Glover Enhanced Energy Plan:

Introduction:

This Enhanced Energy Plan stands as a separate but linked chapter to the Glover Town Plan. This plan has two functions, first to meet the standards of Act 174 which are explained in more detail below and second, to guide the actions of the town and town energy committee in meeting the goals set out in the 2016 Vermont Comprehensive Energy Plan (also known as 90 x 2050 strategy).

The 2016 Vermont Comprehensive Energy Plan (90 x 2050), aiming for 90% renewable energy by 2050, specifies the following energy goals for Vermont:

- Reduce total energy consumption per capita by 15% by 2025, and by more than one third by 2050
- Meet 25% of the remaining energy need from renewable sources by 2025, 40% by 2035, and 90% by 2050
- Meet the 25 by 25 goal for renewable energy (25% in-state energy supply for all energy uses by 2025)

In 2016, the Energy Development Improvement Act (a.k.a. Act 174) was passed to address the siting and development of commercial energy generation facilities, specifically solar and wind projects under the jurisdiction of 30 V.S.A Chapter 5, Article 248a. These energy projects are exempted from local permitting. Project developers must obtain a Certificate of Public Good (CPG) from the Public Utility Commission. Therefore, the local municipality (i.e., Glover) would not have control over the location of these facilities. The only involvement available to a municipality is through public hearings in the CPG process.

If a municipality meets the standards of Act 174, it will receive a "determination of energy compliance" and be afforded "substantial deference" to land conservation measures adopted by the municipality. These land conservation measures, or "siting criteria", are included in the Town Plan, and provide Glover with more control over siting.

While all municipal plans are required to contain an energy element, Act 174 created additional voluntary standards. The effect of the inclusion of these additional standards affords a municipal plan "substantial deference" rather than simply the "due consideration" that is afforded to municipal plans that meet the basic requirements of 24 VSA Section 4382.

The basic requirements for an energy plan are:

- *an analysis of energy resources, needs, scarcities, costs and problems within the municipality,*
- *a statement of policy on the conservation of energy, including programs, such as thermal integrity standards for buildings, to implement that policy,*
- *a statement of policy on the development of renewable energy resources, and*
- *a statement of policy on patterns and densities of land use likely to result in conservation of energy*.

The additional standards specified by Act 174 are voluntary, and are outlined in a document created by the VT Department of Public Service. These standards are divided into three parts: Analysis & Targets, Pathways, and Mapping. The analysis of existing energy use must be broken out by electric, thermal and transportation energy, and the "pathways" must include actions that can be taken to achieve the targets. The enhanced standards also include a mapping component that should demonstrate that there is sufficient opportunity for achieving the energy generation targets. A description of areas that are suitable and unsuitable for the siting of renewable energy facilities should be included, and identification of preferred sites in the municipality is encouraged.

This new Energy Plan for the town of Glover has been developed to address the enhanced Energy Planning Standards established by the Vermont Department of Public Service, pursuant to Act 174. The document will lead you through the following sections:

I: Analysis of Energy: Use, Generation, and Distribution
II: Implementation of Energy Efficiency Measures: Goals and Objectives

A) Energy conservation & more efficient energy use
B) Reducing transportation demand and single occupancy vehicles trips, and encouraging the use of renewable sources for transportation
C) Patterns and densities of land use likely to result in conservation of energy

III: The siting of renewable energy generation
IV: MAPS

I: Analysis of Energy- Use, Generation, and Distribution:

In order to effectively evaluate where the Town of Glover needs to go in terms of their energy future, the community needs to understand how it is currently using and generating energy. This section outlines the estimates of current energy use for the community in the areas of electricity, thermal, and transportation. This information is based on best available data and may change over time as new information is provided.

Here are a few definitions that may help in reading this document:

- MMBTU- Millions of British Thermal Units- this measurement is used to compare the output from different energy sources, all of which come in different units, such as gallons, cords, or kilowatt hours. By converting all of these sources to BTUs we can get a rough approximation of how we consume energy -- how much goes to heating homes, how much gets burned when we drive, and how much we use when we keep the lights on.

- MWh- Megawatt Hour- this measurement is used to measure the expected output of renewable energy generation, i.e. how much you can expect to generate over one hour. For example if you have a fixed solar installation with a capacity of 4 megawatts (MW), it would be reasonable to expect to get a little over 4,900 MWh a year. You would calculate that by multiplying the capacity factor (which is different for each energy source) by the number of hours a year. The capacity factor for solar in this example, is approximately 14% to account for the fact that the sun isn't always shining. A typical Vermont home uses 11 MWh a year.

- REC: Renewable Energy Credit: each REC represents the environmental benefits of 1MWh of renewable energy. Power generators can sell the green attributes of the energy they produce as RECs and whoever buys the RECs can then claim the environmental value of that energy as their own – even though they did not generate that clean power.

A: ELECTRICITY

Electricity is provided to the town of Glover primarily by Vermont Electric Coop (VEC). Lyndonville Electric Department provides service to a small section in the southernmost section of Town, shown in Image 1. Although Washington Electric Coop is assigned a small service area in Glover it provides no active service in the town of Glover. VEC is meeting the Vermont Renewable Portfolio Standards (RPS) and is approximately 55 percent renewable and 73 percent carbon free. VEC's 2019 initial power supply mix is shown in Image 2 below. This chart does not represent the Renewable Energy Certificates (RECs) associated with the energy, but rather the initial fuel sources of the energy VEC purchased to meet the demand of its membership in 2019.

Image 1: Vermont Electric Utility Service Territories

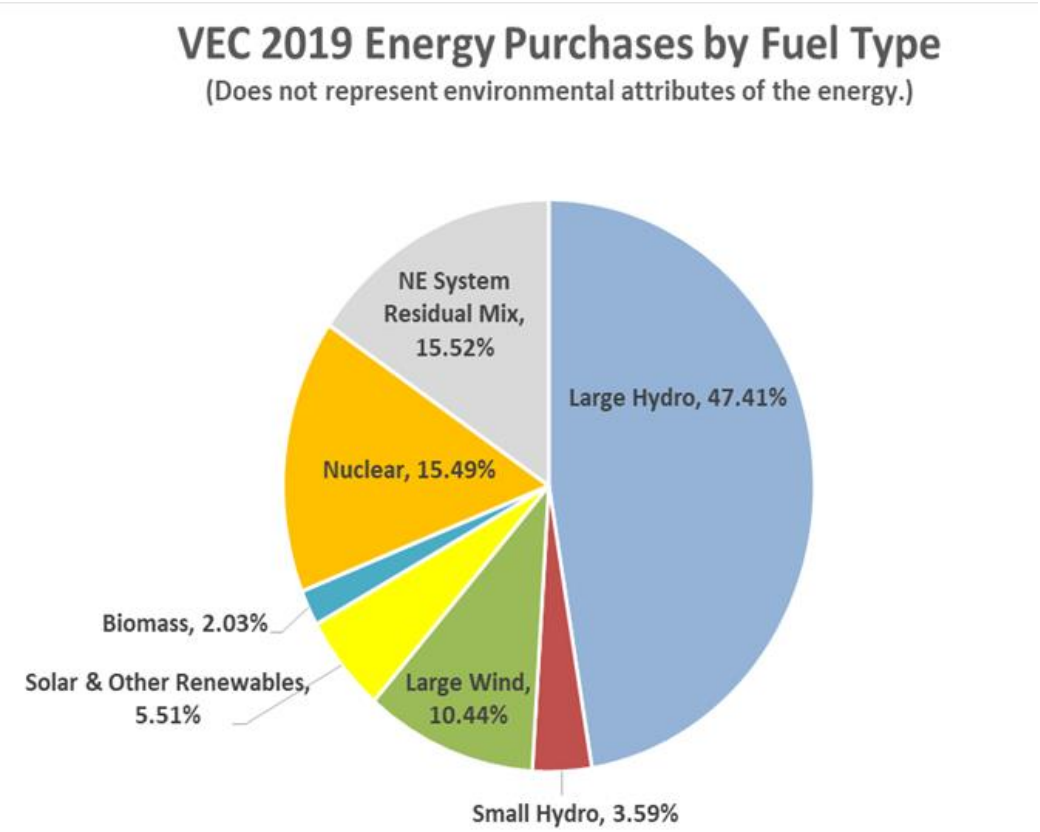

Image 2: Vermont Electric Cooperative 2019 Fuel Mix *before* sale of Renewable Energy Credits

At VEC over 50% of electrical energy is produced from large hydro such as Hydro Quebec, and smaller hydro stations in Vermont. 15.49% is nuclear energy. 17.98% are renewables such as wind, wood, solar, and methane. The remaining 15.52% comes from the New England Residual mix.

A small portion of the Town of Glover receives its electricity from the Village of Lyndonville Electric Department. Similar to VEC, a significant portion of the energy produced by Lyndonville Electric is renewable. Image 3 shows the breakdown of their fuel mix for 2017. Residual mix, is a combination of market purchases and contracts.

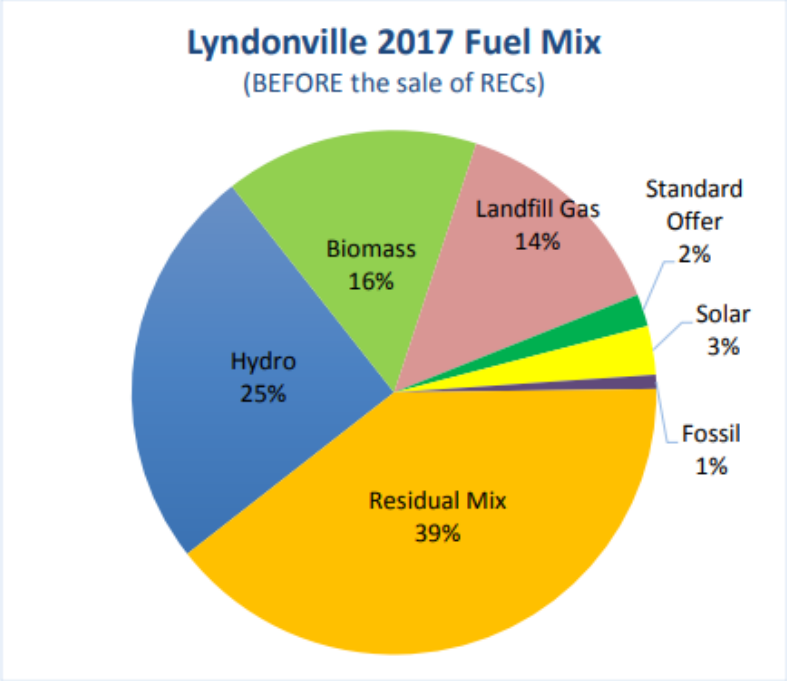

Image 4: Lyndonville Resource Report 2017 Available at: https://vppsa.com/wp-content/uploads/2018/12/Lyndonville-Resource-Report-2017.pdf

Electricity usage in Glover for the years 2016-2019 by sector in MWh is shown in Table 1. Because most of the electric energy in the VEC and WEC distribution sheds are sourced from renewables such as hydro, wind, wood and solar, increased usage may mean decreased usage from nonrenewable energy sources and is not purely a sign of less energy conservation. Total consumption for 2019 for both commercial/industrial and residential was 5,410 MWh, the equivalent of **18,445 MMBTU.**

Electricity Usage in Glover in MWh per year				
	2016 (MWh)	2017 (Mwh)	2018 (Mwh)	2019 (MWh)
Residential	3,609.297	3,704.722	3,925.508	3,876.868
Commercial & Industrial	1,356.309	1,707.326	1,748.768	1,533.424
TOTAL:	4,965.606	5,412.048	5,674.276	5,410.292

Table 1. Efficiency Vermont Calculations of MWh per year

B: THERMAL

The estimated number of commercial buildings in Glover in 2019, according to the Vermont Department of Labor, is 29. The estimated total heat energy consumption of these 29 buildings is 26,429 MMBTU.

Vermont Electric Company services 724 housing units in Glover. The total number of units may be higher, to account for those that are not connected to the electrical grid. The ACS 2015 5-year estimates 787 housing units in Glover, of which 484 are occupied and 303 are vacant. “Vacant” housing units include those that are used seasonally. Approximately 30% of the houses in Glover were built before 1940 and often require more energy to heat. The estimates provided in the chart below account for the age of the housing stock, since pre-1940 housing structures are likely to be “leaky” and poorly insulated. The total energy used for heating all occupied homes is 65,505 MMBTU.

Combined MMBTU for all buildings in Glover is currently **91,934 MMBTU.**

Table 2 shows the breakdown of households by primary fuel type and the annual average use per fuel type. The predominant fuel type used in Glover is wood, making up 48% of all households primary heat source. Fuel oil makes up 37% of households followed by 12% using Tank/LP gas. The category "other" includes all fuels not specified elsewhere.

Please note that ACS numbers are *estimates,* and are not ground truthed numbers. While the 2015 ACS 5-year estimates have 11 households using electricity, the 2018 5-year estimates have 0 households using electricity. With margins of error, there are most likely somewhere between 0-11 households using electricity as the primary heating source.

Occupied Residential Heating by Fuel Source			
Fuel Type: Space Heating	**# of Households**	**Total Average Use (Annual)**	**% Use: (All Households)**
Tank/LP/Etc. Gas	56	56,179 gallons	12%
Electricity	0	0 KWh	0%
Fuel Oil	179	99,933 gallons	37%
Wood	234	1,055 cords	48%
Coal/Coke	8	40 tons	1.5%
Solar	0	--	0%
Other	7	--	1.5%

Table 2: 2018 ACS 5-year Estimates of Occupied Residential Heating by Fuel Source

C: TRANSPORTATION

Transportation is the second largest consumer of energy in Glover. Transportation typically consists of passenger vehicles and light duty trucks.. Transportation accounts for **59,907 MMBTU annually**. The breakdown of gallons used and vehicle miles traveled to calculate total annual MMBTU is shown in Table 3. The average Vehicle Miles Traveled (VMT) is estimated by Northern Vermont Development Association (NVDA) data which accounts for longer commutes and incidental trips in the rural region. Registered Electric vehicles (EV) numbers are determined by the Vermont Energy Investment Corporation and use the Department of Public Service's average of 7,000 VMT's per EV annually. The VMT for EV's is lower than for traditional combustion engine vehicles for a few reasons; they tend to be used in more densely settled areas, they are often a second car and do not get as heavily used, and it may be that users of EV's opt for transportation alternatives when possible, such as bicycles and walking for short trips and mass transit for short and long trips.

According to the 2018 ACS 5-year estimates, there are approximately **847 vehicles** in the municipality. As of 2018, 3 vehicles were registered as EV's; one is an All Electric vehicle (AEV) and two are Plug-In Hybrid Electric (PHEV). EV's are more energy efficient than gasoline and diesel combustion engine vehicles. In comparing the MMBTU between EV's and internal combustion engine vehicles, one EV typically uses 7.96 MMBTU annually while a single internal combustion engine vehicle consumes 74.68 MMBTU annually.

Transportation Energy Usage

Total Vehicles: **847**	Average Annual Vehicle Miles Traveled: (VMTs) per vehicle: 14,000	Fossil Fuel: **462,115** gallons **56,036** MMBTU Ethanol: 45,704 gal 3,872 MMBTU Total: **59,907 MMBTU**
Total Registered EV's: 3 AEV: 1 PHEV: 2	Average Annual Vehicle Miles Traveled: 7,000	Total: **24 MMBTU**

Table 3: 2018 ACS 5-year Estimates on Total # of Vehicles, gallons consumed, and MMBTU
** Registered EV's as of 2018, Vermont Energy Dashboard*

In total, the amount of energy currently consumed by electricity, thermal, and transportation is summarized in Chart 1.

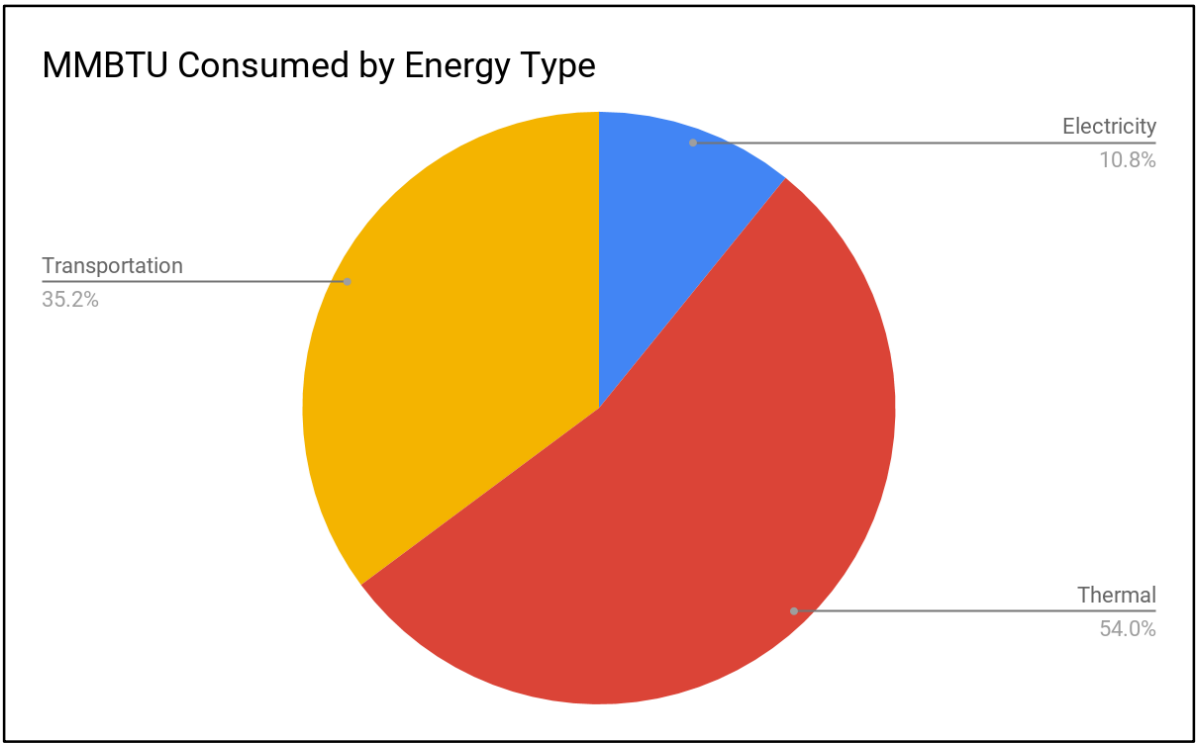

Chart 1: MMBTU Consumed by Energy Type for Town of Glover*
*from most recent ACS-2018 projections and Efficiency Vermont data

D) Current Renewable Generation

The Municipality of Glover currently generates **141.5 MWh** of renewable energy.

Wind accounts for 57.7 MWh. There are two known sites of wind energy generation in Glover; one owned by Nathaniel Gordon and the other by Bertold Francke. Both sites are small scale wind.

Current solar energy generation accounts for 83.8MWh. There are currently 24 solar sites in the Town of Glover according to Brighter Vermont's Community Energy Dashboard (see Energy Dashboard website for complete listing of all solar sites). Three of these sites are ground mounted solar displays, one is a ground mounted solar tracker, and 20 sites are rooftop solar arrays.

No energy is being generated by hydro, biomass, or other sources within the town of Glover at this time.

II: Implementation of Energy Efficiency Measures: Goals and Objectives

Fulfilling the goals of the 2016 Comprehensive Energy Plan (The 90 x 2050 approach) requires two overarching actions:

- reducing energy use through energy conservation and
- replacing fossil fuel sources with renewable fuel sources

Targets for future energy use and generation were developed by Vermont Energy Investment Corporation using a regional **Long-Range Energy Alternatives Planning (LEAP)** analysis. **The LEAP analysis identifies pathways that Glover can take in order to meet the statewide 90x2050 goal.** It is very important to note that LEAP projections exist to show the massive scale of change that needs to happen, but they remain hypothetical.

Targets for Future Energy Use:

The 2025, 2035, and 2050 targets for thermal and electric efficiency improvements, and use of renewable energy for transportation, heating, and electricity for Glover are broken down into the following 3 themes:

A) Energy conservation & more efficient energy use
B) Reduction of transportation demand and single occupancy vehicles trips, and utilizing renewable sources for transportation
C) Patterns and densities of land use that are likely to result in conservation of energy

A) Energy conservation & more efficient energy use

Consuming less energy is the most effective way to reduce energy needs. More efficient electrical equipment, high efficiency heating systems and improved insulation and weatherization of new and existing structures, using less energy in homes, and less fossil fuels for transportation are key parts of meeting the 90 X 2050 goal. These methods are supported and encouraged by the town. For the purposes of this section, thermal and electrical efficiency will be defined as overall improvements or reductions in the amount of energy used to run mechanical systems or provide climate control for structures.

Glover Energy Committee has been active in promoting conservation of energy. Past projects include:

- Window Dressers Project - Building and installing window inserts in Glover and surrounding communities to help retain thermal heat and reduce energy demand in housing units
- Community environmental and energy conservation movie and discussion events to help inform community members about these important topics and engage community members in next steps to help reduce energy usage
- Ongoing outreach about energy conservation measures at Glover Farmer's Market on Sundays
- Mailing postcards to community members to share information about, Efficiency Vermont incentives, and NETO home weatherization opportunities for low-income residents.
- Collaboration with Area Agency on Aging conducting home energy visits, with distribution of energy efficient light bulbs and water saving showerheads
- Hosting Button Up and similar information sessions in the local K-8 school and for local residents
- Replacement of traditional fluorescent tubes with LED tubes in the Municipal Building and Town Hall first floor.
- Improved air sealing, insulation and storm windows in the Town Hall.
- Foam insulation and an efficient pellet-fired furnace installed in the basement of the Municipal Building.

GOAL 1: Promote conservation of energy by individuals and organizations.

A large part of encouraging conservation of energy and more efficient energy use is providing information to people about conservation and supporting environmental and sustainability efforts. Understanding energy use includes electrical, thermal and transportation energy, plus all the systems embedded in those veins; food production and

distribution, waste management, housing, economics, and business. Increasing the town's awareness of energy issues and ways to make positive changes, are a vital part of achieving this goal.

ACTIONS:

- Continue established events and efforts to provide the community with information about energy conservation, energy efficiency, sustainability, and climate change hazard mitigation
- Provide virtual opportunities to learn about energy conservation, energy efficiency, sustainability, and climate change hazard mitigation especially during times when in person learning opportunities pose challenges
- Promote local farming, local food production, and the adoption of regenerative agriculture
- Encourage conservation of material through sharing networks (such as clothing swaps, tool libraries, reuse of building materials, and Take it or Leave it items at the recycling center)
- Encourage participation in recycling, composting, and reducing single use containers

GOAL 2: Encourage more efficient use of energy in building structures and systems, including upgrades to electrical equipment, improved weatherization to reduce heating energy demand, and thermal heat switching to a renewable fuel source

Electrical Efficiency Improvements: Upgrades to electrical equipment will reduce the amount of energy used to run mechanical systems in residential and commercial buildings and increase energy efficiency. Electrical efficiency is defined as overall improvements or reductions in the amount of energy used to run mechanical systems. This can include replacing older appliances with more energy efficient models, switching traditional lawn tools to high efficiency electrical lawn tools, and upgrading to more efficient lighting, such as LED.

TARGETS:

Electricity Efficiency Improvements

	2025	2035	2050
Estimated number of residential customers	752	797	845
% of residential customers to upgrade electrical equipment	24%	35%	49%
# of residential customers to upgrade electrical equipment	179	281	412

Table 4: Electricity Efficiency Improvement LEAP Targets

Thermal Efficiency Improvements: Increasing the number of buildings that are adequately weatherized, defined as buildings that achieve an average of 20- 25% reduction in MMBTU, will reduce heat energy demand. Reduction in heat energy demand through weatherization is an **absolutely essential** component of meeting 90x50 goals. Increased fuel switching (from non-renewables to renewables) will not compensate for lower weatherization targets. On the other hand, more aggressive weatherization strategies will reduce fuel switching targets.

TARGETS:

Residential and Commercial Thermal Efficiency Improvements	2025	2035	2050
Estimated number of households	501	531	563
% of households to be weatherized	18%	30%	30%
# of households to be weatherized	92	160	171
Estimated number of commercial establishments	13	13	14
% of commercial establishments to be weatherized	5%	7%	13%
# of commercial establishments to be weatherized	1	1	2

Table 5: Residential and Commercial Thermal Efficiency Improvement LEAP Targets

Thermal Heat Switching: Thermal heat switching is focused on shifting from nonrenewable sources such as propane and oil, to renewable sources such as wood, solar, and electric heat pump technology. Reducing a home's heat demand comes first, weatherization can not be substituted by thermal heat switching. However, a more sustainable and efficient renewable heating system in tandem with improved weatherization can greatly conserve energy and provide more efficient energy use.

TARGETS:

Thermal Fuel Switching Targets for Residential and Commercial	2025	2035	2050
New Efficient Wood Heat Systems in Residences	235	192	139
% of households with Wood Heat Systems	47%	36%	25%
New Efficient Wood Heat Systems in Commercial Establishments	2	2	3
% commercial establishments with wood heat systems	14%	17%	22%
New Heat Pumps in Residential Units	70	146	186
% of households with Heat Pumps	14%	28%	33%
Estimated commercial establishments with Heat Pumps	1	1	2
% of commercial establishments with Heat Pumps	5%	9%	13%

*Table 6: Thermal Fuel Switching LEAP Targets for Residential and Commercial Buildings**

**Targets are based on a methodology developed by the regional Long-term Energy Alternatives Planning (LEAP) analysis and are cumulative. The overall percentage of households with wood heat systems is decreasing because the percentage of households using heat pumps increases more rapidly and accounts for a greater percentage of all heat source types.*

For heating purposes, the primary options for fuel switching are modern, efficient wood heating systems and heat pumps. Images 4 and 5 show the more efficient 90% x 2050 scenarios. Even if the population and economy grows, energy use *actually declines* because of efficiency and electrification. Electrification of heating and transportation has a significant effect on total demand, because the electric end uses are three to four times more efficient than the versions they replace. This explains why even though wood heating (including cord wood) continues to play an important part in the area's energy use, it is the ***growth in electric heating that reduces overall energy use.***

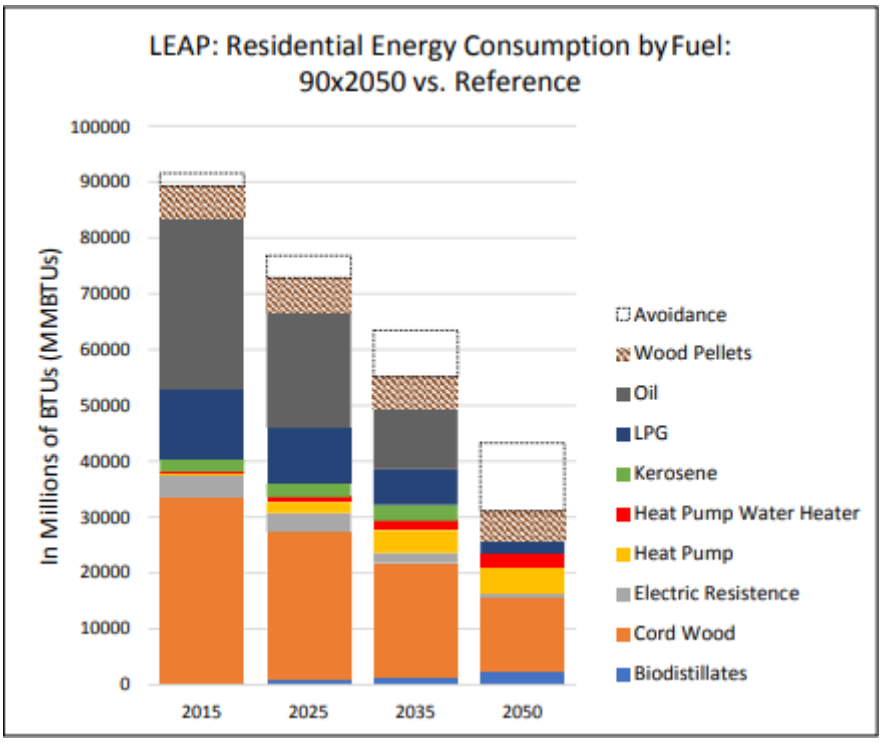

Image 5: LEAP Scenario for Residential Thermal Efficiency and Fuel Switching

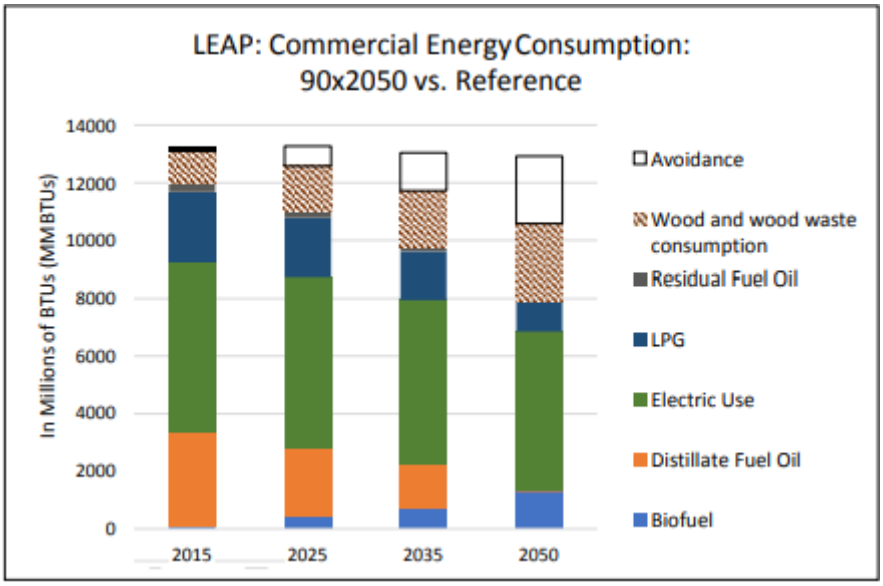

Image 6: LEAP Scenario for Commercial Thermal Efficiency and Fuel Switching

ACTIONS:

- Share Efficiency Vermont, Vermont Electric Cooperative, and Lyndonville Electric, HEAT Squad and NETO incentives that promote electrical and thermal efficiency and thermal heat switching on multiple media outlets
- Provide information sessions for town residents and property owners about energy efficiency upgrades, weatherization, thermal heat switching, and the economic benefits of efficiency improvements.
- Encourage roof mount and ground mount solar installations on houses and commercial buildings and share solar tax credit and incentive information

GOAL 3: Demonstrate municipal leadership in energy conservation and efficiency

The municipality of Glover can lead the way on energy conservation and energy efficiency by modeling energy efficient practices. Successful modeling of energy efficiency can encourage town residents and property owners to make energy efficiency changes to their own homes and properties as well.

ACTIONS:

- Support efforts to establish a municipal solar power site in West Glover to have net-metered credits offset the energy demands of town buildings, streetlights, and sewer pump stations.
- Continue weatherization and efficient electrical and heating system upgrades in the town buildings and Glover Community School as a model of best practices in energy conservation and energy efficiency
- Promote municipal buildings' and properties' use of renewable energy sources such as high efficiency wood heat, rooftop solar, or heat pump technology
- Encourage the placement of any new municipal building in existing compact village areas, as appropriate
- Report annually the energy use of Town buildings as improvements are made

B) Reducing transportation demand and single occupancy vehicles trips, and encouraging the use of renewable sources for transportation

According to the 2016 Vermont Comprehensive Energy Plan, transportation accounts for approximately one third of the overall energy use in Vermont, at 33.7%. Nationally, transportation represents 28.6% of overall energy use. This difference is a result of Vermont's higher dependence on automobile transportation due to the state's rural character, more dispersed population, as well as a relatively small industrial base.

In order to meet the 90% renewable energy use by 2050 two actions need to happen:

- fewer vehicle miles need to be traveled and
- those miles travelled need to be far less energy consuming.

Targets for fuel switching as a method for making miles traveled less energy consuming are in Table 10 below. Please keep in mind that the LEAP projections exist to show the massive scale of change that needs to happen.

As the Municipal Plan and this Energy Plan progress and targets are met, the Town of Glover should evaluate additional actions that will promote a shift away from vehicle use rather than rely on the conversion of vehicles to renewable fuels.

GOAL 1: Promote alternative systems and structures that reduce transportation demand and single occupancy vehicle trips.

The average resident from the NEK travels approximately 14,000 vehicle miles a year. That is 2,000 more miles than the national average of 12,000 VMT. Reducing vehicle miles traveled is a critical component of reducing energy consumption. There are many ways to encourage drivers to spend fewer miles on the roads.

As seen in electrical and thermal energy sectors, reducing overall demand for transportation is the most effective way to reduce transportation energy consumption. Conserving energy can happen through opting to walk or bicycle to destinations, and by telecommuting or holding virtual meetings. Either by not moving or by moving your own body as transportation, the number of vehicle miles travelled is reduced.

Even if people are using cars less, cars will continue to be necessary for some travel. We will continue to need to move from place to place over large areas. Carpooling and use of public transit, such as RCT (Rural Community Transport), as well as car sharing options, can further reduce the amount of energy used for transportation. Having one car driving with three people in it is much more energy efficient than driving three cars with one person each. Car sharing can help reduce miles travelled as well, by placing a "pause" into the "choosing to drive cycle". When a vehicle is not available all the time, there is a greater likelihood the individual will think about the necessity of the trip. Small trips are often reworked into larger trips (aka. "trip chaining") when vehicles are a shared tool, reducing VMT.

ACTIONS:

- Maintain membership in the Communications Union District (CUD) and support NEK Broadband's efforts to provide high speed reliable internet access to all 911 addresses
- Encourage the extension of sidewalks in the village center for safe walking to amenities (to the library and town offices, to the school) and in West Glover from Parker Pie to Ambulance Bay and Church
- Provide opportunities for community members to try e-bike technology as a means of local transportation, and share incentives offered by Efficiency Vermont and Electric Utility companies
- Support Rural Community Transport (RCT) for public transportation to farther reaching locations
- Maintain local businesses that provide essential services in the village centers (grocery, library, EV charging stations)
- Promote the concept of car sharing and seek opportunities to provide Glover residents with a car share system, as appropriate
- Encourage and investigate the building of a bike path between Glover and Barton

GOAL 2: Encourage the use of renewable energy sources for transportation

Fuel switching from a single internal combustion engine vehicle to a more efficient renewable fuel sourced vehicle, such as EV, greatly reduces the number of MMBTU consumed per vehicle. A typical internal combustion engine vehicle uses approximately 65-75 MMBTU of energy annually. An electric vehicle accounts for far less, 7.96 MMBTU annually. This accounts for an 88-90% reduction in energy consumption.
TARGETS:

Fuel Switching Targets for Transportation

	2025	2035	2050
Projected number of light-duty vehicles in the area, by year	901	1,014	1,140
Number of vehicles powered by electricity	105	334	719
% of vehicles powered by electricity	12%	33%	63%
Number of vehicles using bio-fuel blends	711	489	86
% of vehicles using bio-fuel blends	79%	48%	7%

Table 6: Fuel Switching LEAP Targets for Transportation developed by Vermont Energy Investment Corporation

ACTIONS:

- Install EV Charging station at the Park and Ride location next to the library/town offices and in West Glover at the Ambulance Bay or Parker Pie
- Host an EV demo day so residents have an opportunity to learn about and test out EV technology
- Share incentives from Vermont Electric Cooperative, Lyndonville Electric, Efficiency Vermont, Drive Electric Vermont, and other organizations that encourage the switch to EV
- Provide information about the economic and environmental benefits of fuel switching (both from internal combustion engines and bio-fuels) to EV
- Support legislation at the state level that furthers the switch to EV technology for transportation

GOAL 3: Demonstrate municipal leadership in transportation energy conservation and energy efficiency

The municipality of Glover can lead the way on energy conservation and energy efficiency in transportation by modeling energy efficient practices. Successful modeling of energy efficiency can encourage town residents and property owners to make energy efficiency changes in their own transportation patterns and choices as well.

- Continue our practice of routine upgrade of equipment and be aware of upgrading to energy efficient vehicles when affordable and available

Install EV charging stations when developing or redeveloping municipally owned property as well as schools

C) Patterns and densities of land use likely to result in conservation of energy

The Energy committee is committed to supporting efforts to encourage individuals to live in the village centers where goods and services are close by and require less vehicle miles traveled. The Energy Committee promotes mixed-use village centers, a livable place where essential goods and services such as grocery stores are in close proximity to where houses are. The Energy Committee encourages "in-fill" development that concentrates new construction and reconstruction to the village centers with attention to the historic layout of the village centers too. Clustering homes in village centers requires shorter networks of streets and utilities, which require less energy to build and maintain, and require less vehicle miles traveled. There is also less line loss with shorter electrical lines. Any additional efforts to make Glover a more centralized community and requiring fewer VMT to get to essential goods and services are encouraged by the Energy Committee.

GOAL 1: Encourage patterns and densities of land use that conserve electrical, thermal, and transportation energy, and a Town that is more energy efficient in design and form

Compact settlement patterns, mixed-use development and redevelopment, and a walkable and cyclable community will conserve energy. Tied in with ample spaces and places to recharge an EV vehicle, Glover can encourage land use design and form that promotes energy conservation and energy efficiency.

Actions:

- Encourage the extension of sidewalks or pedestrian lanes through the village center for safe walking to amenities (to the library and town offices, to the school) and in West Glover from Parker Pie to the Ambulance bay and church
- Provide information about "in-fill" development in village settings (Accessory Dwelling Units, converting single family into duplex or triplex) that best fit the Glover context
- Support the maintenance of the existing housing stock so as to maintain the existing housing cluster in the village center (share weatherization incentives, rental rehabilitation grants, Town beautification efforts)
- Encourage small businesses to locate in the village centers of Glover and West Glover to provide proximity to services
- Support the Glover Planning Commission's work during the town green & village municipal planning process.

III: The siting of renewable energy generation

Targets have been developed by the State for each region in Vermont for the provision of renewable electrical energy generation, to work towards the State goal of meeting 90% of its energy needs through renewables by the year 2050. **Glover's share of the state renewable energy generation goal is 317 MWh.**

An analysis of existing land and renewable resource potential has helped to determine the amount of local renewable energy that could be developed within the Town of Glover. This analysis uses maps produced by NVDA and evaluates only prime areas (no known constraints). Rooftop solar is calculated at 10% of structures (including seasonal residences) and assumes 4kw capacity for residential, 20kW for small commercial, and 200 kW for large commercial. NVDA is not planning for additional utility scale wind, so wind is calculated assuming an average output of 9.5 kW (residential), based on average capacity of existing installations in the region. This estimate assumes no locally designated restraints, which may reduce generation capacity. Table 7, identifies the amount of renewable energy generation (in megawatt hours) that The Town of Glover could generate; a total of 132,725 MWh, well over the town's target of 317 MWh.

Megawatt Capacity for Preferred and Potentially Suitable areas for Renewable Energy Generation

Renewable Type	Capacity in MegaWatts (MW)	Capacity in MegaWatt Hours (MWh)
Residential Rooftop Solar	0.31	383.1
Small commercial rooftop solar (<40,000 sq. ft.)	0.024	29.4
Large commercial rooftop solar (>40,000 sq. ft)	0.0	0.0
Ground-mounted Solar	20.13	24,684.0
Wind	1.42	2494.6
Hydro	0.004	14.02
Biomass and Methane	20	105,120
Total Potential Generation Capacity	**41.888**	**132,725.12**

Table 7: NVDA analysis of only Prime Areas for Renewable Energy Generation Potential

From Table 7, biomass and methane can potentially produce 105,120 MWh energy. While biomass facilities are great generators of energy, they use a renewable fuel that grows at a specific rate (trees), so overharvesting of the regional woodshed is a concern. If biomass energy generation is sought by the Town, **a commitment to responsible stewardship** of the region's forestry resources, accomplished through the use of forestry overlays that minimize fragmentation (regulatory), or enrollment in Vermont's Current Use Program and conservation easements (non-regulatory) **is a must.** The Vermont Climate Action Commission noted in their 2018 Final Report that "the potential loss of carbon from the loss of forestland is real and substantial. Every acre of forest lost to development has the potential to release a hundred metric tons of carbon dioxide equivalent into the atmosphere – like adding 25 cars for a year." (VCAC Final Report, 2018, p.54) and recommended that a carbon sequestration* component (*leaving lands forested to soak up carbon from the atmosphere) be added to the Vermont Comprehensive Energy Plan.

Glover has two larger scale farms, Andersonville and Youngs farm, that are potential methane generation sites. On farm use of methane energy is the most feasible and desired option. Wastewater from Glover and W. Glover villages is treated at the Barton Wastewater Treatment facility (WWTF). At this time, Barton WWTF does not capture methane for energy. This potential source of energy could be considered by Barton WWTF in the future.

Different fuel sources generate different amounts of energy. Table 8 shows how each renewable source compares in its potential energy output. Capacity factor is the percent of time an identified resource is actively producing electricity. For example, a single methane power generating site can greatly outproduce solar power generation, mostly because methane is a constant fuel, while the sun is not. Carefully looking at capacity factors will allow the municipality to utilize whatever renewable resource is most appropriate for the specific circumstances.

Renewable Generation Outputs and Capacity Factors		
Resource Type	Capacity Factor (%)	Annual MWh output per installed MW
Solar	14% -16 %	1,300
Small Wind	20% -25%	2,000
Utility Scale Wind	25%-35%	2,600

Methane	60%-90%	6,600
Biomass	60%-80%	6,100
Small Hydroelectric	40%- 60%	4,400

Table 8: Vermont Public Service Information regarding Renewable Generation Outputs and Capacity Factors

The sources of renewable energy generation that are identified in this plan include current technologies that are known and supported in Vermont. Advances in the development of renewable energy technologies may result in generation measures or techniques that are not currently considered in this plan but may be more efficient or effective. As such, this plan will consider renewable generation technologies that do not have an adverse impact on the Town of Glover, the Northeast Kingdom region of Vermont, or the policies that guide the Planning Commission and not be limited exclusively to the generation techniques and technologies noted herein.

In addition to the discussion about renewable generation, we recommend serious conversation and effort should be put toward renewable energy storage. There are days when renewables outproduce the immediate need for energy. Renewable energy curtailing may not be the best solution. With adequate storage, excess energy can be used at a later date when the renewable source doesn't produce enough to cover demand. Simply put, the days that are sunniest and windiest may not be the days of highest demand.

This information will better position the Town of Glover to evaluate the renewable energy generation options that are available to meet the 90x 2050 energy generation goals. It is important to remember that energy generation targets are ***only one*** of several energy goals in this plan. While the analysis shows Glover to be in a good position to meet the energy generation targets, there is much work to be done to meet the goals set out for energy conservation, reducing energy demand, and fuel switching.

Siting Potential:

The regulations mentioned earlier require that a mapping analysis be conducted to identify potential sites for renewable energy development. The NVDA prepared a set of maps (hydroelectric, solar, wind, and biomass) for Glover. The purpose of the maps is to determine whether there is sufficient land to meet the Town of Glover renewable energy target of 317 MWh. The following maps are an indicator of siting potential, but NOT a definitive siting tool.

Statewide preferred locations include :

- rooftops (and other structures)
- parking lots
- previously developed sites
- brownfields
- gravel pits
- Quarries
- Superfund sites

Statewide Known Constraints, including areas not likely to be developed for renewable energy because they contain one or more of the following:

- Vernal pools
- River corridors
- FEMA floodways
- Significant natural communities
- Rare, threatened and endangered species
- National wilderness areas
- Class 1 and 2 wetlands
- Regionally or locally identified critical resources

Statewide Possible Constraints, including areas that would likely require mitigation because they contain one or more of the following:

- Agricultural soils
- Special flood hazard areas (outside of the floodway)
- Protected (conserved) lands
- Deer wintering areas
- Act 250 mitigated agricultural soils
- Hydric soils
- Highest priority forest blocks

Regional Known Constraints:
NVDA's regional plan has long held that rural areas should receive very little commercial or industrial development unless it occurs in an established industrial park, or in an area specifically designated in the local bylaw or plan as being well suited to such uses. Additionally, renewable energy generation or storage sites should not exceed an elevation of 2,000 feet to protect the fragile environment of high elevations. This plan agrees with NVDA's stated position on rural commercial and industrial developments.

Preferred Siting Criteria:

- **SOLAR:**
    - Rooftops of structures, residential and commercial
    - Brownfield sites not located in a designated downtown or village center
    - Earth extraction sites (e.g. gravel pits, quarries), active or abandoned
    - Parking lot canopies and surface parking lots
    - Farms, where more than 50% of the power generated is used by the farm
    - Industrial parks, where more than 50% of the power generated is used by the tenants of the industrial park
    - Undersized lots and otherwise undevelopable land in existing industrial parks
    - Minimally invasive sites
        - use gentle and south facing slopes that do not have shading features such as tall trees or large structures
        - locate close to existing transmission or distribution electric lines and have access for the tie-line from the project to the grid
        - locate on suitable soils for installing piles for foundations
    - Ensure that alternative and renewable energy generator fields (i.e.: solar) are placed so as to maintain and preserve the historic character of the compact village and views of rural countryside and preserve any site of scenic value to the community
    - If topography alone does not provide sufficient screening, a combination of materials (such as trees and shrubs) shall be used to create a naturalized screen rather than a large expanse of uninterrupted, uniform material. This will limit visual impacts as viewed from the streets. Plantings that die or become diseased are expected to be replaced within six months.

WIND:

- **It is the position of NVDA that no further development of industrial-scale (sic16) wind turbines should take place in the Northeast Kingdom**.This plan agrees with NVDA's position.
- Small scale residential (non-utility) wind, defined as "turbines under 200 feet in height, including the length of the blades" (NVDA Regional Plan 2018), could be installed on privately held lands. Sites appropriate for small scale wind are very low density areas and on farmland. Small scale wind sites should be located away from residential areas because of the known disturbances small wind turbines can produce.
- A setback of 10 times the height of the facility from neighboring full-time or part-time residences is recommended for small scale residential (non-utility) wind.

- **METHANE:**
    - Preferred siting is on working farms, where more than 50% of the power generated will be used by the farm

- **BIOMASS:**
    - Sourcing woody biomass for large scale energy generation can be detrimental to the forests and woodlands that surround Glover IF not sustainably harvested. Unsustainable harvesting can cause increased forest fragmentation, reduced volume of “low grade” trees that provide air and water filtering, diminished soil maintenance, harm to wildlife habitats, and reduced carbon storing capabilities of forests.
    - Siting large scale wood-generation and cogeneration facilities can also be fraught with challenges. There are limited amounts of spaces for industrial facilities. There are infrastructure limitations related to transportation of wood chips and pellets, tying into public systems such as water and sewage, and the transmission of heat and power to the locations that would make use of it. Noise, emissions, truck traffic, and unsightly smoke stacks are concerns when siting facilities near residential neighborhoods.
    - Biomass generation facilities should be located on individual residential/commercial/municipal properties and be scaled to fit on-site energy consumption.

Siting Conclusion:
Glover is well positioned to meet its energy generation goal of 317 MWh. Given the contentions around biomass energy generation and large scale wind energy generation, it is recommended that the Town meet the renewable energy generation goal primarily through solar, some small scale wind generation, on-farm methane energy generation, and residential level biomass energy generation. Using sustainable harvesting measures is possible as long as the **energy generated is used primarily for on-site energy demand.**

IV: MAPS

Map 1 shows the potential for hydroelectric energy development in Glover. There are no existing hydroelectric sites in the Town. One potential site has been identified and is located on the eastern tip of Shadow Lake.
http://nvda.net/energy_maps/glover_hydro.jpg

Map 2 shows the potential for solar energy development in Glover. All areas in red are prime solar sites with no state constraint. Ground-mounted solar accounts for potentially 24,684.0 MWh of energy, well over the municipality's target of 317 MWh.
http://nvda.net/energy_maps/glover_solar.jpg

Map 3 shows the potential for wind energy development in Glover which is minimal. No new sites are proposed, but small-scale wind development by individual property owners or increased output from current small-scale wind infrastructure accounts for the potential generation increase from 57.7 MWh to 2494.6 MWh shown in Table 11.
http://nvda.net/energy_maps/glover_wind.jpg

Map 4 shows the potential for woody biomass energy development in Glover. All areas in green are potential woody biomass areas. The total capacity of biomass for the area amounts to 105,120 MWh, well over the municipality’s target of 317 MWh.
http://nvda.net/energy_maps/glover_bio.jpg