Shaftsbury Enhanced Energy Plan

Prepared by Bennington County Regional Commission and the Shaftsbury Planning Commission

September 2023-February 2024

Shaftsbury Energy Plan

Energy Use and Policy in Shaftsbury and Vermont

Shaftsbury Energy Goals and Policies

- Reduce overall energy consumption through conservation and efficiency.
- Develop renewable energy resources locally.
- Pursue land use patterns that reduce reliance on fossil fuels and imported energy sources.

Energy is a resource that must be considered in any comprehensive planning process. The Town of Shaftsbury recognizes that the future resilience of its community will require lowering dependence on imported, non-renewable fuels, tapping local energy sources for enhanced self-reliance, and improving energy efficiency. These actions are not only the economically prudent thing to do, but they will also reduce greenhouse gas emissions and mitigate the effects of climate change.

The State of Vermont established markers through its Comprehensive Energy Plan (VT CEP, updated in 2022) to help guide Vermont communities to a sustainable future. The central goal of the plan is to attain 90% renewable energy by 2050 (90 X 50). To achieve this goal, 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. For Shaftsbury specifically, total energy consumption would have to be cut by more than a third by 2050 from 2015 levels to meet the 90 X 50 goal. **Energy conservation efforts combined with improved energy efficiency through technology upgrades and building weatherization will enable Vermont towns to reduce energy consumption in line with state energy goals.**

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 is expected to be supplied through electricity according to projections in the VT CEP.

Though this shift in energy use is considerable, there are opportunities to lower costs and bolster the regional economy through a transformation of the energy sector, which costs the Bennington region over $150 Million a year in imported fuels and electricity costs (see **Figure 1**). **Nearly all of this money flows out of the region and the state. Redirection of these funds to local energy businesses and jobs will better retain wealth in local communities.**

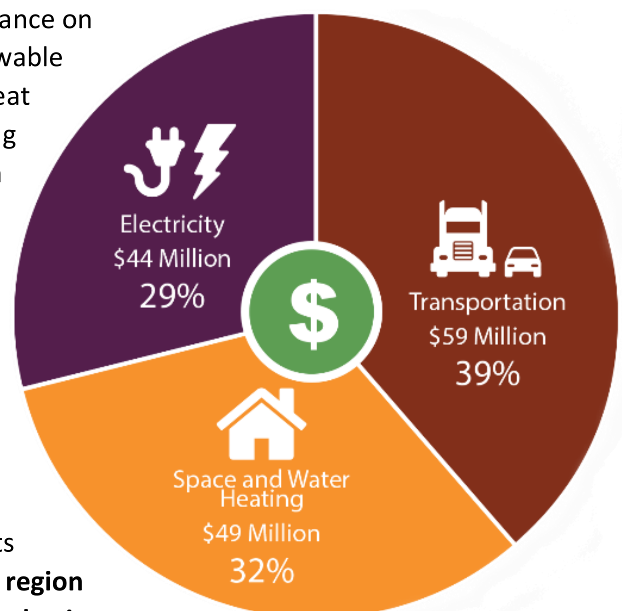


Figure 1: BCRC Region Energy Cost Estimates, 2014

Based on data from Census Bureau, VT Dept. of Motor Vehicles, and US Energy Information Administration.

This energy element of the Shaftsbury Town Plan is intended to provide residents and town officials with information and strategies needed to plan for an energy future that maintains a vibrant community as the energy sector evolves to reduce consumption and lower costs. This energy plan promotes energy conservation, conversion to more efficient technologies, and local renewable energy development, all of which will better protect the environment and strengthen the local economy. Much of the data presented here come from Low Emissions Analysis Platform (LEAP) model projections. The LEAP model is a tool used by the State of Vermont to analyze and project energy supply and demand at the state and regional levels for the years 2015-2050. The following LEAP data identifies Shaftsbury's use based on the town's share of the regional population, and commercial and industrial establishments.

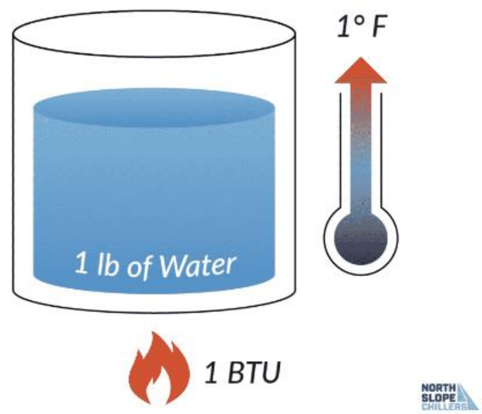
Current and Future Energy Use

As a rural town with 3,598 residents housed mostly in single family homes, Shaftsbury consumes a considerable amount of energy every year to meet its transportation, space heating, and electricity needs. According to LEAP model projections, in 2015 Shaftsbury used more than 540 thousand million British Thermal Units (MMBTU) per year (see **Figure 2**).

Residential energy use is customarily separated from commercial and industrial energy use and then further grouped into three major sectors: transportation, thermal (heating and cooling), and electricity. Before addressing each sector, modeled total energy use for Shaftsbury is depicted. **Figure 2** illustrates one path the town might follow to achieve energy targets through gradual adaptation and fuel switching over the next few decades. With the year 2015 as a baseline, energy use targets by fuel and energy carrier (e.g., electricity) for years 2025, 2030, 2035, 2040, and 2050 are shown. These same six years will be used for depictions of energy use by sector in the following sections of this energy element of the town plan.

What is a BTU?

A BTU, or British Thermal Unit, is a measure of energy value or heat content. A BTU is the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit at a constant pressure of one atmospheric unit.



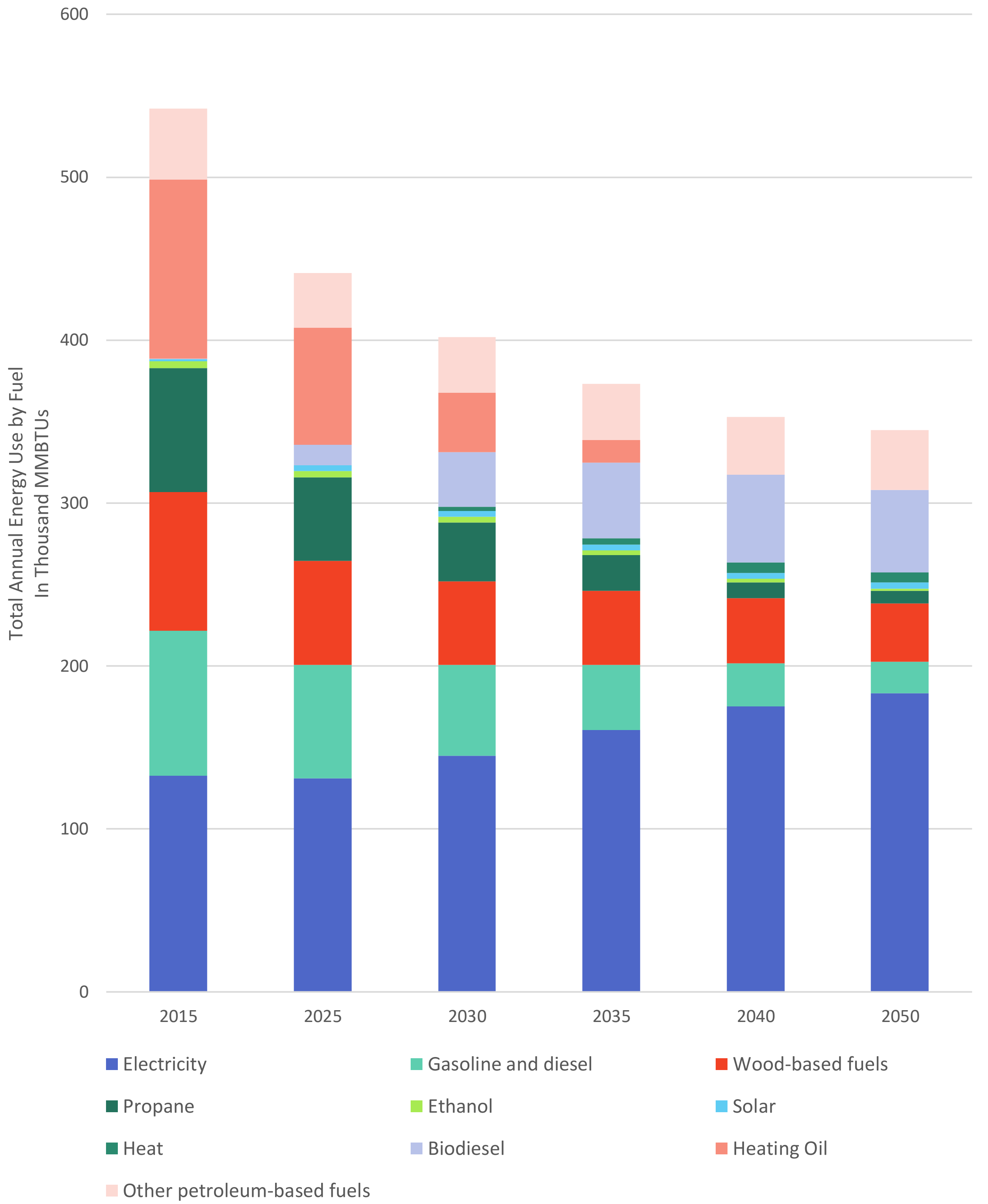
(Illustration from: www.northslopechillers.com)

1 MBTU = 1,000 BTU
1 MMBTU = 1,000,000 BTU

Annual energy use is typically measured in units of Thousand MMBTUs

According to LEAP projections, Shaftsbury would phase out fossil fuels through electrification of the transportation and heating sectors, with biodiesel replacing some conventional diesel and oil fuels, and with continued use of woody biomass for space heating. More details on how specific technologies and strategies will achieve this energy reduction and fuel conversion are broken down by energy sector, illustrated, and discussed in the following pages.

Figure 2. Shaftsbury Total Energy Demand by Fuel Type, 2015–2050. *Source: LEAP projections.*

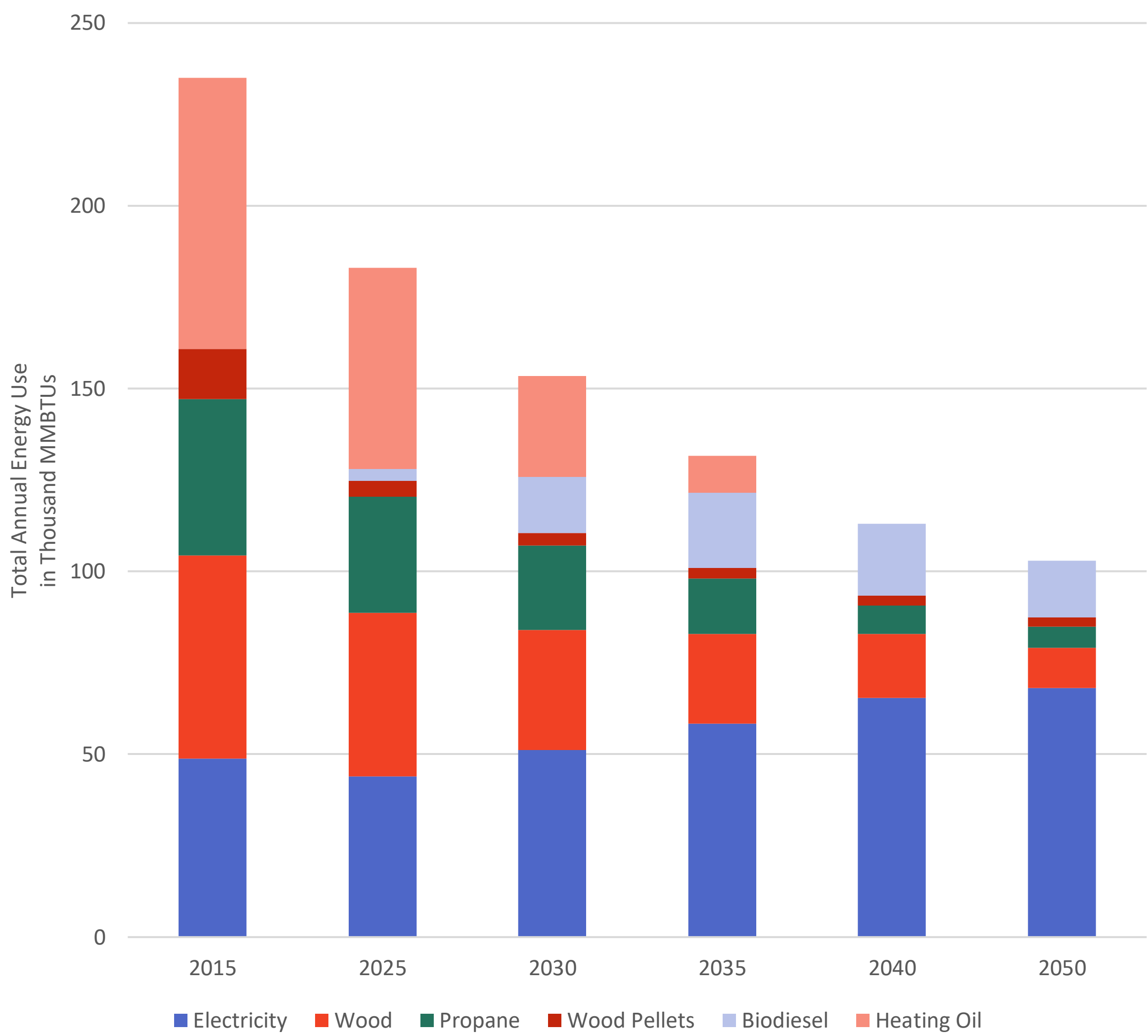


Note: Other petroleum-based fuels includes kerosene, asphalt and road oil, residual fuel oil, lubricants, and aviation fuels.

Residential Energy Use

Shaftsbury's more than 3,500 residents consume energy for transportation, heating space and water, and powering lights and appliances with electricity. **By identifying technologies and practices capable of catalyzing the transformation of each energy sector, Shaftsbury aims to provide its residents and municipal officials with the tools necessary to realize the state's energy goals. Figure 3** presents a guide to how residential energy use could change over the next several decades to meet state energy and emissions goals with increased efficiency, growing electricity and biodiesel use, and a phasing out of fossil fuel use.

Figure 3. Shaftsbury Total Residential Energy Use by Fuel Type, 2015–2050. *Source: LEAP projections.*



Transportation

Due to Shaftsbury's rural location, people and goods constantly travel long distances to move to and from the community. The light duty vehicle, or car, 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 on fossil fuel vehicles, transportation represents one of the greatest challenges to reducing overall energy use.

For example, consider commuting to work. The average worker living in Shaftsbury has a mean commute time of 21.9 minutes, or about 25 miles roundtrip per day. With roughly 1,625 resident workers mostly commuting to work alone (79%), commuting accounts for approximately 32,100 miles per day of travel (approximately 8.3 million miles annually), over 460,000 gallons of gasoline per year, and a yearly cost of over $1.6 million to commuters.[1] It is estimated that Shaftsbury residents own over 2,600 vehicles and drive about 32.7 million miles per year, so commuting represents only about one quarter of total transportation in the area (all data based on US Census 2021 American Community Survey+ estimates).

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, Shaftsbury residents can improve transportation efficiency and divert money currently spent on fossil fuels.***[2] Targets for gradually converting to EV technologies and reducing energy consumption by passenger car use are presented in **Figure 4**.

Over the next three decades, total energy for transportation would fall gradually to just 20%, or one fifth, of 2015 levels. Electrification of 70% of 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 Shaftsbury: 65 EVs by 2025; 245 EVs by 2030; 569 EVs by 2035; 895 EVs by 2040; and 1,322 EVs by 2050*** (**Figure 5**). A combination of biodiesel and gasoline fuels will power the remaining portion of passenger and light duty vehicles.

[1] Calculations based on 25.4 mpg vehicle average, approximate gasoline cost of $3.50/gallon, and 260 workdays per year.

[2] Policy recommendations in this enhanced energy plan are indicated in ***orange bold italics*** and goals are indicated in ***bold blue italics***.

Figure 4. Shaftsbury Light Duty Vehicle Energy Use by Fuel, 2015–2050. *Source: LEAP projections*

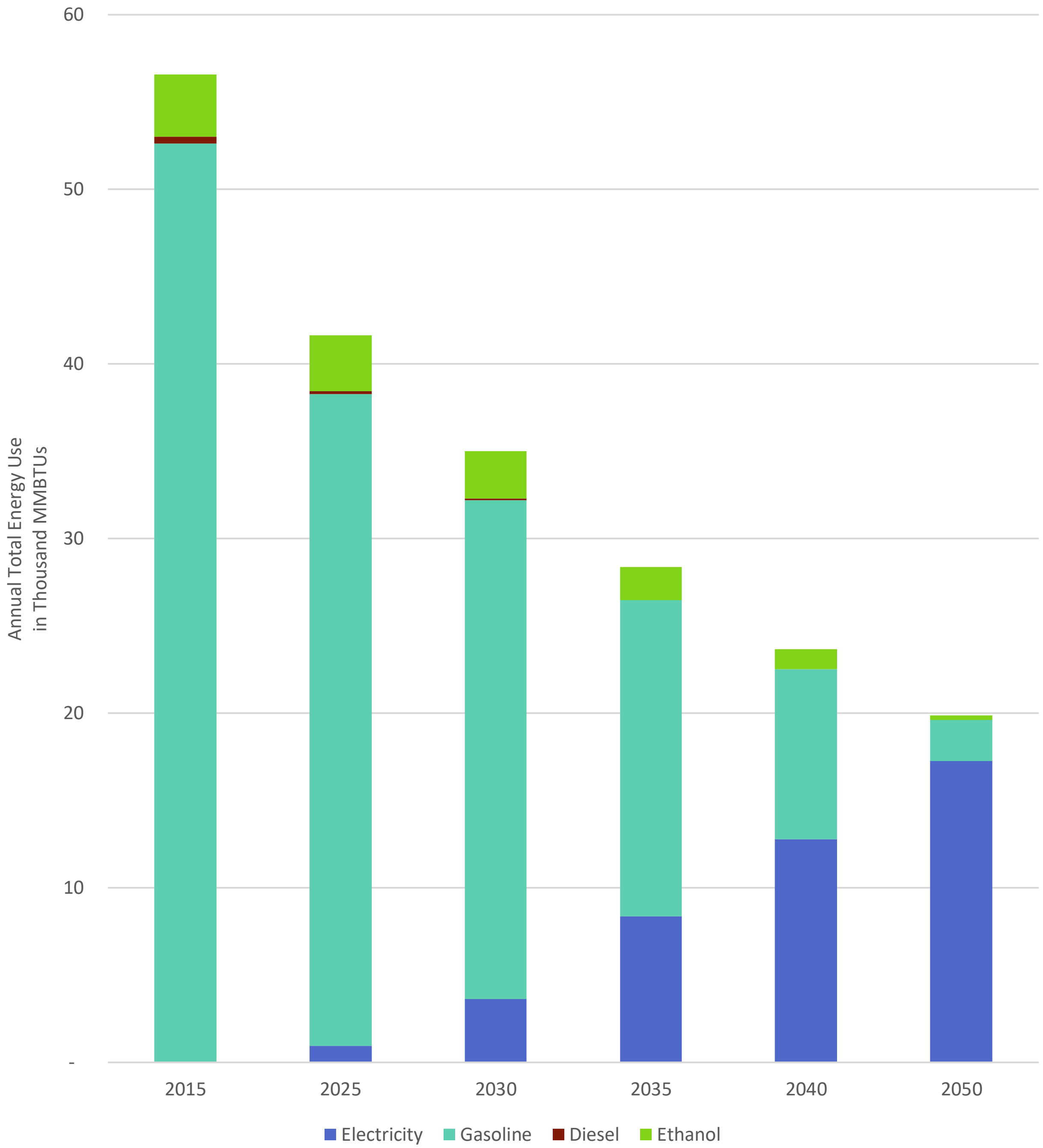
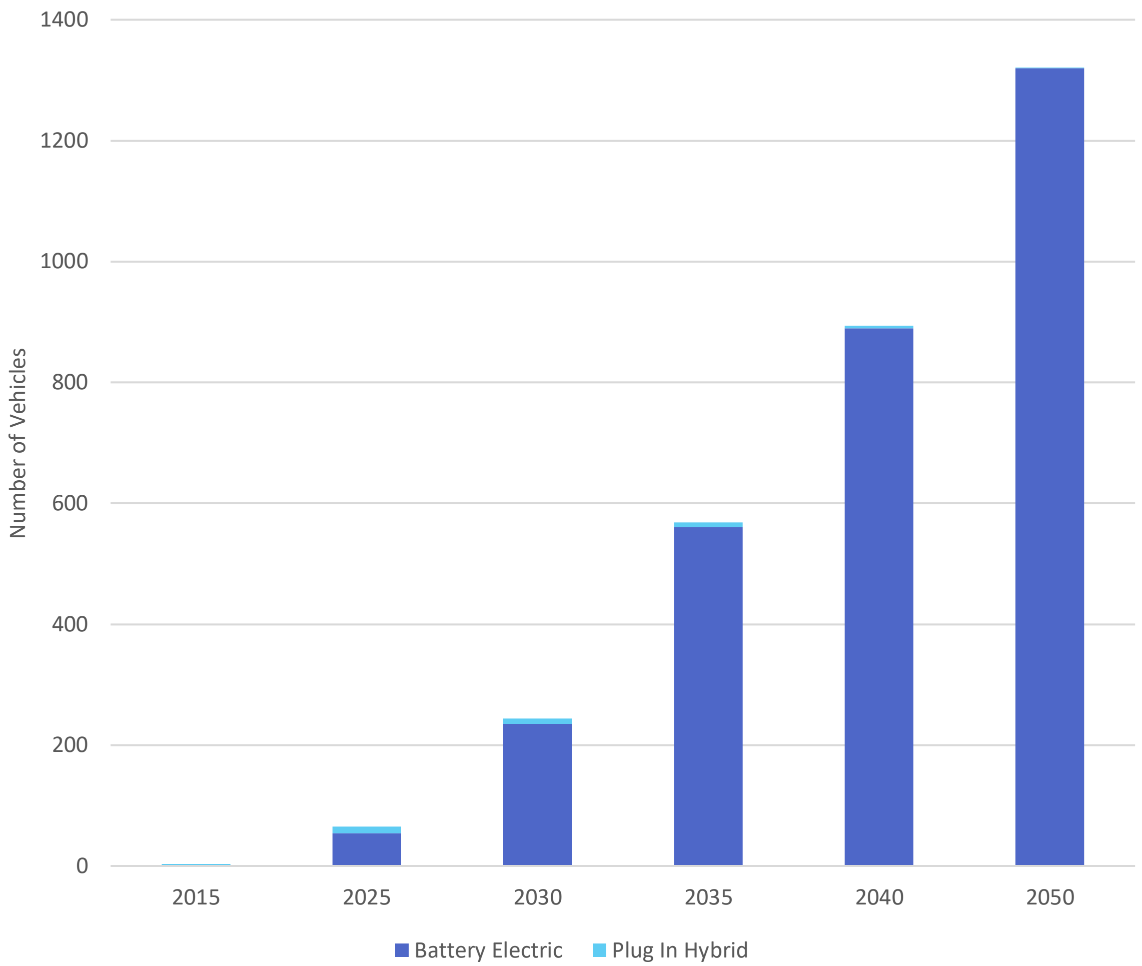


Figure 5. Shaftsbury Electric Vehicle Targets, 2015–2050. *Source: LEAP projections*

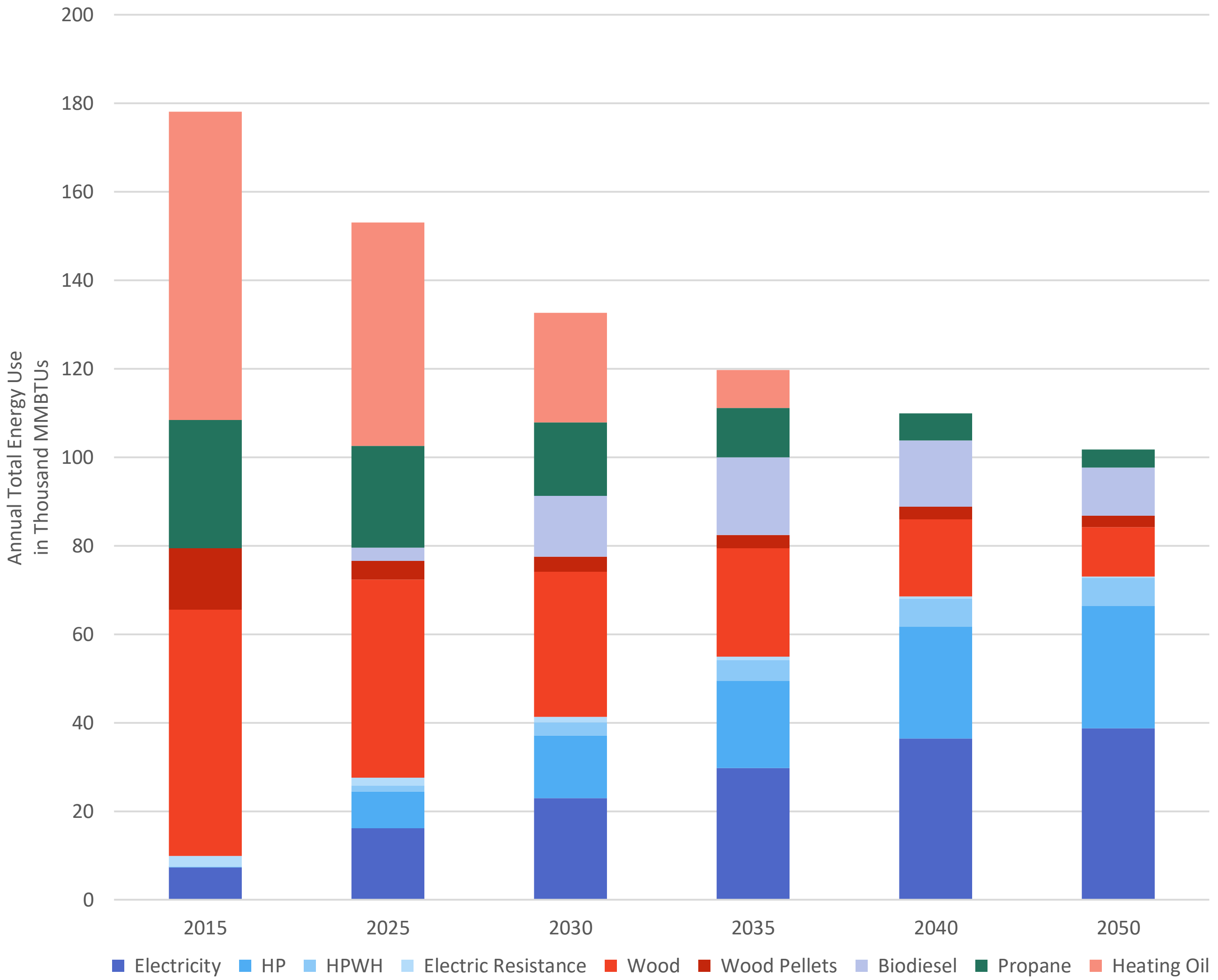


While EVs will play a major role in reducing transportation energy use while allowing Shaftsbury residents to continue to rely on personal vehicle travel, efficiency gains from EVs alone will not account for all the energy reduction needed to meet future transportation energy targets. Conservation through behavior changes such as carpooling, transit use, and increased reliance on walking and biking will be critical to reaching 2050 energy targets. Additionally, dense, multiunit dwellings are more efficient than single unit homes due to lower average square footage and efficiencies arising from passively shared heat. ***Land use and transportation policies that encourage denser development in Shaftsbury's village centers along with implementation of "complete streets" road design are necessary to shift the predominant transportation model from being vehicle-centric to multimodal and efficient-by-design.*** Shaftsbury's land use, economic development, transportation, and natural resources policies as presented in other chapters of the town plan re-enforce these strategies.

Thermal

Close to half of Shaftsbury homes are heated throughout the seven-month cold season by fossil fuels (primarily oil and propane). Though these fuel sources have been inexpensive and widely accessible in the past, projected shortages of fossil fuels suggest that the town should mitigate reliance on fossil fuel sources by switching to more efficient systems that can be powered by local resources. Switching away from fossil fuels will also be important for reducing greenhouse gas emissions and mitigating the effects of climate change. Woody biomass is one abundant local resource already used for space heating. Wood and pellet stoves currently heat 32% of Shaftsbury residences and wood will be an important transition fuel as the residential thermal sector electrifies (See **Figure 6**).

Figure 6. Shaftsbury Total Residential Energy Use for Heating, 2015–2050. *Source: LEAP projections*



HP = Heat Pump. HPWH = Heat Pump Water Heater. Electricity here signifies electric furnace (space heating), and central and room AC units (space cooling).

Shaftsbury's energy use for residential heating is projected to decline by 43% of current use, or about 77 thousand million BTUs, by 2050 (**Figure 6**). Cold-climate electric heat pumps are a highly efficient technology that will play a major role in lowering overall energy consumption. To be in line with state energy goals by 2050, more than one in four homes in Shaftsbury 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 also cool homes during the warmer months. ***To meet 2050 goals, electric heat pumps can be adopted in accordance with the following target counts: 665 heat pumps in use by 2025; 1,206 by 2030; 2,322 by 2040; and 2,596 by 2050*** (**Figure 7**).

According to LEAP estimates and using 2020 decennial Census data, by 2050 more than 200 of Shaftsbury's 1500 households should rely on woody biomass for heating, delivered via high efficiency pellet and wood stoves, while more than 160 homes would use biodiesel-based systems. Some homes would continue to use liquid propane gas (LPG), but at a fraction of today's usage (about 61 homes in 2050). The overall shift in residential thermal energy use is shown by portion of households in **Figure 6**.

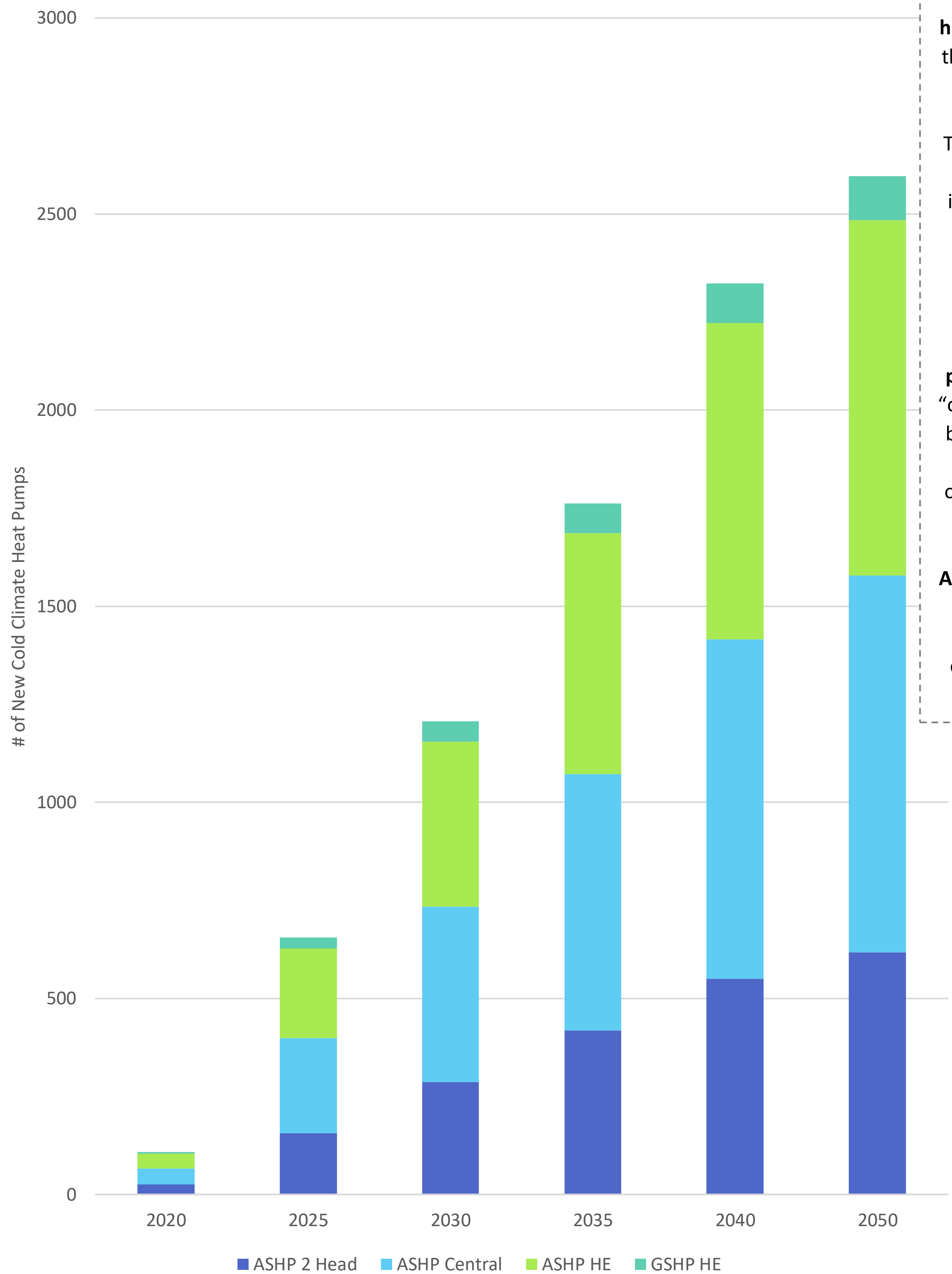
Table 1: Shaftsbury Residential Heating and Electric Use and Costs.

The vast majority of Shaftsbury's occupied housing units are single unit homes, which together consume close to $4.6 million a year in heat and electric energy use. Shaftsbury residents spend the most money on heating oil and non-heat electricity.

House Type	Occupied Residential Units	Total Oil Use (gallons)	Total LP Gas Use (gallons)	Total Wood Use (pellet bags)	Electric Use for Heat (kWh)	Non-heat Electric (kWh)	Total Cost by HH Type	Cost Per Unit
Single Unit	1190	577,837	261,538	79,442	0	11,900,000	$4,566,905	**$3,838**
Two Unit	13	4,734	2,143	651	0	117,000	$39,373	**$3,029**
Multiunit	18	4,370	1,978	601	0	144,000	$43,029	**$2,390**
Mobile Homes	27	9,833	4,451	1,352	0	216,000	$79,770	**$2,954**
Cost Factor	-	$2.75/gal	$3.45/gal	$5.00/bag	$0.15/kWH	$0.15/kWH	-	-
Totals	**1248**	**$1,641,129**	**$931,879**	**$410,229**	**$0**	**$1,745,839**	-	-

Methodology: Assumed heating efficiency of 60,000 BTU/sf and the following area assumptions: 2,000 single-unit; 1,500 two-unit; 1,000 multiunit; and 1,500 mobile homes (higher sf due to generally lower efficiency). Units by house type and heating source shares from ACS Census data (indicating no electrically heated units in 2021). ACS 2021 Estimates.

Figure 7. Shaftsbury New Heat Pump Targets, 2020–2050. *Source: LEAP projections*



Powered by electricity, **heat pumps** move—rather than create—heat to keep a space comfortable.

They can work through all seasons, moving heat indoors in cooler months and distributing it outdoors in warmer months.

Ground source heat pumps are also known as "cold climate" heat pumps, because of their ability to reliably and efficiently operate in extremely cold temperatures.

Air source heat pumps are often less expensive to install, but can lose efficiency at much lower temperatures.

ASHP = Air Source Heat Pump. GSHP = Ground Source Heat Pump. HE = High Efficiency.

Gradually switching thermal systems to more efficient electric options would do much to improve energy efficiency, but thermal conservation gains will also rely on extensive weatherization of existing homes and adherence to building energy codes for new construction. ***In accordance with state law, and upon completion of construction, Shaftsbury will require permittees to submit the Residential Building Energy Standards (RBES) certificate to the town clerk for recording in the town land records***. ***The following household weatherization count targets can help guide efforts in Shaftsbury: 140 households weatherized by 2025; 430 households by 2035; and 935 households by 2050*** (**Figure 8**).

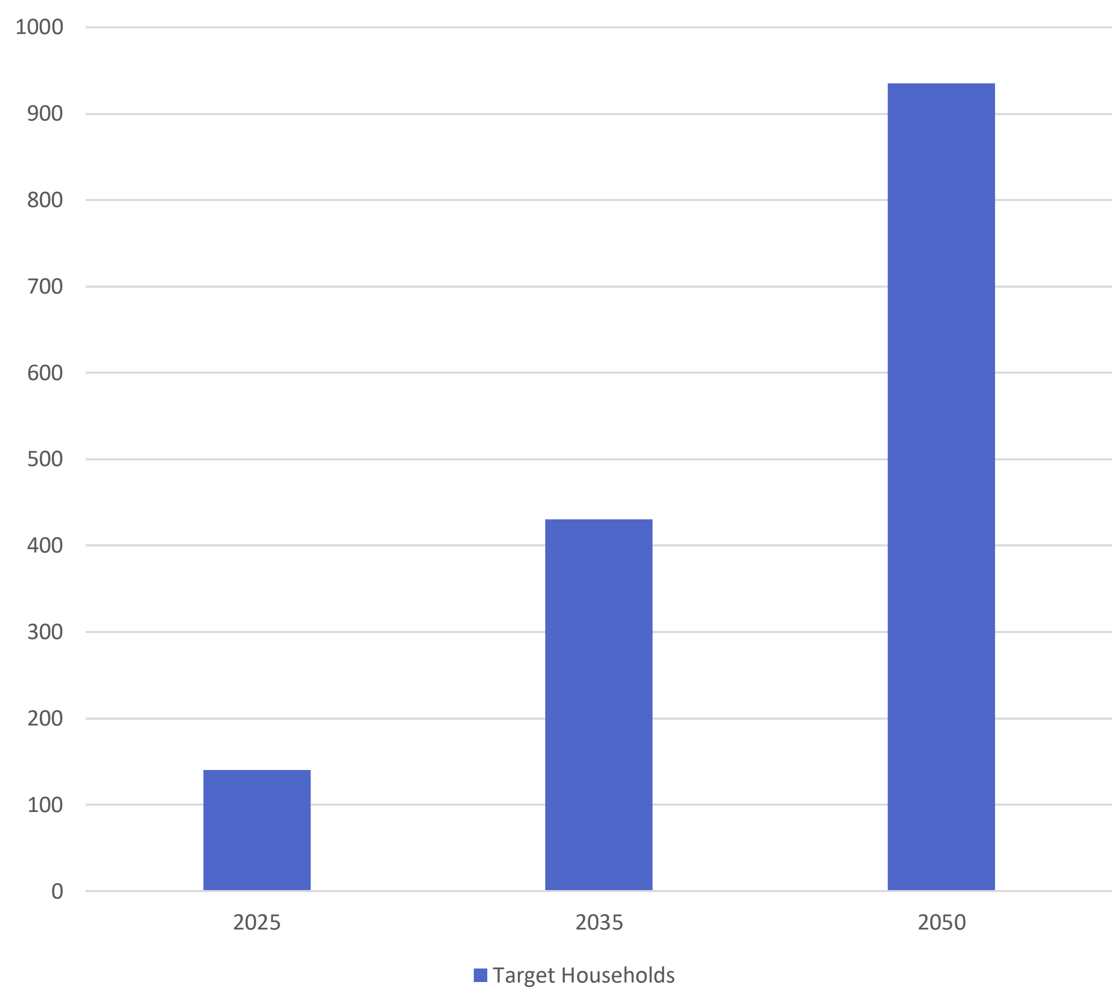
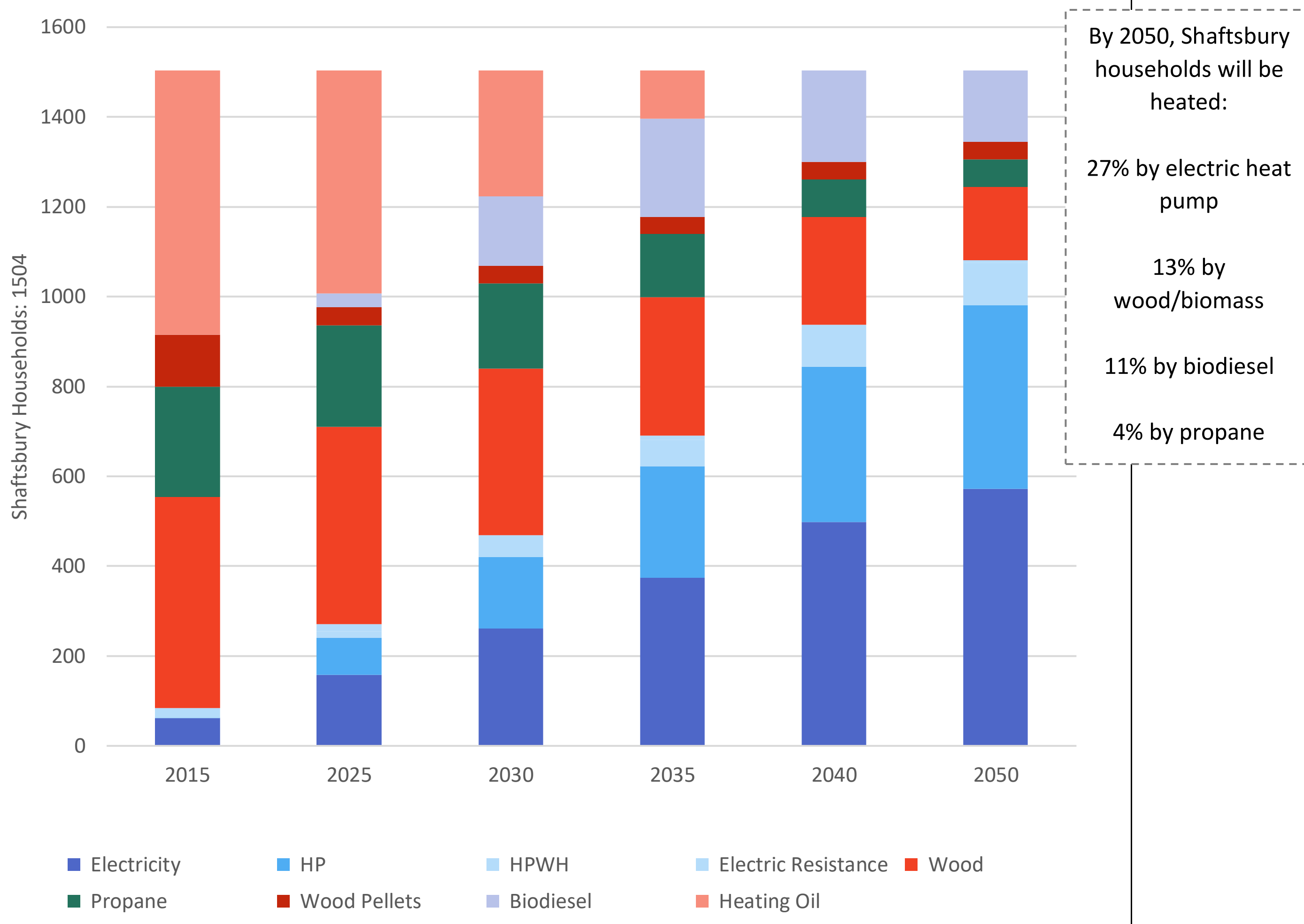


Figure 8. Shaftsbury Household Weatherization Targets, 2025–2050. *Source: LEAP projections*

By better sealing and insulating homes, total energy use will decrease significantly 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. Efficiency Vermont data show that from 2020 to 2022 at least 19 Shaftsbury households made thermal shell improvements (home performance with energy star projects and other weatherization projects), and 247 heat pump water heaters and cold climate heat pumps were installed during the same period, indicating that residents already value this approach to efficiency.

Figure 9. Shaftsbury Total Residential Energy Use for Heating by Household, 2015–2050. *Source: LEAP projections*



HP = Heat Pump. HPWH = High Performance Water Heater. Electricity here signifies electric furnace (space heating), and central and room AC units (space cooling).

Electricity

As mentioned previously, electricity use will expand since it is a reliable way to make renewable energy sources available for use (see **Figure 9**). Although technically a conductor of energy and not a source, electricity is referenced here as an energy source since widespread adoption of appliances, vehicles, and thermal technologies powered by electricity are critical to achieving Vermont's energy goals. Current trends suggest that total electric use is increasing in Shaftsbury homes and businesses as indicated in **Table 2**.

Table 2: Shaftsbury Electricity Usage by Sector (in kWh) 2019-2021. *Source: Efficiency Vermont*

Sector	2020	2021	2022
Residential	13,201,344	13,554,195	13,784,734
Commercial & Industrial	5,113,168	5,866,161	6,615,135
Total	**18,314,512**	**19,420,356**	**20,399,869**
Residential Sector Breakdown			
Count of Residential Premises	1,676 units	1,686 units	1,693 units
Average Residential Usage	7,877 kWh	8,039 kWh	8,142 kWh

Efficiency Vermont also reports that electricity use has increased in residences over the past few years, in part due to electrification measures (such as the installation of heat pumps). Efficiency Vermont estimates that Shaftsbury homes have saved approximately $137,900 between 2020 and 2022 by switching to high efficiency appliances and weatherizing their homes. These data show electricity consumption increasing, and it will likely continue to increase as Shaftsbury residents switch to electric transportation and thermal systems.

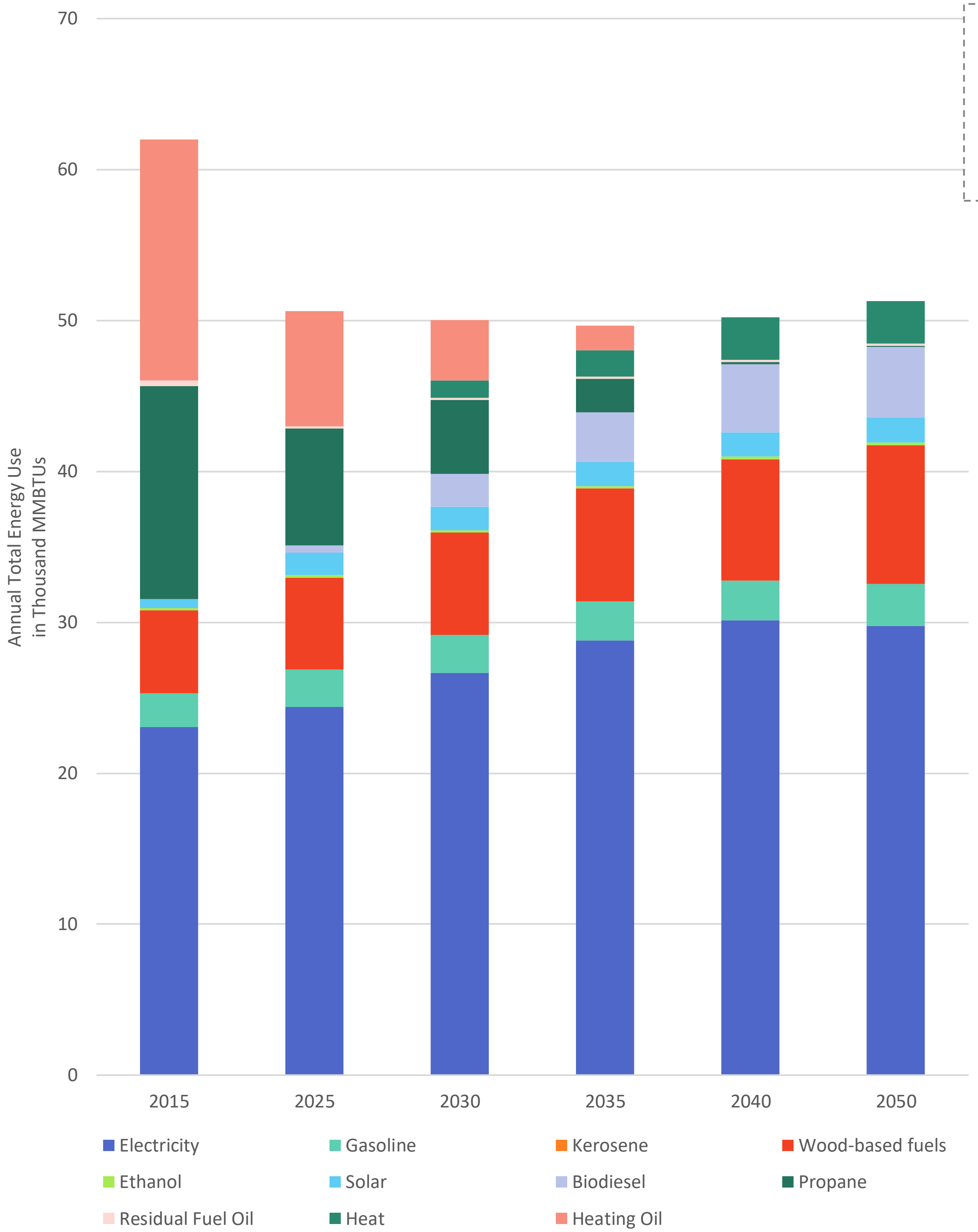
Total electricity use is expected to increase to 183.2 thousand million BTUs (see **Figure 2**), nearly 40% more than current usage, by 2050. This increase may seem contrary to energy use reduction goals, but since electricity is much more efficient than the fuel-based systems it will replace, total energy consumption will decline even as electricity use rises. Local generation of electricity will be covered in a later section on *Local Renewable Energy Generation Potential*.

Commercial and Industrial Energy Use

Shaftsbury is home to several manufacturing, utility, and service-based establishments that provide 452 jobs. About 61 establishments are classified as commercial (service producing) and 18 as industrial (goods producing) (Vermont Dept. of Labor, 2022).

It is clear at a comparative glance that overall energy use reduction at Shaftsbury's businesses and industries is not projected to be as dramatic as for Shaftsbury homes (**Figures 10–11**). 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. ***In accordance with state law, and upon completion of construction, Shaftsbury will require permittees to submit the Commercial Building Energy Standards (CBES) certificate to the town clerk for recording in the town land records***.

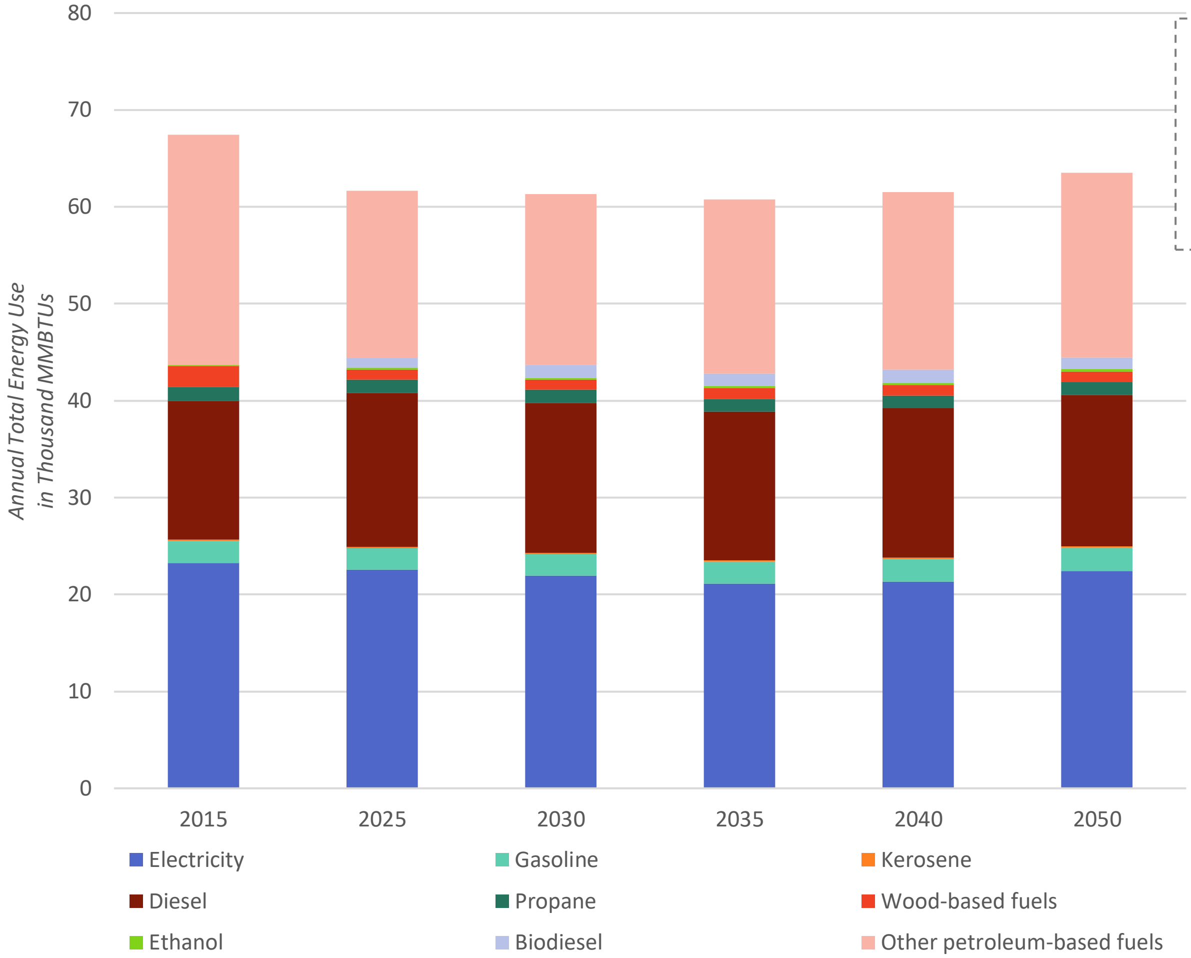
Figure 10. Shaftsbury Total Commercial Energy Use by Fuel Type, 2015–2050. *Source: LEAP projections and VT Department of Labor data*



By 2050, total Shaftsbury commercial sector energy use is projected to decline by 17% to 51 thousand MMBTUs.

Regional data prorated to account for Shaftsbury's share of commercial entities.

Figure 11. Shaftsbury Total Industrial Energy Use by Fuel Type, 2015–2050. *Source: LEAP projections*



By 2050, total Shaftsbury industrial sector energy use is projected to decline by 6% to 63.5 thousand MMBTUs.

Regional data prorated to account for Shaftsbury's share of industrial entities.

Heating oil use is projected to decrease to zero in the commercial sector and road oil is expected to decrease slightly 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. For more information about rooftop solar generation potential, see the Local Renewable Energy Generation Potential section below.

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 (**Table 3**). ***Shaftsbury will pursue energy conservation and use of renewable energy systems by town government***. Implementation of this policy will produce significant savings for the community and set a visible example of responsible energy use. Cole Hall, which houses Shaftsbury's town office, is almost 200 years old and is heated by an oil furnace. The town is pursuing plans to redevelop Cole Hall and the surrounding site with energy upgrades, including insulation, solar panels, and EV charging stations. The town garage is a new building, completed in 2019. The main fire station on Buck Hill Road was built in the 1950's and an addition was constructed in 1977. The building's windows were replaced in 2020.

Table 3: Annual Fuel Consumption and Cost for Town Offices and Garage, FY22: Shaftsbury, VT. *Estimates from Town, 2023*

Energy Source	Quantity Used	Cost Factor	Total Cost
Town Offices			
Oil Heat	1,061 gallons	$2.98/gallon	$3,166
Electricity	14,813 kWh	$0.15/kWh	$2,222
Town Garage			
Propane Heat	1,730 gallons	$2.00/gallon	$3,449
Electricity	18,233 kWh	$0.15/kWh	$2,735
Fire House			
Oil Heat	839 gallons	$7.65/gallon	$6,416
Electricity	17,500 kWh	$0.15/kWh	$2,625
Diesel Fuel (Town Garage & Fire House)	26,604 gallons	$2.95/gallon	$78,404
Streetlighting			
Hawk's Avenue	2,040 kWh	$0.15/kWh	$306
South Shaftsbury Village	75,253 kWh	$0.15/kWh	$11,288
Total Cost			**$110,611**

The town garage consumes slightly more electricity than the town office and the firehouse, and town vehicles consume a large amount of diesel fuel. Over 70% of total municipal energy expenditures go to diesel fuel costs and the town could see significant savings by pursuing improvements to its heavy-duty vehicles through programs like the Diesel Emissions Reduction Financial Assistance Program.

Shaftsbury Elementary School serves about 218 children in kindergarten through sixth grade school levels. The school building (about 38,100 square feet on the main floor) is deeded to 1956. The school uses oil heat. The school has not undergone any major facility improvements in recent years. In FY 2022-23, the school switched all the 4' lamps with LEDs, and there is a near-future plan to replace the existing heating and ventilation equipment with energy efficient units. Shaftsbury Elementary subcontracts out transportation services, so does not own any buses, and therefore cannot directly control fleet fuel type.

Table 4: Fuel Consumption and Cost for Shaftsbury Elementary School: Shaftsbury, VT. *Source: Estimates from Southwest Vermont Supervisory Union, 2023*

Energy Source	Quantity Used	Cost Factor	Total Cost
School Building			
Electricity (January 2022–September 2022)	380,416 kWh	$0.19/kWh	$73,833.28
Oil (January 2022–December 2022)	14,446 gallons	$3.64/gallon	$52,600.40

The school spends over $70,000 each year on electricity costs (**Table 4**). Ways to lower this cost include weatherizing the building to use energy more efficiently, installing timed motion sensor light switches that automatically turn off after a few minutes of inactivity, and completing the upgrade of the school electrical system to new and digital systems.

Local Renewable Energy Generation Potential

Working toward meeting the state's renewable energy generation goals is a significant component of the energy planning process in Vermont. Renewable energy contributions for area towns were established in the 2017 BCRC Regional Energy Plan, in line with the state's 90 X 50 goals.

To establish prime areas for renewable energy development, namely solar- and wind-generated electricity, enhanced energy plans are required to include a map study of wind and solar resources. Act 174 establishes the steps that a town should take as it assesses its potential for generating electricity from its solar and wind resources:

1. Identify and map areas within the town where wind and solar resources are present.
2. Remove areas with known constraints, as established in Act 174, from those mapped resource areas.
3. Identify areas that have possible constraints, as established in Act 174, within the mapped resource areas.
4. Identify areas where development should be avoided and where it should be encouraged.
5. Determine other site-specific concerns relevant to potential project development.

How is Electricity Measured?

Watts are a measurement of power describing the rate at which electricity is being used at a specific moment. For example, a 15-watt LED bulb draws 15 watts of electricity at any given moment when it is turned on.

Watt-hours are a measurement of electrical energy describing the total amount of electricity used over time. Watt-hours are a combination of how much electricity is used (watts) and the length of time it is used (hours). For example, a 15-watt light bulb drawing 15 watts at any one moment, uses 15 watt-hours of electricity in the course of one hour.

One **kilowatt** (kW) equals 1,000 watts, and one **kilowatt-hour** (kWh) is one hour of using electricity at a rate of 1,000 watts. (The average American home uses about 10,600 kilowatt-hours of electricity annually – 2021 USEIA data).

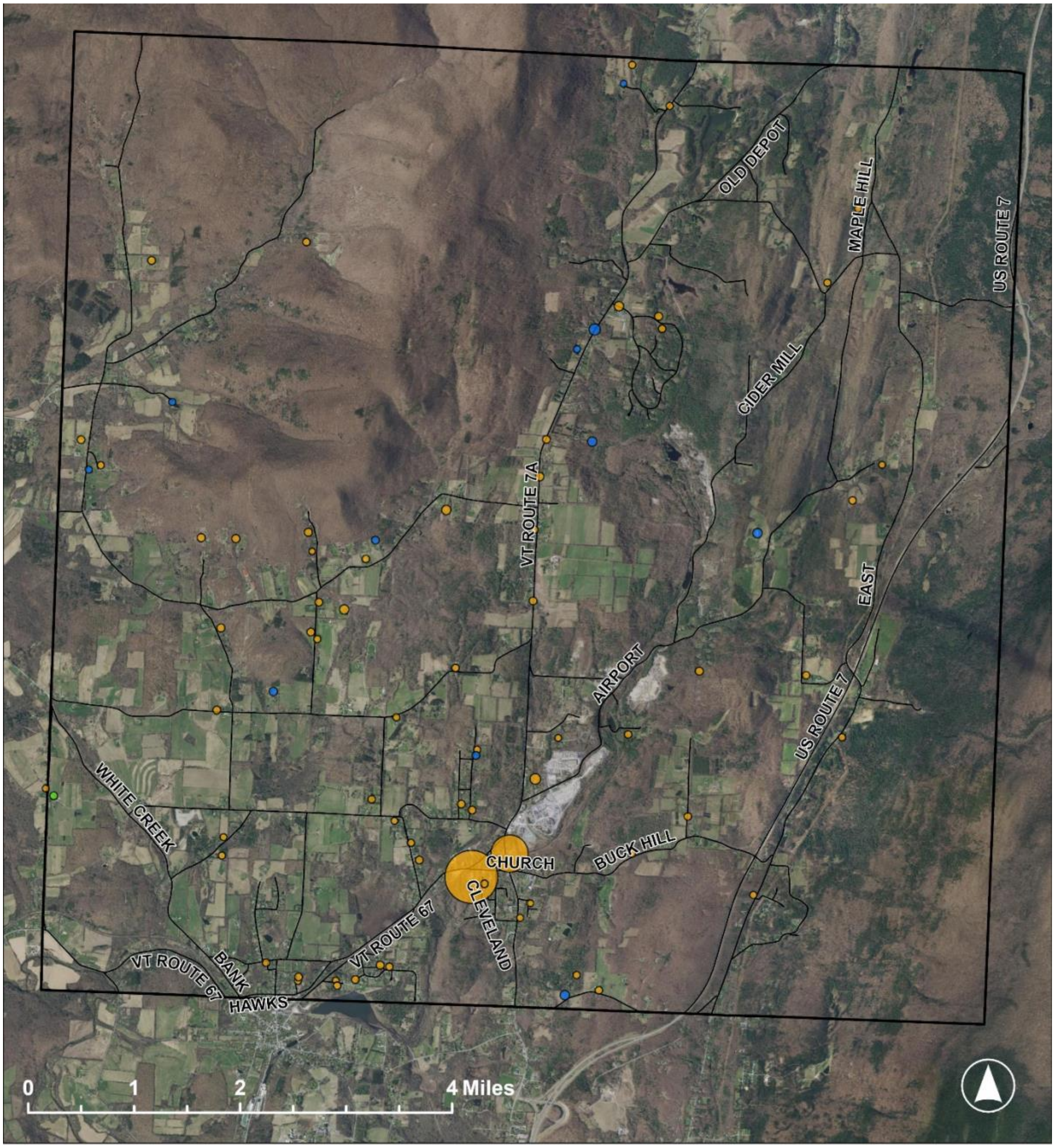
Megawatts are used to measure the output of power plants or the amount of electricity required by an entire city. One megawatt (MW) = 1,000 kW = 1,000,000 watts.

Gigawatts measure the capacity of large power plants or of many plants. One gigawatt (GW) = 1,000 MW = one billion watts.

Existing Renewable Energy Generation Sites

Nearly all energy consumed in Shaftsbury 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. Today limited energy production occurs in Shaftsbury in the form of rooftop solar arrays (total installed capacity of 790 kW as of 2021) and solar hot water heaters (**Figure 12**). At least five local businesses have placed solar panels on the roofs of their commercial buildings: Clearbrook Farm (14.4 kW), Arlington Equine (15 kW), Classic Metal Restorations (21.9 kW), Shaftsbury Self-Storage (150 kW), and T&M Enterprises (225 kW). Shaftsbury also has a number of ground-mounted solar arrays, with capacity of about 112 kW as of 2021, and one biodiesel facility.

Figure 12. Existing Renewable Energy Generation Sources in Shaftsbury. *Source: Vermont Energy Dashboard*



Biofuel Production Facility
Ground-mounted PV
Roof-Mounted PV
— Roads

Size of renewable energy generation source marker scaled relative to site's electricity generation capacity.

There are many more areas in the town where specific scales of solar and wind development are appropriate. The following map analyses, which comply with Act 174 standards for renewable resource mapping (for more details, see Bennington County Regional Energy Plan, pages 80-83), are intended to provide information about renewable resource availability in the town. Maps were generated using GIS (geographic information systems) data layers developed by the Vermont Center for Geographic Information (VCGI). Renewable resource layers were mapped, and 'Known Constraints' (class 1 and 2 wetlands; confirmed vernal pools; floodways; river corridors; significant natural communities; rare, threatened, and endangered species; and national wilderness areas) were removed entirely from available resource areas. Then 'Possible Constraints' (unconfirmed vernal pools; special flood hazard areas; agriculturally important soils; agricultural soil mitigation areas; hydric soils; deer wintering areas; conservation design highest priority forest blocks; and protected lands) were overlapped with renewable resources to highlight where there are 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.

Site-specific study, by the Town Administrator and the town planning commission, is required in order to ascertain whether a mapped constraint truly exists on the site. Maps are good indicators, but are not definitive siting tools.

Regional and Locally-Identified Constraints:

The Town's Planning Commission has decided to implement the following locally-identified constraints (described in greater detail later in this document):

- ***No solar facilities will be permitted in which the solar panels cover more than 20 acres of land.***
- ***No wind turbines will be permitted greater than 40' in height.***

(see **Shaftsbury Energy Conservation, Efficiency, and Renewable Energy Policies**).

Solar

Taking into account existing solar generation in 2015, the Bennington County Regional Energy Plan determined that Shaftsbury should aim to develop an additional 10.5 MW of solar capacity by 2050 to help meet regional and state energy targets (**Figure 13**). This solar energy goal of 10.5 MW was derived by taking into account Shaftsbury population (ranking third in the region), amount of prime solar resource in the town (ranking second for the region), proximity of prime solar resource areas to existing transmission lines, and capacity of existing solar installations.

Solar resource development in Shaftsbury increased significantly from 2014 until 2019, when additional development ceased probably due to the pandemic (**Figure 16**). There is abundant potential for solar-generated electricity in Shaftsbury, and much of this resource is unrestricted by state-identified environmental constraints (**Figure 14**). The resource areas identified in the Shaftsbury solar resource map are more than sufficient to meet the 10.5 MW target. Prime solar areas within one mile of three-phase power total more than 2000 acres in Shaftsbury, which is more than enough to generate the 10.5 MW target established by the regional plan.

For the siting of large-scale solar projects, the state has identified preferred sites as including, but not limited to: rooftops; parking lot canopies; brownfields; landfills; and disturbed land, such as a previously active gravel pit or quarry. Additionally, the Bennington County Regional Energy Plan identified specific sites for potential large solar projects that were unlikely to impact ecological conditions, scenic viewsheds, or other identified issues. In Shaftsbury, these potential sites include: off Cider Mill Road and Airport Road (abandoned gravel pits) and on Tunic Road; on the roof of Shaftsbury Elementary; and on the roof of Bernstein Display (see Bennington County Regional Energy Plan, p. 91). At present, none of the areas identified by BCRC are near enough to a Three-Phase power line to make the siting of large-scale solar projects possible. ***As energy technology advances, it is possible that this will no longer be a hindrance, at which point the Town should consider seeking to site large-scale solar facilities in these specific spots.***

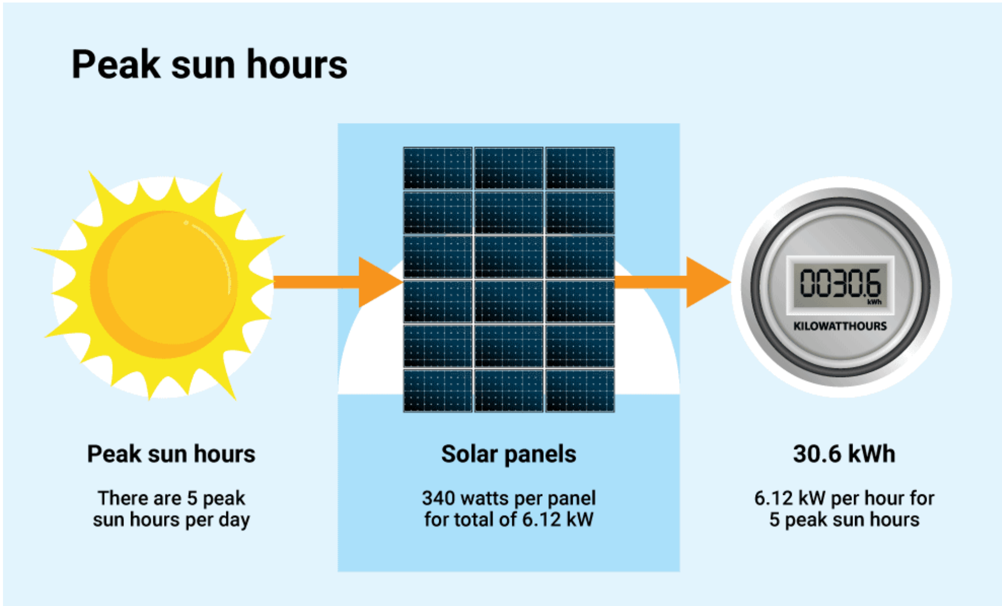
(see **Shaftsbury Energy Conservation, Efficiency, and Renewable Energy Policies**).

Solar Scale Definitions & Examples

Residential-scale:
capacity ≤ 15 kW

Commercial-scale:
capacity ≤ 500 kW

Utility-scale:
capacity > 500 kW

Example illustration of potential electrical energy generated by solar panels

320 watts per panel * 18 panels = 6,120 watts = 6.12 kW 6.12 kW * 5 hours peak sunlight = 30.6 kWh / day (estimated) 30.6 kWh / day * 365 days / year = 11,169 kWh / year
Source: https://www.solarreviews.com/blog/what-is-a-kilowatt-and-what-is-a-kilowatt-hour

Rooftop solar in Shaftsbury could also contribute to the town's solar capacity target (**Figure 15**). The Vermont Public Service Department has developed a rooftop solar generation planning tool that takes into account roof aspect; however, it does not account for roof condition or existing rooftop arrays. Consequently, the tool output is a significant overestimation of rooftop solar potential. For Shaftsbury, this tool estimates potential rooftop generation of 24,790 total MWh in one year. Energy planners in the state have recommended considering only 25% of the potential estimated by the tool until newer versions are developed that can incorporate additional variables. For Shaftsbury, projections estimate about 6,200 MWh of annual rooftop solar generation potential could be achieved.

The Vermont Energy Dashboard currently shows 65 rooftop solar installations in Shaftsbury with a capacity of 790 kW (**Figure 16**). Based on this information and assuming an average rooftop solar installation has a 15 kW capacity, it would take about 700 total rooftop installations to meet Shaftsbury's 10.5 MW share of the regional solar energy goal. **To achieve Shaftsbury's 10.5 MW regional solar capacity contribution, the town would need to add about 10 times the number of rooftop installations currently in place, or installations on about one half of the number of housing units in town.**

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

Solar Screening – The objective of screening policies is to mitigate the visual impacts of ground-mounted solar facilities on natural and historic vistas as viewed from public roads and neighboring residential properties. A summer 2023 survey question about screening solar developments in Shaftsbury received strong support, with 82 percent of respondents indicating that they want the town to adopt screening guidelines for large ground-mounted solar installations. The Town of Shaftsbury is working to adopt a Civil Ordinance which sets specific guidelines for screening of solar facilities with a production capacity in excess of 60kw (AC).

(see **Shaftsbury Energy Conservation, Efficiency, and Renewable Energy Policies**).

Maximum Size – The summer 2023 survey also asked whether Shaftsbury community members wanted to identify a maximum size for a ground mounted solar array in the town. Most respondents agreed that a maximum size should be established. ***The Town of Shaftsbury has established 20 acres as the maximum size for solar facilities in its jurisdiction***.

(see **Shaftsbury Energy Conservation, Efficiency, and Renewable Energy Policies**).

Figure 13. Solar Contributions by Town. *Source: Bennington County Regional Energy Plan*

	2015 Population	Prime Solar (Acres)	Prime Solar in one mile of 3-phase *(Acres)*	Solar Installations *(Count, 2015)*	Existing Solar Capacity *(kW, 2016)*	2050 Goal, New Capacity *(MW)*
Arlington	2,453	493	402	10	260.2	4.0
Bennington	15,483	3,034	2,682	46	2,532.3	25.1
Dorset	2,172	1,113	995	17	683.6	5.2
Glastenbury	9	51	0	0	0	0.0
Landgrove	111	1,835	1,729	2	3.4	5.9
Manchester	4,339	1,870	1,856	23	1,017.3	10.4
Peru	335	2,338	1,016	4	49.7	3.7
Pownal	3,484	1,083	586	6	4,538.7	1.6
Rupert	595	603	458	5	62.5	2.2
Sandgate	481	206	0	0	16.3	0.6
Shaftsbury	3,535	2,693	2,045	17	603	10.5
Stamford	878	302	254	3	30.2	1.9
Sunderland	985	708	696	1	110.8	3.4
Woodford	340	185	75	1	3.2	0.7

Figure 14. Shaftsbury Solar Resource Map. *Source: Vermont Center for Geographic Information*

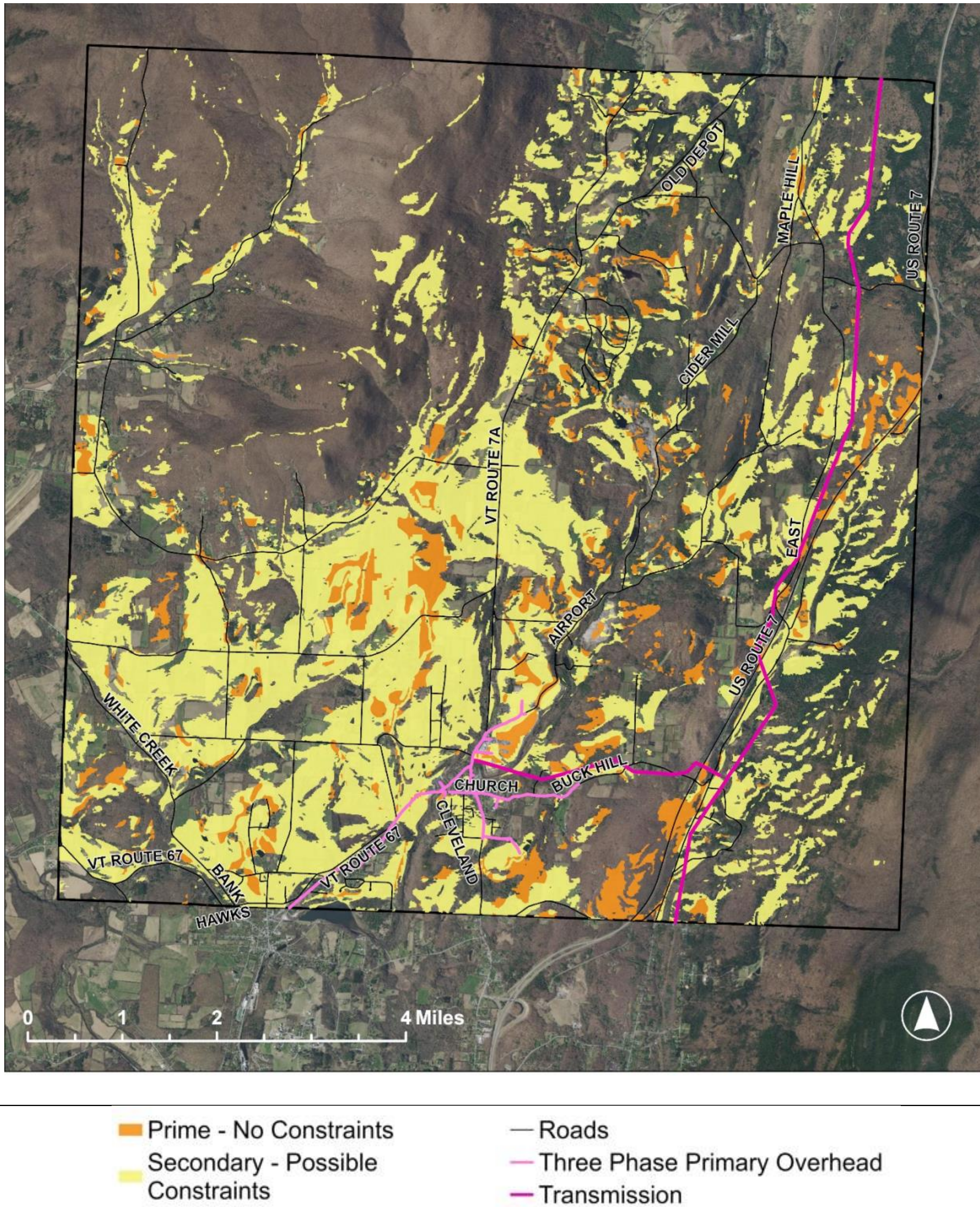
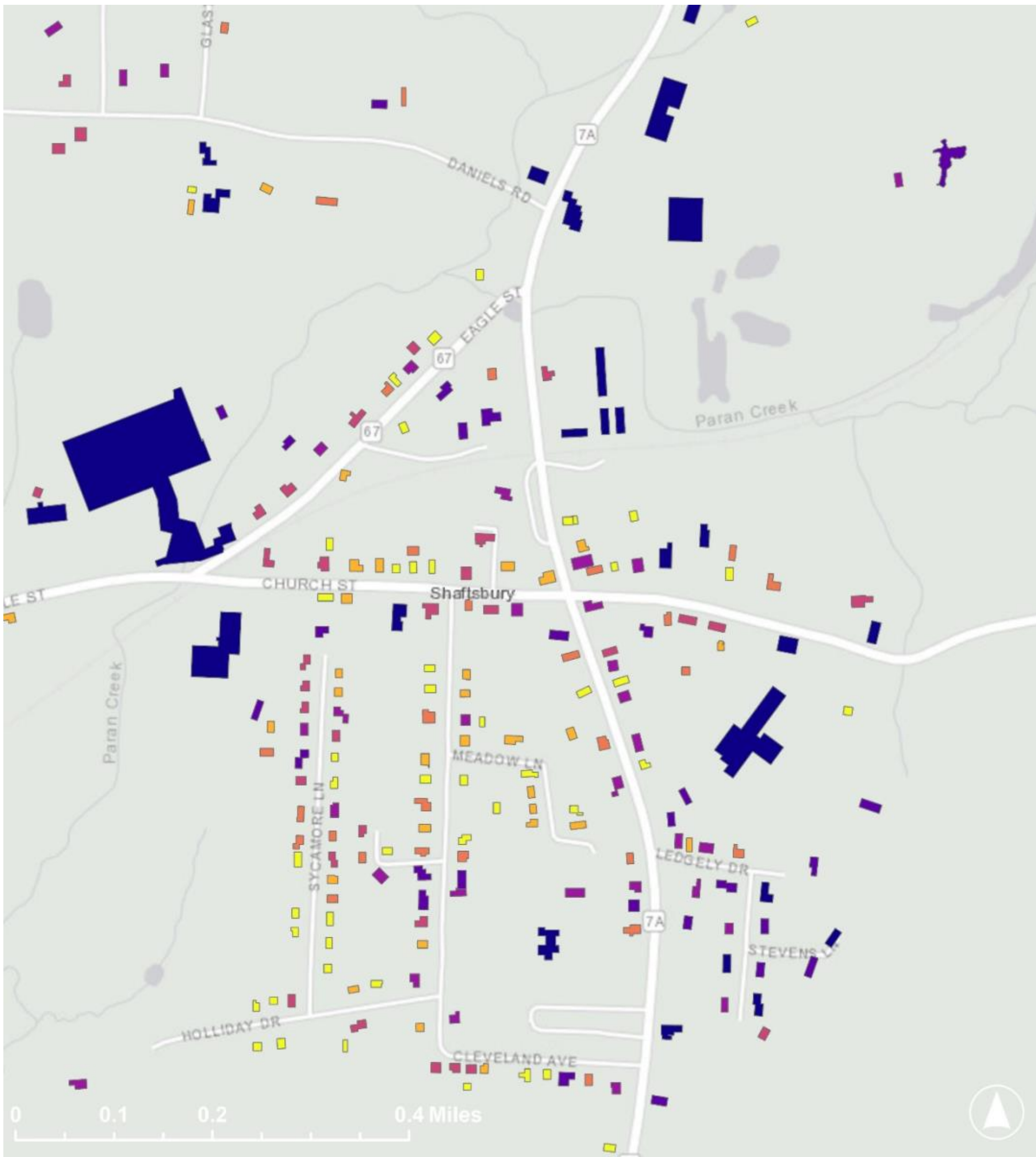
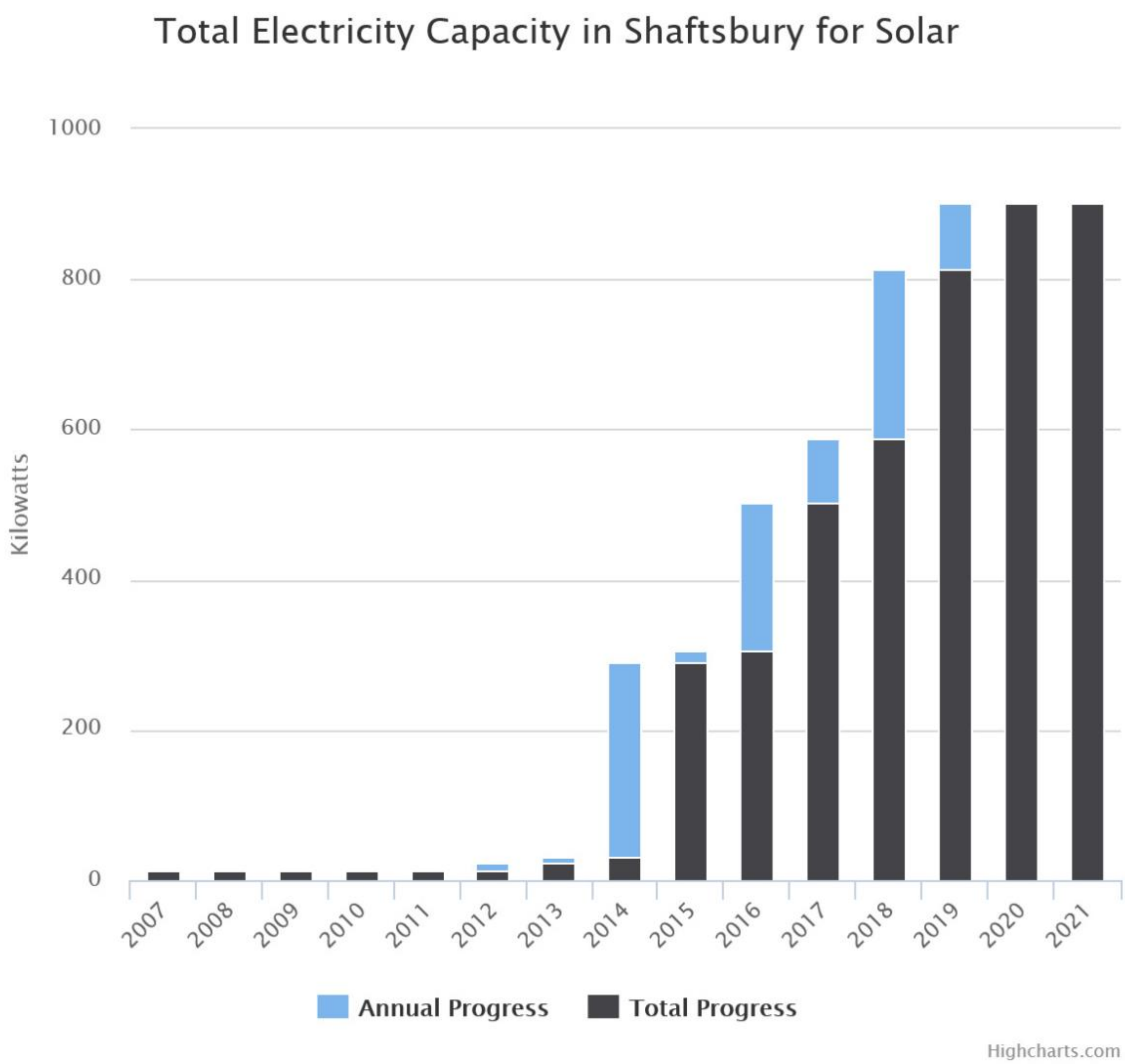


Figure 15. Potential for Roof-Mounted Solar Development in South Shaftsbury. *Source: Vermont Center for Geographic Information*



Electric Productivity (MWh)
- 3.58 - 5.36
- 5.37 - 6.57
- 6.58 - 7.94
- 7.95 - 10.03
- 10.04 - 12.51
- 12.52 - 16.98
- 16.99 - 2392.18

Figure 16. Solar Capacity in Shaftsbury. *Source: Vermont Community Energy Dashboard*



Wind

The Town of Shaftsbury currently has no wind generation facilities connected to the grid. Most of the regional wind energy generation goal is likely to be achieved by a small number of large scale (i.e., greater than 1 MW capacity) installations in towns that have significantly more wind energy generating potential than does Shaftsbury. These towns include Arlington, Sandgate, and Stamford. So, although by population, Shaftsbury's share of the regional goal may be considered to be 2.3 MW, it is likely that Shaftsbury's wind share will be smaller.

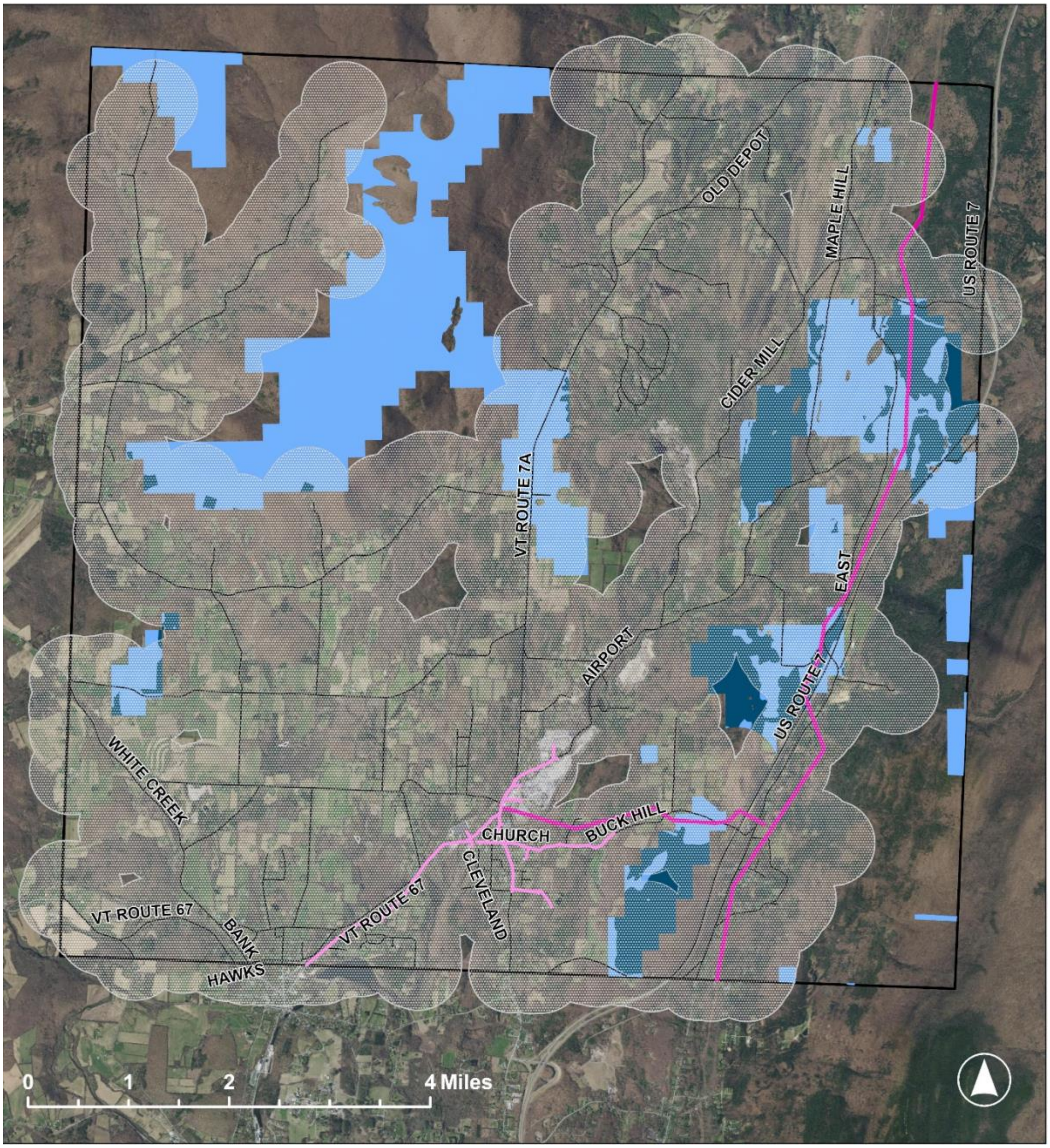
The wind resource map (**Figure 17**) illustrates the limited prime and secondary areas for wind development in Shaftsbury, especially when taking into account a 500-meter buffer around residences for turbines with a generation of 1 MW or more. Incorporating the aforementioned constraints leaves some areas with possible constraints in the northwest quadrant of the town where there is no access to existing transmission lines, as well as spotty areas of prime wind and areas with possible constraints in the southeast quadrant of the town. Other areas throughout Shaftsbury could be considered on a site-specific basis for smaller scale wind development. For example, community-serving wind development that offsets electrical use at municipal buildings or in a defined neighborhood may be appropriate. All wind development must comply with the state's turbine noise standards and environmental regulations.

Since Shaftsbury's 2.3 MW portion of the region's 2050 goal for wind energy development can be reached by the employment of micro-turbine technologies only, Shaftsbury will seek to encourage small-scale household turbines and small-scale community wind projects that conform to the following criteria and limitations:

- ***Antennas, towers, and windmills shall not be located in front yard areas and shall be setback from all property lines a distance equal to or greater than the system height of the structure plus 20 feet;***
- ***Turbines will not exceed a system height – that is, the tower height plus the blade radius from the hub – of 40';***
- ***Turbine-generated sound will never exceed 70 decibels at the property line.***

(see **Shaftsbury Energy Conservation, Efficiency, and Renewable Energy Policies**).

Figure 17. Shaftsbury Wind Resource Map. *Source: Vermont Center for Geographic Information*



Prime - No Constraints
Secondary - Possible Constraints
500 meter Residential Buffer
Roads

Green Mountain Power Utility Distribution
Three Phase Primary Overhead
Transmission

Other Potential Renewable Energy Sources

Due to environmental regulations, it is highly unlikely that new dams or hydro sites will be developed in Vermont. Shaftsbury does not have obvious potential hydroelectric generating resources and therefore hydroelectric generation in Shaftsbury is unlikely.

The soils in low-lying, developed areas of Shaftsbury have high resource potential for geothermal well heating systems. ***Shaftsbury encourages this technology in new residential and commercial construction.***

With about 70 percent of Shaftsbury's land area covered by forested lands, the town has abundant woody biomass resource to be used for local heat generation. High-efficiency wood pellet and wood chip heat systems are a good choice for buildings of sufficient scale such as apartment buildings, schools, and other institutional structures. 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.

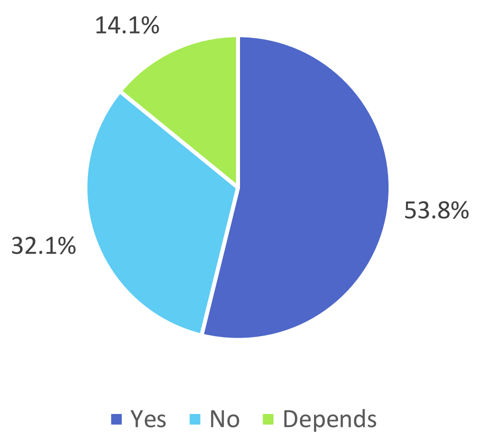
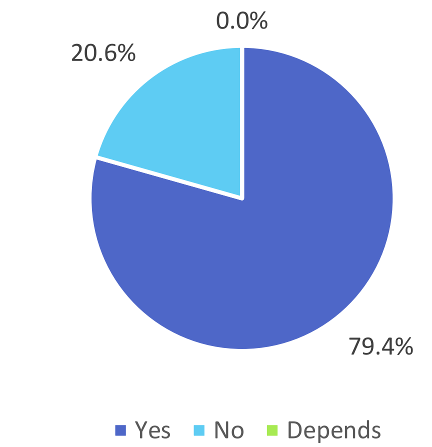
Shasftsbury Energy Conservation, Efficiency, and Renewable Energy Policies

To achieve the energy goals advanced by the state of Vermont, Shaftsbury'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 two-and-a-half decades.

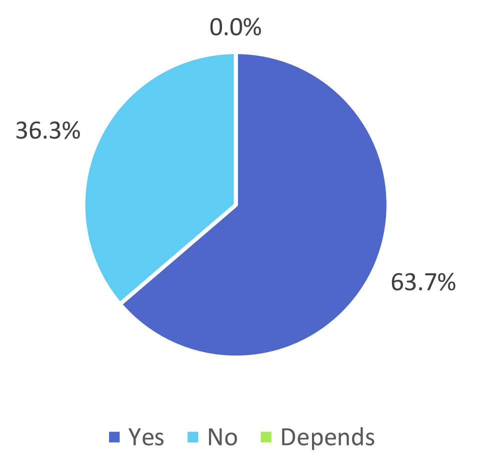
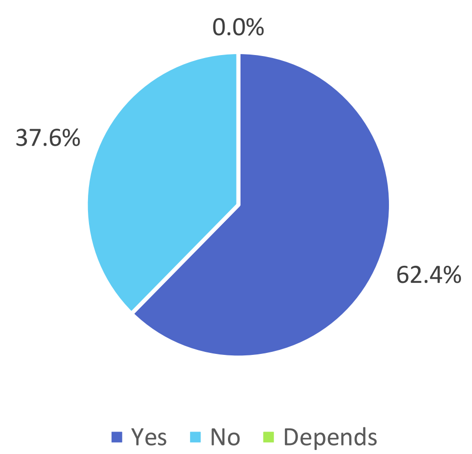
Implications of Summer Survey. To help develop town energy policy, in summer 2023 the planning commission sought public input on the development of town energy policy through a meeting and survey. The survey asked community members to weigh in on questions of municipal leadership, land use planning, municipal infrastructure, transportation planning, and more. The survey was available online from June 15th through July 17th and received 99 responses. Selected results are displayed on the following pages and the full results are included as an appendix.

- **Municipal Leadership.** Respondents favored Shaftsbury's selectboard appointing a town energy committee to shape local energy policy, as well as the creation of a town webpage dedicated to sharing information on energy efficiency programs, and the installation of EV charging stations and ground mounted solar panels at Cole Hall (**Figures 18–21**). Respondents also indicated that they would like the town to adapt zoning to require bike and pedestrian infrastructure be built with new mixed-use and commercial development (**Figure 22)**.
- **Solar Projects.** On questions of land use planning around solar projects, respondents indicated that they would like the town to establish screening standards for ground-mounted solar installations and identify preferred sites for such installations (**Figures 23–24**).
- **Wind Projects.** Feedback on planning for wind developments was more mixed. 60% of respondents stated that they would not like the town to identify preferred sites for large-scale wind turbines in areas with prime wind resources and transmission lines, and responses to a question about promoting small-scale wind did not provide a clear preference (**Figures 25–26**).

Figures 18 and 19. Community Input on Municipal Leadership

<table>
<tr><td>Should the Shaftsbury selectboard appoint a town energy committee that will be responsible for implementing town energy policy?</td><td>Should the town website include a page devoted to providing energy resources and information?</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Figures 20 and 21. Community Input on Municipal Infrastructure

<table>
<tr><td>Should Shaftsbury install EV charging stations at Cole Hall?</td><td>Should Shaftsbury install a ground-mounted solar array or solar canopy at Cole Hall?</td></tr>
<tr><td>
</td><td>
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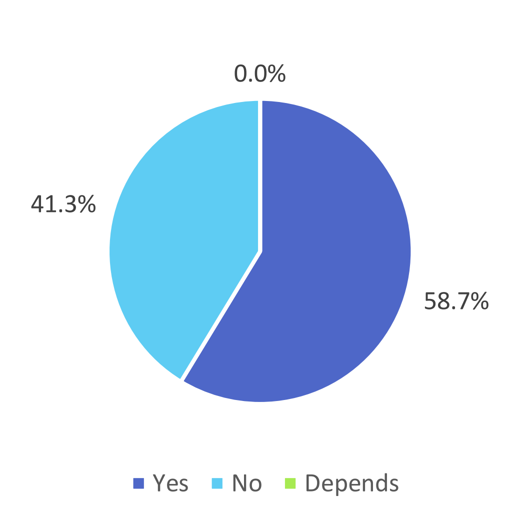
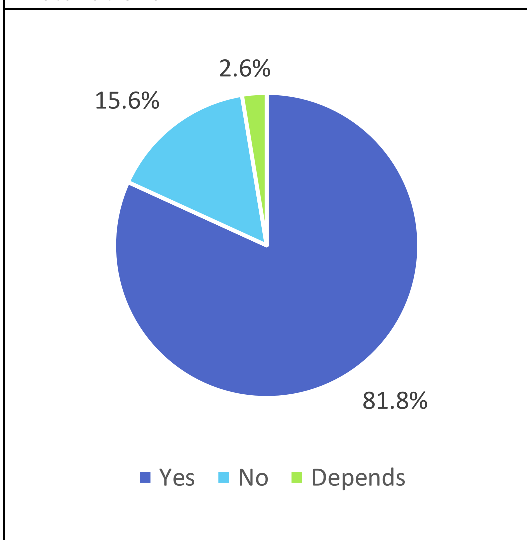
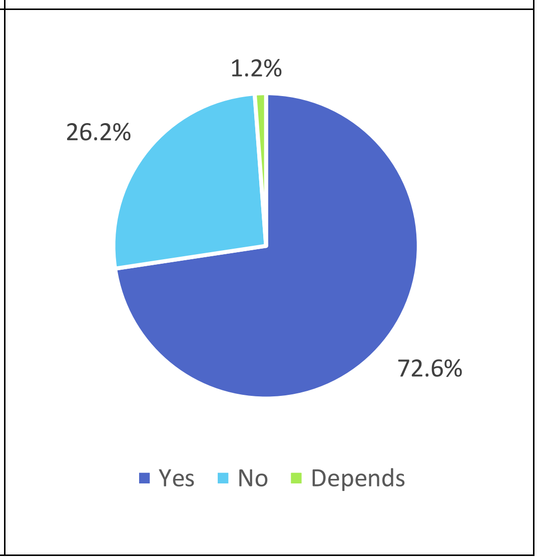
</table>

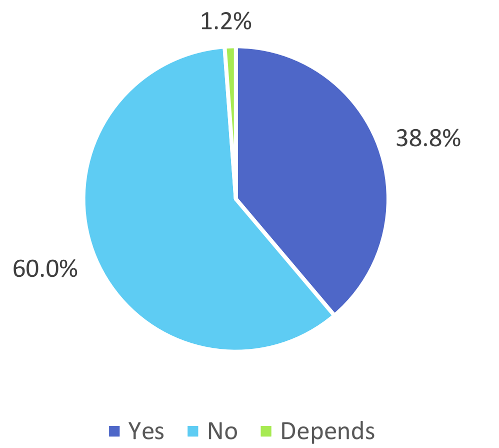
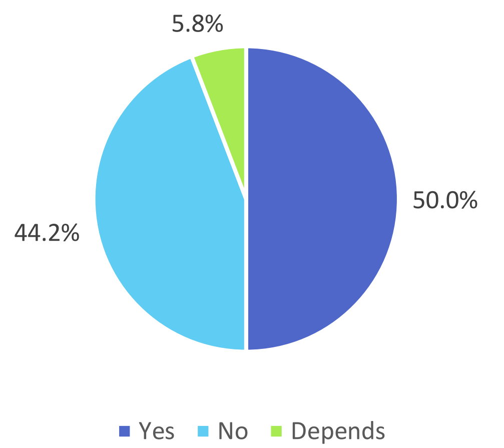
Figure 22. Community Input on Transportation Planning

Should Shaftsbury's zoning regulations require the installation of bike racks and walkways for all new mixed-use and commercial development?


Figures 23 and 24. Community Input on Land Use Planning – Solar

Should Shaftsbury adopt screening policies for large ground-mounted solar installations?	Should Shaftsbury identify preferred sites for ground-mounted solar installations?
	

Figures 25 and 26. Community Input on Land Use Planning – Wind

Should Shaftsbury identify preferred sites for large-scale wind turbines in prime wind resource areas near electrical transmission lines?	Should Shaftsbury promote the installation of smaller scale wind turbines?
	

Constraints on Size. ***Large-scale solar facilities in Shaftsbury will be limited to a maximum of 20 acres in size.***

Requirements for Screening. ***Any solar installation in Shaftsbury that exceeds I acre in size must be screened according to the guidelines and processes of an ordinance on Screening of Solar Facilities the Town of Shaftsbury is working to adopt.***

The following strategies elaborate on and provide additional pathways to realize the town's energy planning objectives. Many of the policies indicated here are discussed in more detail in relevant sections of the Shaftsbury Town Plan, particularly in the areas of transportation and land use. The town 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 town will establish a municipal energy committee to implement this plan and track progress on the policies and actions stated herein.*** This committee could work in partnership with the existing NorShaft Energy Committee to educate residents and business owners on efficiency and electrification programs, promote resources that subsidize energy-related improvements, and share information about current state guidelines on renewable energy siting. The municipal energy committee should also take the lead on gathering community input to develop additional Shaftsbury-specific energy policies as needed. A town staff member or select board member should serve as a liaison to the energy committee.

2. Land Use Policies: Some land use policies promoting compact development in designated villages are already in place in Shaftsbury. ***To further the goals of conservation, increased efficiency, and development of renewable energy laid out in this plan, a new municipal energy committee in Shaftsbury should work with the Shaftsbury Planning Commission to update the town's land use policies to reflect evolving community preferences.*** Under the guidance of the energy committee and planning commission, the town could also consider amending its land use regulations to require EV charging infrastructure be included on large-scale developments, and to require bike and pedestrian infrastructure for new developments.
3. Municipal Infrastructure. ***All municipal infrastructure should be evaluated to identify opportunities for efficiency improvements and renewable energy generation and use. Professional energy audits should be pursued for municipal buildings, and the Town should participate in state and federal grant programs to improve the energy efficiency of its buildings.*** The Municipal Energy Resilience Program (MERP) is a current state program dedicated to providing technical support and funding for municipalities, including professional energy audits of municipal structures designed to identify cost-effective energy saving improvements. Shaftsbury has participated in this state program and will continue to seek such opportunities to support this policy.
4. Building Energy Standards: ***New development in Shaftsbury shall adhere to the state mandated Residential and Commercial Building Energy Standards, should be planned to take advantage of a site's solar resource potential, and should be made to accommodate multiple transportation modes through the Site Plan and Subdivision Review processes.***

Conservation and Efficient Use of Energy

The Shaftsbury municipal energy committee should work with BCRC and NorShaft to coordinate presentations and local conversations that promote energy efficiency and conservation.

5. Residential: This can occur through promotion of 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 in commercial and industrial arenas in the following ways: 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 Sector

7. Electric Vehicle (EV) technology: Shaftsbury has an existing policy encouraging the potential installation of electric vehicle charging stations at Cole Hall, Shaftsbury Elementary, and major employers in town. ***The Town of Shaftsbury will pursue installation of an EV charging station at the town offices.*** Informational presentations for Shaftsbury 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 the BCRC and Drive Electric VT. The town should explore adopting a policy requiring the conversion of the town vehicle fleet to more efficient and less polluting fuel sources.

8. Public transit: ***New public transit routes and the 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.***
9. Commuting Alternatives: ***The municipal energy committee, in partnership with NorShaft and BCRC, should 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.***
10. Complete Streets Design: ***The town should assess existing roads for their ability to accommodate safe and convenient sidewalks and bikeways. Areas for improvement should be prioritized and funding sought to align these areas with Complete Streets guidelines.*** Complete Streets enable safe and comfortable mobility for all users, not just drivers. Complete Streets guidelines often emphasize pedestrian and bicycle infrastructure, including sidewalks, crosswalks, bike lanes, public transportation stops, and prioritize reduced risks for pedestrians, cyclists, and drivers alike.

Renewable Energy Development

11. ***The town should offset ongoing fossil fuel consumption by developing renewable energy facilities on appropriate town-owned parcels. The town should support interested residents in developing renewable energy facilities on their properties.***

Local Food Systems

12. 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.
13. ***The municipal energy committee should encourage residents to support the local food system by promoting nearby farmers markets, farm stands, and other local food programs.***