:

Energy Source	Quantity Used	Cost Factor	Total Cost
Village Offices			
Oil Heat *(May 2020 – February 2021)*	1,425.20 gallons	$2.50/gallon	$3,563
Electricity *(April 2020 – February 2021)*	3,380 kWh	$0.22 kWh	$743.60
Village Garage (2 trucks one backhoe, one track loader, one mower)			
Oil Heat *(2019 full year)*	1,313 gallons	$2.50/gallon	$3,282.50
Electricity ***(2019 full year for exterior floodlights and interior fluorescents)***	6,368 kWh	$0.22 kWh	$1,400.96
Diesel Fuel *(2019 full year)*	4,803.1 gallons	$2.70/gallon	$12.968.37
Village Street Lighting			
Union Street ***(2019 full year for Equinox island LED lights, black post streetlights – mercury vapor)***	14,053 kWh	$0.22 kWh	$3,091.66
Municipal Lighting ***(2019 full year for 61 LED lights)***	42,546 kW	$0.22 kWh	$9,360.21
Ornamental Lighting *(2019 full year LEDs)*	1,162 kWh	$0.22 kWh	$255.64

The Village Garage operates efficiently. Municipal trucks are not permitted to idle. The garage building has automatic door openers and closers to prevent heat loss to the outdoors. However, the single greatest municipal energy cost (over $11,000 per year) goes to the diesel fuel to power all the Village's heavy equipment and vehicles.

The best first step to lower municipal energy usage is to pursue a comprehensive energy audit to identify the most cost-effective strategies to reduce the Village's carbon footprint and transition to renewable energy sources. Exploring the use of biofuels in municipal vehicles and equipment is an additional option that some other cities and towns have trialed. There is currently one small local producer of biofuels in Bennington County. In addition, updating lighting for the following uses to LED fixtures would create savings for the Village: floodlights at garage, fluorescent interior lighting in garage, and the black streetlights currently mercury vapor.

Schools. There are three schools operating in the Village: Burr and Burton Academy (BBA) is an independent high school, and the Maple Street School and Manchester Village School are independent K-8 schools. BBA is a major institution and energy user in the Village, with its 90-acre campus and numerous academic and residential buildings serving a population of about 750 students and over 100 staff and faculty. BBA has taken many steps to lower its energy and resource consumption, noting the following accomplishments: "a Mountain Campus LEED certified building and Governor's award for environmental excellence; main campus electricity provided by hydro power; buses powered by biodiesel; hand dryers vs. paper towels; recycling and composting programs; locally sourced food; energy efficient lighting, and water bottle filling stations". A new academic building, the Rowland Project, exemplifies this commitment to sustainability. The building will be 'net zero ready' with no combustion equipment onsite. Heating and cooling for the building will provided by cold climate heat pumps with an electric resistance heating boiler system as back-up in case of extremely cold weather. Efficiency will be maximized by a building automation system and a thermal energy storage system that will lower overall energy use through heat recapture and reduce demand from the grid during peak energy use hours. All lighting will be LED.

Estimates of annual energy use were provided by two schools, 2019-2020:

Energy Source	Quantity Used	Cost Factor	Total Cost
Burr and Burton Academy			
Propane Heat	1,900 gallons	$1.45 / gal	$2,755
Oil Heat	66,000 gallons	$2.50 / gal	$165,000
Electricity	767,000 kWh	$0.22 / kWh	$168,740
Cord Wood Heat	3 cords	$200 / cord	$600
Gasoline Fuel (5 buses, 8 vans, 2 pickups, 3 SUVs, 2 food vehicles)	14,290 gallons	$2.60 / gal	$37,150
Maple Street School			
Propane Heat	79.9 gallons	$1.45 / gal	$182.17
Oil Heat	6,657 gallons	$2.50 / gal	$13,314
Electricity	83,377 kWh	$0.22 / kWh	$18,342.94
Electricity Generated	2,725 kWh	---	---
Gasoline/Diesel Fuel	*Owns no vehicles and uses approx. 20 gallons gasoline fuel per year for lawn mowing machine.*		

10.6 Commercial Energy Use

The Village's economy is shaped by its scenic setting and historic character. The area attracts many annual visitors that support various lodging and restaurant establishments, but the Village is also home to over 700 full-time residents who work primarily in the information, management, education, and arts, recreation, and food industries. A 2020 energy use survey administered by the Village Energy Committee requested information on current energy use levels at prominent businesses in the community. A sample of the findings is provided below, and a more comprehensive analysis of energy use by sector is developed and maintained by the energy committee. Over time, these records will serve to track progress on improving overall conservation, efficiency, and renewable energy development in the Village.

Major Hospitality, Manufacturing, and Non-Profit Organizations in the Village. The following values are estimates based on data provided by the companies and organization:

Energy Source	Quantity Used	Cost Factor	Total Cost
Equinox Resort *(estimated 2019 usage)*			
Propane Heat	121,583 gallons	$1.45 / gal	$176,295
Oil Heat	45,617 gallons	$2.50 / gal	$114,042
Electricity	3,029,797 kWh	$0.22 / kWh	$666,555.34
Gasoline Fuel (2020)	4,210 gallons	$2.60 / gal	$10,946
Diesel Fuel (2020)	2,067 gallons	$2.70 / gal	$5,580
Orvis *(numbers adapted from usage Oct 2017 – Sept 2019 for Flagship Rod Shop, School, and Outlet)*			
Propane Heat	23,228 gallons	$1.45 / gal	$33,680
Oil Heat	3,322 gallons	$2.50 / gal	$8,305
Electricity	960,586 kWh	$0.22 / kWh	$211,328.92
Gasoline Fuel (2019 one box truck)	1,400 gallons	$2.60 / gal	$3,640
Hildene *(estimated 2019 usage)*			
Propane Heat	10,648 gallons	$1.45 / gal	$45,765

Oil Heat	3,365 gallons	$2.50 / gal	$8,414
Electricity	254,252 kWh	$0.22 / kWh	$55,935.44
Cord Wood	45 cords	$200 / cord	$9,000
Pellet Wood	21 tons	$6/40 lb bag	$6,300
Electricity Generated (2020 total)	112,906 kWh	---	---
Gasoline/Diesel (2019)	2,915 gallons	$2.65 / gal	$7,724.75
Kimpton Taconic Hotel *(estimated 2019 usage)*			
Propane Heat	19,200 gallons	$1.45 / gal	$27,840
Electricity	875,000 kWh	$0.22 / kWh	$192,500
Cord Wood	5 cords	$200 / cord	$1,000

Two Senior Living Facilities. The following values are estimates based on data reported by facilities:

Energy Source	Quantity Used	Cost Factor	Total Cost
Equinox Terrace *(estimated 2019 usage)*			
Propane Heat	37,116 gallons	$1.45 / gal	$53,818
Electricity	400,426 kWh	$0.22 / kWh	$88,093.72
Gasoline Fuel (one car and one van)	~460 gallons	$2.60 / gal	$1,200
Equinox Village *(estimated 2019 usage)*			
Propane Heat	60,000 gallons	$1.45 / gal	$87,000
Electricity	550,000kWh	$0.20 /kWh	$110,000
Gasoline/Diesel Fuel	*Owns 1 bus and 1 SUV. Level use unknown.*		

Just as with schools and municipal facilities, completing a comprehensive energy audit is the best first action these businesses can take to identify energy saving opportunities, technology upgrades, and renewable energy sources that will lower their carbon footprint while also serving the company bottom line. NeighborWorks of Western Vermont (NWWVT) is a non-profit organization that provides low-cost comprehensive energy audits, low interest energy loans, and facilitates access to financial incentives from Efficiency Vermont. NWWVT's Heat Squad provides these services and estimates that clients save as much as 32% on annual heating costs after improvements. The Bennington Region Opportunity Council (BROC) and the Vermont State Employees Credit Union (VSECU) also provide access to low-cost energy audits and low-interest financing programs.

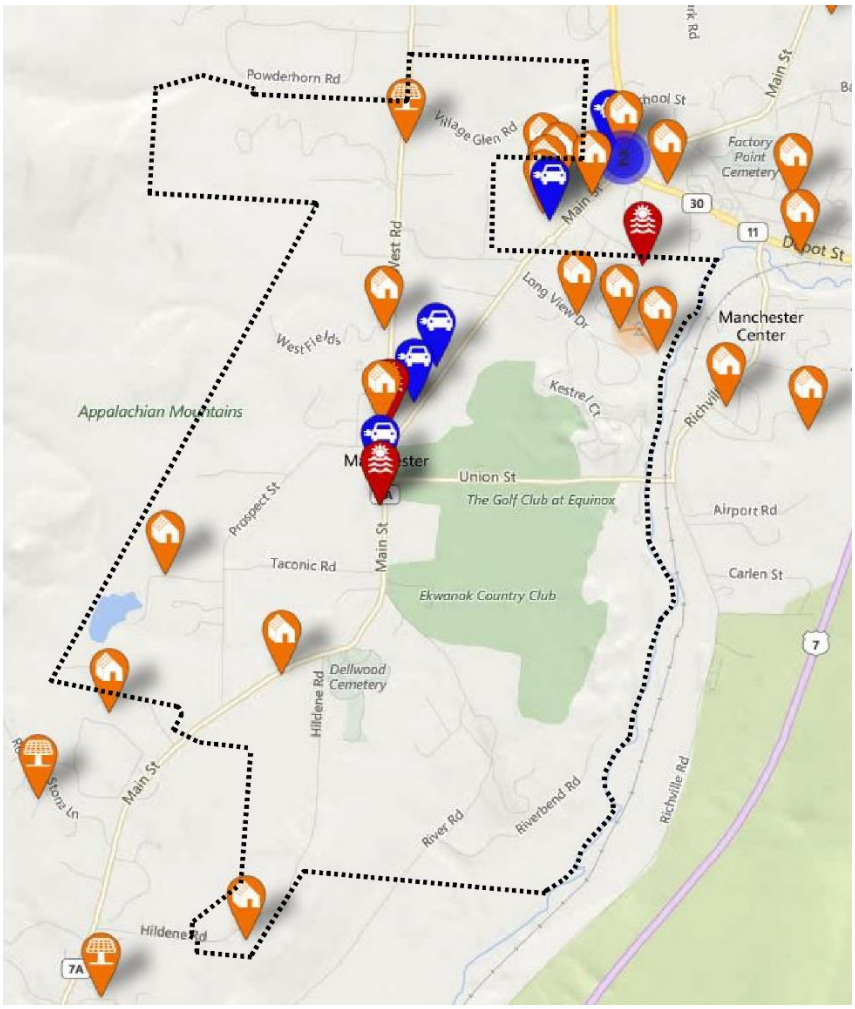
10.7 Local Renewable Energy Generation, Renewables Potential, and Policies

Nearly all energy consumed in the Village of Manchester is currently imported in the form of gasoline, oil, propane, and electricity. Some imported electricity is powered from renewable sources, primarily the electricity purchased from hydroelectric generating facilities in Quebec and Labrador, Canada. One site, Hildene, reports significant levels of wood heating, and BBA and the Taconic Hotel report modest levels of cord wood heating. Today limited energy production occurs in the Village in the form of numerous rooftop solar arrays (approximate total installed capacity of 145 kW) and several residential solar hot water heaters. At least one local business and one independent school have placed solar panels on the rooves of their buildings: Hildene (23.51 kW installed capacity) and the Maple Street School (68.7 kW installed capacity).

There are more areas in the municipality where specific scales of solar development are appropriate. The Village encourages clean, non-polluting energy sources that lower greenhouse gas emissions and improve efficiency. However, the appearance and location of renewable energy facilities and structures is a significant area of concern in this scenic and seasonal-tourism-supported community.

The renewable resource map analyses, which comply with Act 174 standards for renewable resource mapping (for more details, see Bennington County Regional Energy Plan, pages 80-83), in this section are intended to provide information about renewable resource availability in the Village. Maps were generated using GIS (geographic information systems) data layers developed by VCGI (the VT Center for Geographic Information). Renewable resource layers were mapped, and then 'Known Constraints' (vernal pools; river corridors; floodways; state significant natural communities and rare, threatened, and endangered species; national wilderness areas, and class 1 and 2 wetlands) were removed entirely from available resource areas. Then 'Possible Constraints' (VT agriculturally important soils; special flood hazard areas; protected lands; deer wintering areas; conservation design highest priority forest blocks; and hydric soils) were overlapped with renewable resources to highlight resource areas with potential complications for developing generation facilities. Remaining resource areas that do not overlap with any environmental constraints are considered 'Prime' resource areas, and resource areas that overlap with Possible Constraints are considered 'Secondary' resource areas.

Below is a map of known, existing renewable energy facilities in the Village as of October 2020:



Estimated Existing Renewable Energy Facilities in the Village of Manchester, Oct. 2020

3 Level 1 & 2 EV Charging Stations

2 Solar Hot Water Systems
Installed Capacity: 0.1 MMBTU

8 Roof-Mounted Solar Photovoltaic (PV) Systems
Installed Capacity: 115 kW

1 Ground-Mounted Solar PV Systems
Installed Capacity: 29kW

Source: VT Community Dashboard

Siting of Renewable Energy Generation Facilities and Section 248 Proceedings

The Village of Manchester principally implements its Plan of Development through the Zoning Bylaws. Not all development in the Village can be regulated by the Zoning Bylaws. The State of Vermont, through the Public Utility Commission (PUC), has exclusive jurisdiction over development in the areas of solar and wind electric power generation. In 2016, Act 174 authorized municipalities to identify through the municipal plan local resource areas where renewable energy development should be restricted in ways comparable development is already restricted to protect valued resources.

This section of the Plan is intended to assist the PUC in making its decisions about the siting of renewable energy facilities within the Village by clearly stating standards for the PUC to implement in reviewing projects. The Village may also choose to petition for status as a party in proceedings under 30 V.S.A. § 248 to provide testimony on these standards and other local concerns.

Local Constraints – Act 174

The Village is a year-round resort and vacation destination that depends the beauty of the area in which it is located, and the historic qualities of the Village itself. The preservation of the historic village setting, and its natural surroundings is critical to both the Village's economic vitality as a vacation destination for regional population centers.

Local Constraints: Policy in this energy plan is consistent with the Manchester Village Plan of Development and Zoning Bylaws which aim to preserve "historic structures and scenic streetscapes." The Village of Manchester is a designated Design Control District with three specific sub-districts. The Historic Core Sub-District located in the historic center of the Village is the most restrictive district. The Preservation Sub-District which extends along major Village roads is the next least restrictive. The General Review Sub-District encompasses the remainder of the Village and has the least restrictive design criteria. (see location in Figure 11, Solar Map Preferred Sites). The Historic Core and Preservation sub-districts state that "design should be compatible with the area and should be appropriate for a traditional late 19th and early 20th century village", which further goals for historic and scenic resource preservation.
Within the Historic Core and Preservation Sub-Districts, structures which support solar panels would be classified as non-conforming structures due to the materials and aesthetics of their construction and thus would be prohibited within these two sub-districts.
However, if structures which support solar panels are at undisturbed grade with a height of not more than 2 feet, they would be classified as landscape structures and thus would be allowed in these two sub-districts as long as they conform to the Solar Screening Ordinance.

Accordingly, the Village is placing restrictions on the development of solar and wind facilities within the entire village (Design Control District) as detailed in the sections to follow and in the Solar Screening Ordinance. Also identified as a unique resource to be preserved in the Plan of Development and the Village Scenic Resource Inventory are the open space, public recreational lands of the Equinox Preservation Trust. Accordingly, solar and wind energy facilities are restricted in these areas as detailed in the sections to follow.

Solar Scale Examples

4.7 kW residential tracker

150 kW farm installation

1 MW screened by forest

Images are indicative of 2020-and-previous technology.

Solar

There is abundant solar resource throughout low-lying areas of the Village, and much of this resource is unrestricted by state-identified environmental constraints. See 'Prime' and 'Secondary' resource areas and preferred solar sites in the Village Solar Resources and Preferred Sites Map. All solar energy facilities must comply with the Village's siting and screening requirements outlined below and in the Solar Screening Ordinance.

Preferred areas for solar facilities include the following areas:

- Parcels of land in the General Review Sub-District as noted in the Preferred Solar Sites map, Figure 11. These parcels are of sufficient size to accommodate setback and screening requirements in the Solar Screening Ordinance.
- Roof-mounted systems which conform to the Solar Screening Ordinance.
- Parking lot canopies
- Community solar projects;
- Systems located in close proximity to existing large scale, commercial or industrial buildings;
- Proximity to existing hedgerows or other topographical features that naturally screen the entire proposed array,
- Facilities that are sited in disturbed areas, such as gravel pits, closed landfills, former quarries, or water treatment facilities,
- Additional preferred sites may be identified with the support of the Village Board of Trustees and Planning Commission.

The Village encourages solar development at specific scales in residential and commercial areas throughout the Village and sets forth the following definitions and policies to guide solar energy development. Small- and mid-scale solar arrays typically range from 1 to 15 kW for residences and up to and including 150 kW for small commercial properties or community solar projects. The Village **strongly supports the development of small- and mid-scale solar** facilities on rooftops and on ground-mounted facilities at homes, businesses, and public lands in accordance with the Solar Screening Ordinance. **In particular, the Village values potential community solar projects**, which offer access to renewable energy for people whose land parcels may otherwise lack access to the benefits of solar energy generation. Utility-scale solar arrays, which primarily produce energy for sale to the electric grid, are larger than 150 kW and range up to several MWs' worth of capacity. **Utility-scale solar facilities are only permitted in designated preferred sites in the General Review Sub District and are subject to all requirements in the Solar Screening Ordinance.**

The Bennington County Regional Energy Plan has calculated future solar generation targets for its member municipalities to help guide local renewable energy development. Since the Village of Manchester is home to about 15% of the Town of Manchester's population and occupied households, the Village has a 2050 solar generation target of 1.5 MW of new solar capacity to meet local electric energy demand. It is estimated that at most 25% of this target may be met through rooftop solar. The resource areas identified in the Village Solar Resource Map are more than sufficient to meet this target. Resource areas in preferred sites total about **700 acres**, contained on 26 separate properties.

Solar energy policies must consider the constantly evolving nature of energy technologies. As capacity and diversity of solar energy systems increase over time, the policies presented here shall be reviewed to reflect relevant updates in the technology.

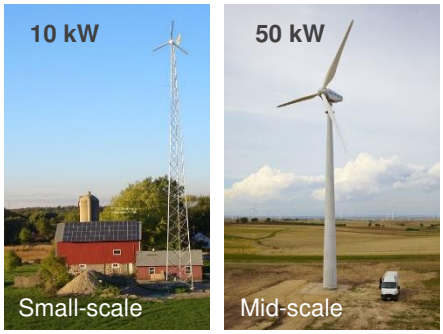
Wind

The Village currently has no wind generation facilities connected to the grid, which is likely due to the fact that the Village, at its low altitude, has very low recorded wind speeds (see Figure 12, Village Wind Resource Map). Given the absence of identified wind resources in the municipality, it is not likely that wind energy facilities of any scale will be able to supply significant energy to the Village.

For the purposes of this plan, the Village finds at this time that no scales of wind facilities are appropriate within the Village footprint due to likely unmitigable negative impacts they would have on scenic resources noted in the Scenic Resource Inventory, and also due to the low efficiencies these systems are likely to provide in an area with insignificant wind speeds. This position is consistent with the Village's development goal to limit new development to preserve the Village's late 19th and early 20th century appearance of the community, particularly as viewed from the Main Street.

However, the Village is open to reassessing current policies if the technology develops to mitigate wind power's aesthetic impact on valued scenic resources in the Village.

Wind Scale Examples



500 kW turbines in Searsburg, VT. New turbines of comparable size in Deerfield, VT have capacities of **3.75 MW** each

Images are indicative of 2020-and-previous technology.

Solar Siting Requirements, and Prohibited Areas

Siting & Screening Requirements: Solar facilities shall be screened to mitigate their visual impacts and shall comply with the municipal solar screening ordinance. Facilities shall not be sited in locations where screening and design are insufficient to mitigate adverse impacts to scenic views, roads, or other valued sites identified in the Scenic Resources Inventory, including the following areas: views across open fields, which form an important foreground; prominent ridgelines or hillsides that can be seen from many public vantage points and thus form a natural backdrop for many landscapes; historic buildings and districts and gateways to historic districts; and scenes that include important contrasting elements such as water. The impact on prime and statewide agricultural soils currently in production shall be minimized during project design.

Solar facilities must be carefully sited and screened in accordance with the Solar Screening Ordinance so that they do not diminish or detract from the historic character of the village.

Design Control Districts: Within the Historic Core and Preservation design control districts, utility-scale solar systems are expressly prohibited. Any small- and mid-scale solar systems must comply with the Solar Screening Ordinance. The Solar Screening Ordinance outlines specific requirements and recommendations for harmonizing solar installations with the scenic and historic appearance of development in the village center.

Equinox Preservation Trust Lands: Solar and wind facilities are not permitted on Equinox Preservation Trust lands, excepting installations of small- and mid-scale facilities that further the open space and recreational purposes of the land.

Unsuitable (Prohibited) Areas: In addition to those areas that do not meet the siting requirements set forth above, solar and wind facilities shall be excluded from (prohibited within), and shall not be supported by the Village, in the following locations:

- Act 174 Known Environmental Constraints
- A location that would significantly diminish the economic viability or potential economic viability of the municipality's working landscape, including productive forest land and primary agricultural soils (as defined in Act 250 and as mapped by the U.S. Natural Resource Conservation Service);
- A location that would fragment or significantly compromise the ecological functions of highest priority forest blocks and habitat corridors as mapped by VT ANR and resilient landscapes as mapped by The Nature Conservancy;
- Steep slopes (>25%);
- Surface waters and riparian buffer areas (except for stream crossings);
- Ridgelines or other landscape features where the facility would be prominently visible against the skyline from public vantage points such as roads;
- A site that causes adverse impacts to historical or cultural resources.

Geothermal

The soils in low-lying, developed areas of the Village have high resource potential for geothermal well heating systems. This technology is highly encouraged in new residential and commercial construction.

Woody Biomass

The Village of Manchester is surrounded by areas with abundant woody biomass resource that may be used for local heat generation – the most efficient use of biomass for energy. High-efficiency cord wood, wood pellet and wood chip heat systems are a good choice for homes and larger buildings such as apartment buildings, schools, and other institutions. Local installations of such large-scale systems include Hildene, which consumes over 20 tons of wood pellets and about 45 cords of wood each year for heating. BBA and the Taconic also use cord wood in a more limited capacity for heating.

When it comes to using biomass for electricity generation, the Village's size is too small to accommodate the type of combined heat and power biomass projects that are considered efficient and suitable for the region. Therefore, **biomass electricity facilities are not appropriate in the Village**. Other plant-derived renewable fuels such as biodiesel can be produced from oil seed crops to support farm operations and to supply businesses in the area.

Hydro

Small-scale systems may be appropriate. Two historic dam sites exist, at Equinox Pond and Way's Lane, and may be evaluated to see if cost-effective and environmentally responsible rehabilitation for energy production as "micro-generators" is viable. New hydroelectric facility development is not currently allowed under State environmental regulations and local hydro is not likely to play a role in the Village's future energy profile.

Large-Scale Energy Storage

Large-scale storage of electric energy in the form of electrochemical batteries has the potential to improve the stability of the electric grid during natural disasters, during peak demand periods, and by allowing more renewable energy sources to serve the system. Storage technologies are rapidly developing and becoming more affordable to deploy, and as technology develops, the role of decentralized storage facilities will become clearer. For now, the **Village supports the development of large-scale electric energy storage facilities in the municipality** as long as they are demonstrably safe for workers and the surrounding environment and comply with setback, screening, and performance standards in the Zoning Bylaw that apply to all commercial development.

10.8 Energy Conservation, Efficiency and Renewable Energy Strategies

To achieve the energy goals advanced by the state of Vermont, the Village's residents and municipal officials must commit to concrete actions that reflect the transformations required for this undertaking. Achievement of 90% renewable energy by 2050 will depend on improving efficiency, conserving energy, and developing local renewable energy facilities at a steady, resolute pace over the next three decades.

The Village has identified the following policies and actions as the most effective pathways to realize the community's energy planning objectives. Many of the policies indicated here are discussed in more detail in relevant sections of the Municipal Plan, particularly in the areas of transportation and land use. The Village has referenced both the Bennington County Regional Energy Plan (2017) and Act 174 guidance and standards documents published by the Vermont Department of Public Service to prepare these policies.

Municipal Leadership and Land Use Planning

1. Municipal Energy Committee: The Planning Commission has formed an energy subcommittee which will continue to implement this plan and track progress on the policies and actions stated herein. This committee shall promote local residential and commercial efficiency and conservation improvements through coordination of information and technical assistance and advocate for appropriate renewable energy generation throughout the Village.
2. Land Use Policies: Land use policies must promote compact, historical development patterns. Future development shall be concentrated in the dense village center to establish a walkable, multi-use hub of community activity. Continued participation in the village center designation program shall be promoted as a catalyst for this development.
3. Municipal Infrastructure. All municipal infrastructure should be evaluated to identify opportunities for efficiency improvements and renewable energy generation and use. At the Village offices, the viability of installing renewable energy systems shall be assessed. Professional energy audits shall be pursued at the Village garage and encouraged at local schools to identify cost-effective energy saving strategies. The Village's capital budget program should consider weatherization improvements and upgrading existing thermal and transportation systems to high efficiency electric technologies, including the support of EV charging station installations in the Village.
4. New Development: New development in the Village shall adhere to the state mandated Residential Building Energy Standards, be planned to take advantage of a site's solar resource potential, and be made to accommodate multiple transportation modes through the Site Plan and Subdivision Review processes.

Conservation and Efficient Use of Energy

5. Residential: The Planning Commission energy subcommittee should work with BCRC to coordinate presentations and local conversations that promote residential energy efficiency and conservation through the following programs: the "Energy Star" building performance rating system; educational programming and appliance upgrade rebates available through Efficiency Vermont; and weatherization assistance provided by the Bennington Rutland Opportunity Council (BROC) and NeighborWorks of Western Vermont (NWWVT). Providing information on programs that assist low-income residents and owners of rental units in pursuing weatherization and thermal systems upgrades should be prioritized.
6. Commercial and Industrial: Energy efficiency and conservation may be promoted at these sites in the following ways: by requiring all new commercial and industrial buildings

meet the state mandated Commercial Building Energy Standards; by encouraging existing business to explore efficiency and conservation strategies outlined by Efficiency Vermont, which include promoting carpooling and alternative commuting modes among employees, completing energy audits, installing EV charging infrastructure, and upgrading thermal and transportation systems to higher efficiency and electric technologies when possible.

Transportation

7. Electric Vehicle (EV) technology: The Village of Manchester shall support installation of EV charging stations at key locations within the Village. Informational presentations for village residents and business owners on the advantages of EV technologies as well as state and federal rebate opportunities may be coordinated with the assistance of Efficiency Vermont.
8. Public transit: New public transit routes should be explored and pursued, including the potential for additional future bus stops along Route 7A. Installation and maintenance of high quality and ADA accessible amenities at public transit stops such as shelters, benches, bike racks, posted signage and schedules, and park-and-rides should be pursued when possible.
9. Alternatives to Single Passenger Vehicle Commuting: The Planning Commission energy subcommittee, in partnership with BCRC and other groups, can share information with local businesses and institutions on promoting rideshare, vanpool, and car-sharing, on strategies to support seasonal bike commuting, and on using telecommuting to reduce energy expended for work travel. A school campaign to increase ridership of the school bus could create community savings.
10. Complete Streets Design: The Village should assess existing roads for their ability to accommodate safe and convenient walking and biking. Areas for improvement should be prioritized and funding sought to align these areas with Complete Streets guidelines.

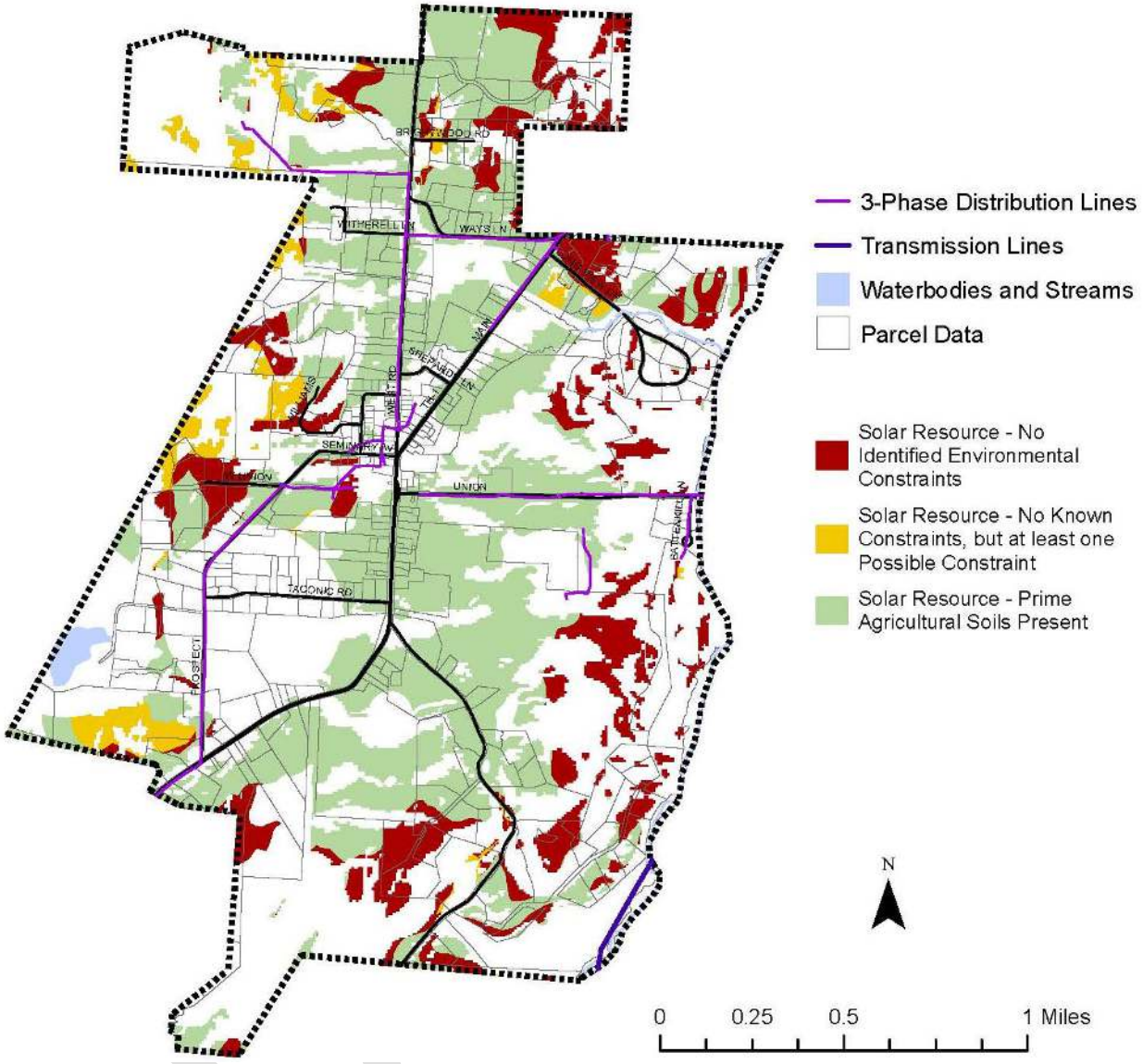
Renewable Energy Development

11. The Village should offset ongoing fossil fuel consumption by developing renewable energy facilities on any appropriate municipally-owned parcels. The Village should support interested residents in developing renewable energy facilities on their properties. The Village should consider trialing use of blended biofuel in diesel-powered municipal trucks and equipment.

Local Food Production

The municipal energy committee can help facilitate dialogue between local/regional food producers and local/regional institutions such as schools, hospitals, and meal delivery or provision programs to enhance the interconnectedness of the regional food system.

Figure 10: Village of Manchester Solar Resource Map



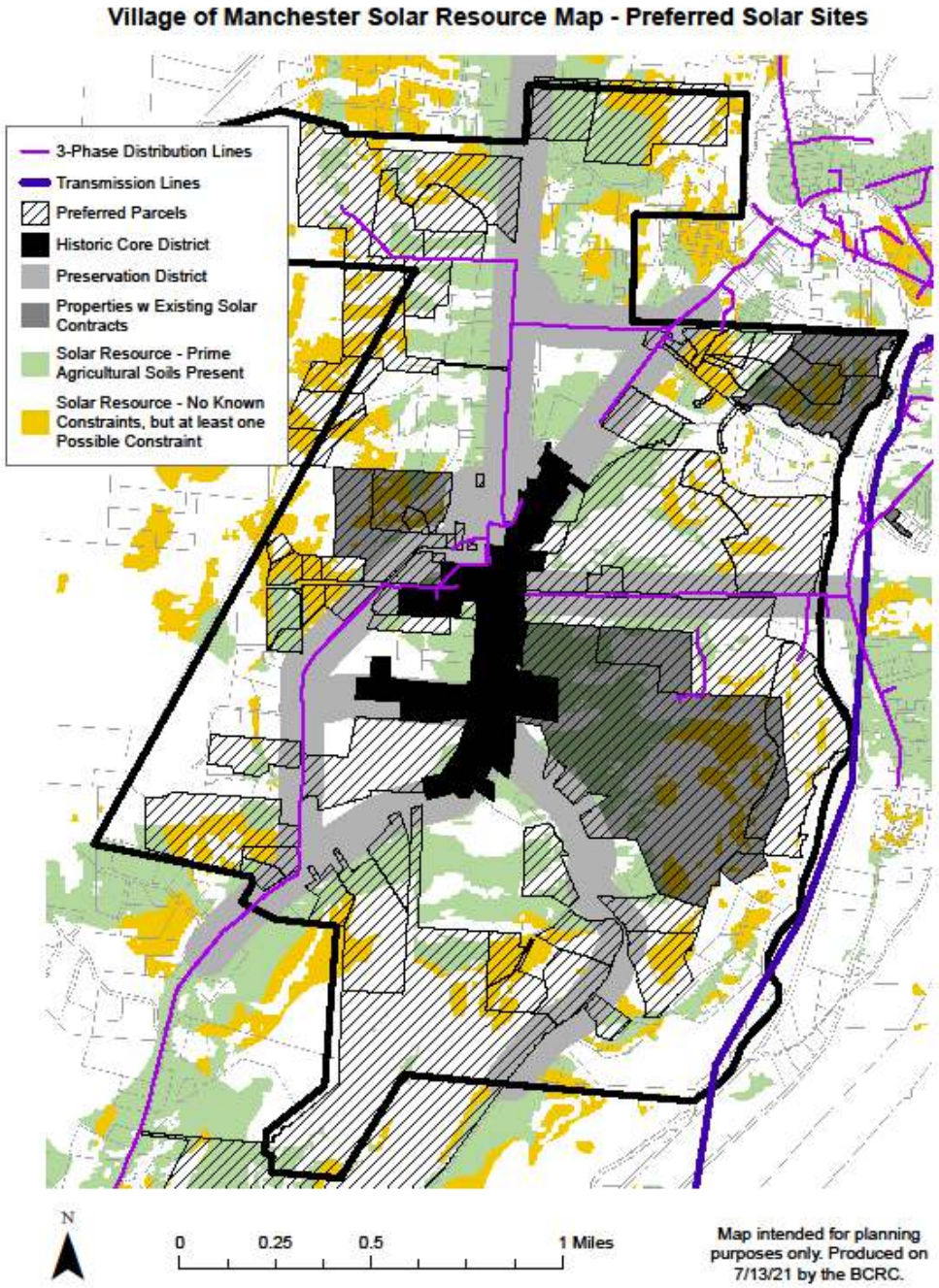
Local Constraints – Restrictions apply within the three design control sub districts as stated above. All solar installations must comply with the Solar Screening Ordinance. Development is restricted on Equinox Preservation Trust lands.

Regional Constraint – Presence of prime agricultural soils is flagged. Special attention shall be paid to preserve agricultural soils for future agricultural activities. If development does occur, efforts shall be made to mitigate impacts to agricultural soils and/or to preserve agricultural soils for future use.

Preferred Sites – See Figure 11: Preferred Sites for Solar Development.

Prime and Secondary Solar Resource Areas – These areas show high levels of solar radiation adequate for solar energy systems. Areas are approximate and based on GIS (geographic information systems analysis). Actual conditions vary. These data layers were developed by VCGI for the purposes of Act 174 enhanced energy planning in Vermont.

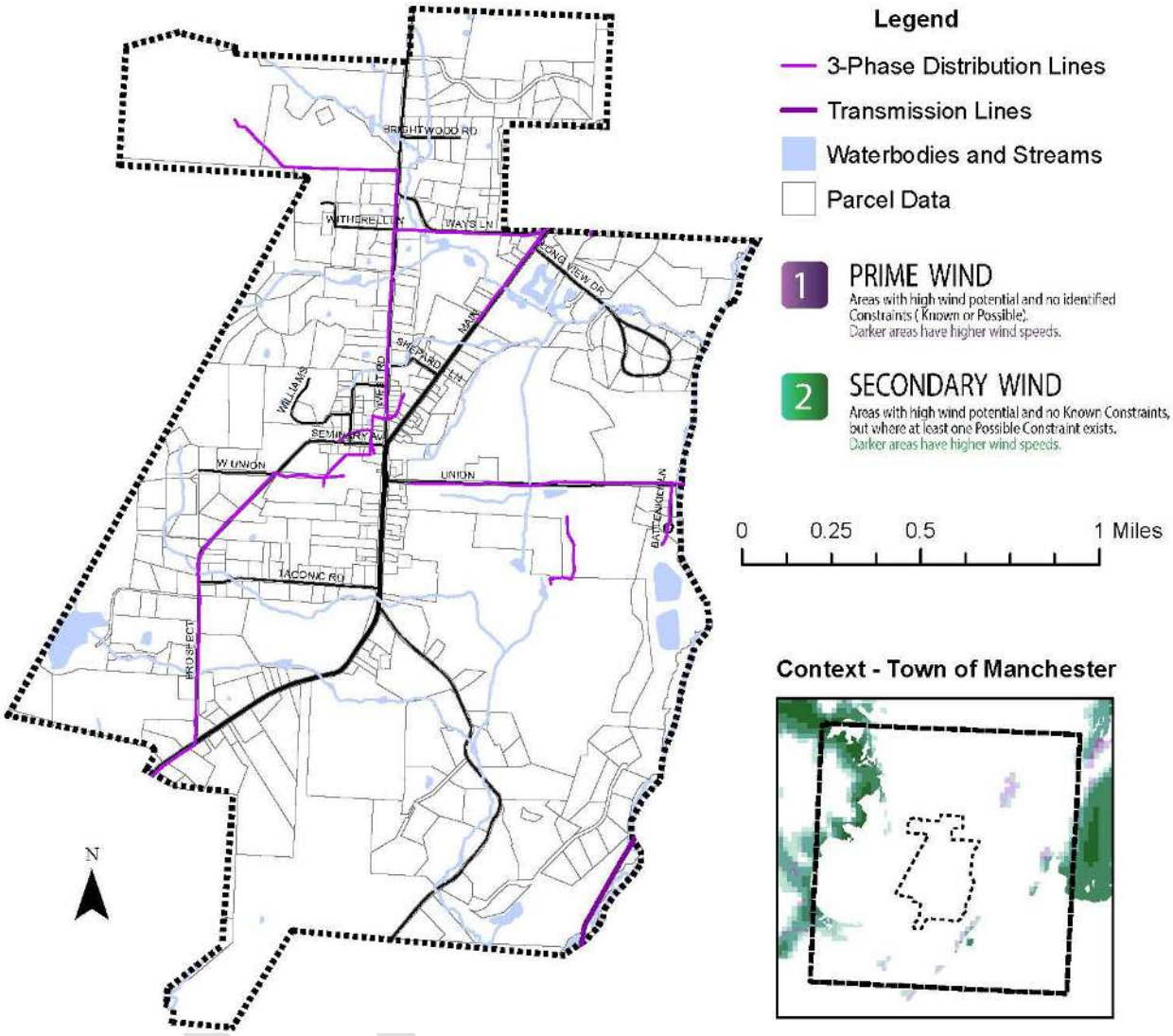
Figure 11:
Village of Manchester Solar Resource Map with Preferred Sites for Solar Development.



Local Constraints – Restrictions apply within the 3 Design Control sub districts as stated above. All solar installations must comply with the Solar Screening Ordinance. Development is restricted on Equinox Preservation Trust lands.

Preferred Sites – Solar development is appropriate in the General Review Sub District and must conform to the siting requirements identified in this document and in the Solar Screening Ordinance.

Figure 12: Village of Manchester Wind Resource Map – Showing No Wind Resource



Local Constraints – Restrictions apply within the 3 Design Control sub districts as stated in previous sections of this plan. The Village Design Control District and all Sub-Districts are not suitable for any scale of wind power development. Development is restricted on Equinox Preservation Trust lands.

Regional Constraints - the Bennington County Regional Energy Plan establishes a regional constraint of 1KM residential buffer for utility-scale wind development.

Preferred Sites – None.

Wind Resource Areas – No areas of high wind speed adequate to support wind energy systems are currently mapped in the Village. Mapped areas are approximate and based on GIS (geographic information systems analysis). Actual conditions vary. Data layers were developed by VCGI for the purposes of Act 174 enhanced energy planning in Vermont.