A. ENHANCED ENERGY PLAN - RIPTON

Section I. Introduction

Intent of Energy Plan

The Town of Ripton recognizes our individual and collective responsibility to help reduce and conserve the energy we all use. Ripton believes it serves its citizen's interests by conserving energy, reducing our consumption of non-renewable energy and shifting our usage to carbon free or carbon neutral renewable energy sources. We also believe the Ripton Town Plan must create a vision and clear policy statements for the town to follow concerning energy conservation, consumption and generation within town. With this Plan Ripton hopes to exe rcise more control over the types of energy choices made within town.

The best way for Ripton to gain more control over its energy policies is to meet the municipal determination standards for enhanced energy planning enabled in 24 V.S.A. 4352, and thus to gain "substantial deference" in Section 248 hearings. As part of pursuing enhanced energy planning, Ripton agrees that it supports regional and state energy goals, including the goal of having 90% of the energy used in Vermont obtained from renewab le sources by 2050 ("90 x 50"), and the following:

Vermont's greenhouse gas reduction goals under 10 V.S.A. § 578(a);
Vermont's 25 by 25 goal for renewable energy under 10 V.S.A. § 580;
Vermont's building efficiency goals under 10 V.S.A. § 581;
State energy policy under 30 V.S.A. § 202a and the recommendations for regional and municipal energy planning pertaining to the efficient use of energy and the siting and development of renewable energy resources contained in the State energy plans adopted pursuant to 30 V.S.A. §§ 202 and 202b (State energy plans); and
the distributed renewable generation and energy transformation categories of resources to meet the requirements of the Renewable Energy Standard under 30 V.S.A. §§ 8004 and 8005;

To receive a positive determination of energy compliance, an enhanced energy plan must be duly adopted, regionally approved and must contain the following information:

An analysis of current energy resources, needs, scarcities, costs, and problems.
Targets for future energy use and generation.
"Pathways," or implementation actions, to help the municipality achieve the established targets.
Mapping to help guide the conversation about the siting of renewables.

A positive determination of compliance with the requirements of enhanced energy planning will enable Ripton's Plan to achieve "substantial deference" from the Public Utilities Commission in Section 248 applications for energy generation facilities (wind facilities, solar facilities, hydro facilities, etc.). The Public Utilities Commission applies th e "**substantial deference**" standard when evaluating a proposed generation or transmission project under Criteria (b)(1)- "0rderly Development of the Region", of Section 248. Substantial deference increases the respect the Public Utilities Commission must give to clearly articulated policies in this Plan (The current standard is "**due consideration**").

This plan includes the required analysis, target data, goals, policies and implementation actions, and the associated mapping necessary to meet the standards for an enhanced energy plan. Topics covered include energy conservation and efficiency as it relates to thermal and electrical energy usage, transportation and land use planning. The plan also includes energy generation and siting standards. It contains a number of policies and statements specifying the type and size, and suitable locations for energy generation facilities in Ripton. Lastly, it articulates the goals, policies and actions Ripton will support and undertake to help meet regional and statewide goals.

Ripton Energy Committee

Ripton has an active Energy Committee. In a 2014 energy survey, 41 percent of homes in the survey had some sort of energy audit, indicating a substantial interest in improving the energy efficiency of Ripton's housing. A majority, 68 percent of homes have upgraded to energy efficient airtight woodstoves, and 20-30 percent would like to upgrade to a more efficient furnace or hot water heater and own a heat pump, solar hot water panels or solar photovoltaic system. These results are based on the tallies from 85 returned questionnaires. Most residences in Ripton are connected to the grid, and Green Mountain Power supplies 84 percent of the electrical needs for those responding to the survey (*see below*).

In 2012 Ripton voters approved the creation of a Ripton PACE District. PACE stands for Property Assessed Clean Energy. PACE makes it easier for homeowners to invest in energy efficiency and /or renewable energy projects in existing homes by making annual payments that are added to their property tax payment or other municipal bill. The Ripton PACE District was created on 14 May 2012. Ripton chose not to use the PACE district at that time because of administrative concerns and financing costs. This plan considers repurposing and reusing the PACE program for community based energy programs.

Outline: How to Read this Plan

This plan is organized into five Sections:

1. **Section I, Introduction**: Introduction and Summary
2. **Section II, Thermal Use**: focuses primarily on Energy used for space heating.
3. **Section III, Electrical Use**: focuses on efficiency and conservation of the energy used for operating equipment (lighting, appliances, motors, electronics), and also addresses the conversion of transportation and heating to renewable electric power, and the consequent increase in electrical demand.
4. **Section IV, Transportation Use**: focuses on energy used for transportation. and
5. **Section V, Land Use, Generation and Transmission**: focuses on planning land uses to reduce vehicle trips and to responsibly site energy generation and transmission resources.

Each chapter is broken into three sub-sections. The first sub-section, "Use Analysis", analyzes current usage data in Ripton for each of the four energy sectors and includes charts of usage and a discussion concerning the data. The second sub-section, entitled "Targets", looks at future projections of usage corresponding to one scenario that theoretically would meet the 90 x 50 goal and interim mileposts. In 2016, the Addison County Regional Planning Commission worked with the Vermont Energy Investment Corporation (VEIC) and the Vermont Department of Public Service to develop regional targets for future energy use and generation that would serve to meet the State's energy goals. . The targets represent one pathway--an approach that appears the most likely, reasonable, and economic given current technology and forecasts through mid-century. For more information about the regional targets, please see the Addison County Regional Energy Plan (www.acrpc.com). The third sub-section in each Section provides goals, policies and recommended actions to implement the plan.

After the three major Sections covering Thermal, Electrical and Transportation Uses, *Section IV, Land Use, Generation and Transmission* adds a mapping analysis of Ripton's energy resources and constraints, and a siting policy for new generation.

Section II. Thermal Use

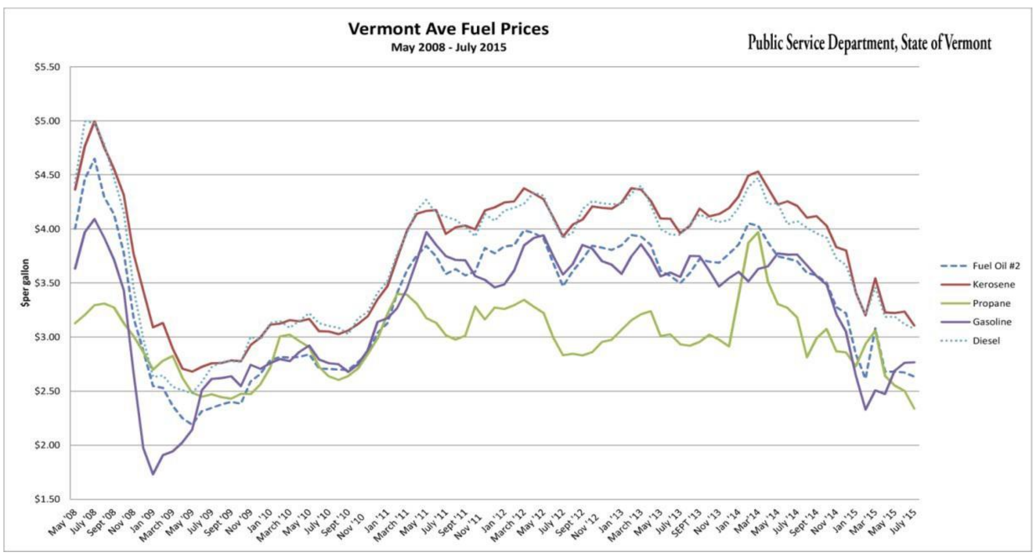
Thermal Use analysis

An estimate of somewhat current residential thermal energy demand in Ripton, based on data from the American Community Survey (2011-2015), is shown in Table 1. The data shows that the majority of residences in Ripton (59%) used wood as their primary heating source. Wood was followed by fuel oil (about 25% of households) and propane (about 16%)[1].

Table 1. Municipal Current Residential Thermal Energy Use

Fuel Source	Ripton Households (ACS 2011-2015)	Ripton % of Households	Ripton Residential Heating BTUs	Ripton BTU (in Billions)
Natural Gas	7	2.6%	13,272	1
Propane	36	13.3%	61,008	4
Electricity	0	0.0%	0	0
Fuel Oil	67	24.7%	115,254	7
Coal	0	0.0%	0	0
Wood	161	59.4%	274,452	16
Solar	0	0.0%	0	0
Other	0	0.0%	0	0
No Fuel	0	0.0%	0	0
Total	271	100.0%	n/a	28

Ripton's significant use of wood heat is something of an anomaly in the Region and is nearly twice as high as most towns. However, it is not surprising given Ripton's wooded, mountainous terrain. The following graph, Graph 1, compares the price trends of various fuels used by Ripton residents from May 2008 through July 2015.



Like the graph above, the table below lists the relative cost per million BTUs of heating fuels in Vermont as of January 2015 (November 2014 for natural gas and September 2014 for green wood and pellets).

[1] The survey shows that 2.6% of households' heat with natural gas. However, since that fuel source is not currently available in Ripton, we believe it may be an error in response and that those respondents likely heat with propane.

Comparing the Cost of Heating Fuels							Public Service Department, State of Vermont
Type of Energy	**BTU/unit**	**Typ Effic**	**$/unit**	**$/MMBtu**		**High Efficiency**	**$/MMBtu**
Fuel Oil, gallon	138,200	80%	$2.84	$25.73		95%	$21.67
Kerosene, gallon	136,600	80%	$3.41	$31.23			
Propane, gallon	91,600	80%	$2.73	$37.25		93%	$32.05
Natural Gas, therm	100,000	80%	$1.48	$18.55	*	95%	$15.62
Electricity, kWh (resistive heat)	3,412	100%	$0.15	$43.46			
Electricity, kWh (cold climate heat pump)	3,412		$0.15			240%	$18.32
Wood, cord (green)	22,000,000	60%	$ 227.14	$17.21	*		
Pellets, ton	16,400,000	80%	$294.00	$22.41	*		

* The natural gas price is based on the rate effective 11/1/14. *Wood green and Pellets updated 9/19/14.

Firewood is the least expensive fuel in Ripton. Firewood is renewable, arguably carbon neutral, and for Ripton, locally abundant. If harvested by the homeowner, the cost is even lower than the listed heating fuel cost. This means that Ripton residents on the whole spend considerably less to heat their homes than a lot of their neighbors. However, firewood is heavy to move and generates smoke and particulates to a degree dependent on the age and efficiency of the wood stove and the quality of the firewood. For some, the effort and mess are unacceptable and/or unfeasible.

Both fuel oil and propane gas are fossil fuels. In order to meet State targets, their use will need to be largely eliminated by 2050. Simply making homes more thermally efficient by insulating and air-sealing reduces fossil fuel use, and improvements in technology can make fuels work more efficiently. However, a much more impactful solution is to replace fossil fuel sources with renewable fuel sources, such as electricity produced through ren ewable generation. The cost of the change, principally the capital investment in new equipment, and possibly the comparative price of the fuels used, constitute the major barriers to entry. While the Town of Ripton has little control over the cost of energ y, it can and does work to encourage conservation, efficiency and lower local generation costs.

As an example, in response to rapidly rising heating fuel prices in late 2008, several Ripton residents formed the Ripton Energy Assistance Program (REAP) to provide a range of heating fuels to income-qualifying Ripton residents at no cost. Partnering with HOPE (formerly ACCAG), REAP provides firewood and arrangements for fuel oil or propane delivery to several Ripton households annually. Ripton residents needing help with heating fuel may call HOPE at 388-3608.

Other services available promoting weatherization and efficiency include:

- The Champlain Valley Office of Economic Opportunity (CVOEO), which provides fuel assistance to income-qualified residents either on a seasonal basis (call CVOEO at 800-479-6151) or on a crisis basis (call CVOEO Addison Community Action at 388-2285). The CVOEO website, CVOEO.org, describes additional fuel assistance programs available to Vermont residents.
- Efficiency Vermont, the nation's only efficiency utility, has a number of programs to improve energy efficiency. It describes most on its informative home page at Efficiencyvermont.com. Current programs, including energy audits, incentives for Home Performance with Energy Star, information on appliances and compact fluorescent and LED bulbs, building an Energy Star home, home heating help, rebate information, and Efficiency Vermont's reference library.
- Champlain Valley Weatherization Service, part of CVOEO, provides free weatherization services to income-qualified Addison County households.
- Neighborworks of Western Vermont also offers audits and subsidized weatherization services through their HEAT squad program https://heatsquad.org/.

Vermont has residential energy construction standards. Officially called the "Residential Building Energy Standards" (RBES), the Residential Energy Code is a minimum standard of energy efficiency for all new residential construction in Vermont. The Vermont Residential Energy Code Handbook edition 4.1 March 1, 2015. The REBS encompasses two requirements:

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

The Zoning Administrator's duty to enforce the RBES also provides an opportunity for the Town to communicate with homeowners regarding energy programs and conservation opportunities.

Estimates for commercial and industrial thermal energy use are difficult to calculate. An estimate of total commercial energy use (thermal and electricity) is provided in Table 2 and based on data from the Vermont Department of Labor (VT DOL) and the Vermont Department of Public Service (VT DPS).

Table 2. Current Municipal Commercial Energy Use			
Column1	Commercial Establishments in Municipality (VT DOL)	Estimated Thermal Energy BTUs per Commercial Establishment (in Billions) (VT Dept. of Public Service)	Estimated Thermal Energy BTUs by Commercial Establishments in Municipality (in Billions)
Municipal Commercial Energy Use	14[2]	1	10

As the table immediately above shows, Ripton has ~~a~~ very few commercial establishments. However, Green Mountain Power ("GMP") has efficiency incentives for businesses as well as homeowners. All businesses in Ripton are encouraged to speak with GMP about conducting an energy audit and determining improvements that may help them increase their efficiency to conserve the amount of energy they use for heating and other purposes.

Further analysis of electrical use depicted in Table 4, below, and discussed in the next Section, calculates that residential structures consume two and a half times as much electrical energy as the commercial entities within town. Accordingly, most of the thermal energy changes that will need to take place in Ripton to meet the targets will need to be done by individual home owners.

[2] In a GMP survey of Ripton customers, cited in the Section of this plan addressing Electric usage, GMP recorded 33 commercial enterprises versus the 14 cited by the Department of Labor. The Ripton Energy Committee expects this discrepancy may stem from home based businesses and different meters belonging to a single entity. In any case, the vast majority of total electrical use in Ripton is still attributable to residential use. Further, we suspect the State estimate of commercial thermal energy above is an overestimate owing to the differential between State average and Ripton average commercial establishment size.

Thermal Targets

Thermal targets for Ripton include increasing weatherization of homes, an increase in new efficient wood he at systems and switching to efficient heat pump systems. See the tables below for target numbers to meet the 90 X 50 State goal with our chosen scenario.

TABLE 3A. Residential Thermal Efficiency Targets	2025	2035	2050
Residential - Increased Efficiency and Conservation (% of municipal households to be weatherized)	2%	9%	47%

TABLE 3B. Commercial Thermal Efficiency Targets	2025	2035	2050
Commercial - Increased Efficiency and Conservation (% of commercial establishments to be weatherized)	17%	18%	51%

Table 3C. Thermal Fuel Switching Targets (Residential and Commercial) - Wood Systems	2025	2035	2050
New Efficient Wood Heat Systems (in units)	1	2	11

Table 3D. Thermal Fuel Switching Targets (Residential and Commercial) - Heat Pumps	2025	2035	2050
New Heat Pumps (in units)	28	67	133

Targets have been established for each of four classes of change, based on improved efficiency and fuel switching. In order to hit these targets, Ripton property owners will need to make significant improvements to their homes and businesses. Approximately half of the houses and businesses in Ripton will need to be weatherized to conserve energy used to heat those spaces. Given the significant weatherization effort Ripton has already completed, Ripton may have an easier time reaching these targets than other communities. For instance, given the significant number of homes currently using wood as a heating source, the cost to invest in upgraded technology to burn that wood more efficiently is relatively modest. Lastly, nearly all of the houses currently heating with oil or propane (and some heating with wood) will need to switch to efficient electric heat pumps. Electricity currently plays an insignificant part in heating Ripton homes. A 2015 survey indicated only three homes owned a heat pump at that time, although 21 percent of respondents indicated a desire to own one. We have no more current reliable data, but can assume many more have been installed since. Additionally, at least 13 residents have installed solar domestic hot water systems, and least three have opted for heat pump water heaters. At least one resident uses ground-source heat pump home heating.

Thermal Pathways to Implementation - Goals, Policies and Recommended Actions

Given the large changes that Ripton will need to effect to conserve energy and switch fuels in pursuit of its energy targets, Ripton adopts the following Goals, Policies and Recommended Actions for itself and its citizens.

Goal

A. Increase Ripton's thermal energy efficiency and self-sufficiency by reducing its energy use, and reducing its carbon footprint to meet local and State targets of 90% renewable energy by 2050.

Policies and Recommended Actions

1. Promote thermal efficiency in Ripton's municipal buildings
   a. Conduct further energy audits of all municipal buildings including the school, community house, fire station, and town offices to identify weatherization retrofits; incorporate the recommendations into the municipal capital budget.

2. Encourage and promote local and sustainably harvested wood and efficient wood heating
   a. Require outdoor wood boilers in Ripton to comply with state efficiency and emission standards
   b. Promote energy efficient wood stoves approved under current EPA standards.

3. Assure that no Ripton resident goes without heat.
   a. Continue to support the REAP program.

4. Encourage Ripton residents to weatherize their homes, and support that effort.
   a. Coordinate with CVOEO, Neighborworks of Western Vermont, Efficiency Vermont and other weatherization service providers to encourage Ripton residents to participate in weatherization programs.

5. Promote and encourage the retrofitting of existing homes with air-source or geothermal heat pumps

6. Encourage proposed development to optimize design features and energy systems that conserve energy or use renewable sources.
   a. Promote the installation of air source and geothermal heat pumps to reduce residential energy consumption and CO^2 production.
   b. Promote the use of the residential and commercial building energy standards by asking the Zoning Administrator to distribute information about Vermont's Energy Codes to permit applicants, explain options for energy efficiency, and responsibly monitor compliance.

Section III. Electrical Use

Electrical Use Analysis

According to Green Mountain Power data from March 7, 2015 Ripton had 289 residences, 33 commercial sites and 10 streetlights serviced by the electrical grid. Ripton's average annual use of electricity over the five-year period from 2010 to 2014 was 2,675,478 kWh or an average of 222,952 kWh/month.

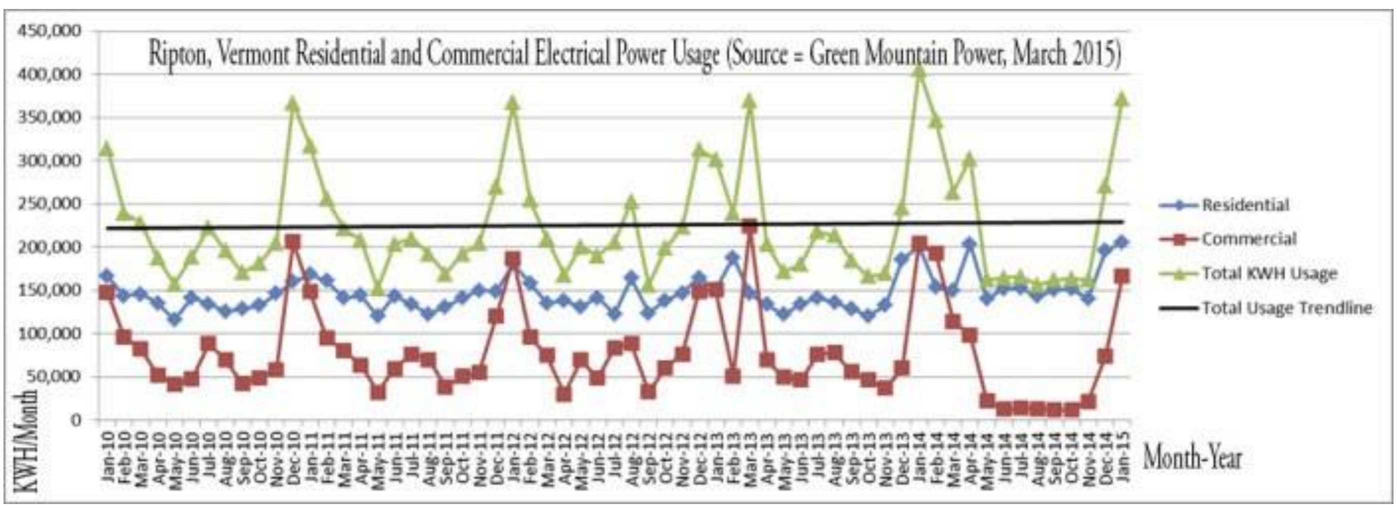
Analysis from VEIC contained in Table 4, shows a very similar total usage figure.

Table 4. Current Electricity Use - Town of Ripton

Sector		Current Electricity Use (Efficiency Vermont)
Residential (kWh)		1,790,604
Commercial and Industrial (kWh)		739,687
Total (kWh)	2,530,291	

In both cases, residential usage is more than twice that of commercial or industrial uses. The next graph shows Ripton's relatively stable yearly electrical consumption, which rises only slightly from January 2010 to January 2015. The red commercial plot in the second graph shows that beginning in the summer of 2014 there was a decline in summer usage, which is consistent with the installation of a 50 KW solar generator on the roof of the elementary school toward the end of the preceding year.

GRAPH 2



The Town of Ripton is already working to reduce its electrical consumption. It signed onto a municipal street lighting initiative offered by Efficiency Vermont in 2012. In July 2015 Green Mountain Power had replaced bulbs in nine of Ripton's ten streetlights with LED bulbs (One bulb had been converted previously). Efficiency Vermont covered the cost of the installation, noting that it will save 2,939 kWh and $400 per year.

Electrical Targets

As with the thermal targets noted in Section II above, Ripton will need to focus on efficiency and conservation to reduce the amount of electricity that it uses. Since electrical consumption by commercial entities is comparatively small, the process will require individuals to increase the efficiency of appliances, electrical fixtures, various motors, electronics and lighting used in their homes.

However, even with significant efficiency steps taken by businesses and residents, Ripton's electrical usage will increase, principally because many of the new technologies needed to reduce fossil fuel consumption, primarily heat pumps and electric cars, involve fuel switching to electricity and so will increase Ripton's consumption. This means the strategies for thermal efficiency discussed in the previous Section will do additional duty here, reducing electrical loads for heating with heat pumps. It is worth noting that fuel switching to electricity serves to reduce greenhouse gases only if the electricity comes from renewable sources.

Table 5A., below, illustrates the fact that Ripton must increase its efficiency and conservation by nearly 60% by 2050 to meet the proposed targets. Much of that change will be driven by technological improvements in household equipment like appliances, lighting, electronics, and "smart home" strategies, but these will have to be actively embraced by homeowners. Tables 5B. and 5C. indicate fuel switching to renewable electric sources for transportation and for heating will need to occur at rates between 80 and 90 percent by 2050. Table 5D. tells us that overall electrical consumption will double by 2025, and triple between 2025 and 2050 as fossil fuel use is retired. That is a six-fold increase in consumption from current levels, and will require considerable additional generation.

Table 5A. Electricity Efficiency Targets	**2025**	**2035**	**2050**
Increase Efficiency and Conservation	10.80%	37.20%	59.20%

5B. Use of Renewables - Transportation	**2025**	**2035**	**2050**
Renewable Energy Use - Transportation	2.70%	18.20%	83.50%

5C. Use of Renewables - Heating	**2025**	**2035**	**2050**
Renewable Energy Use - Heating	47.30%	60.50%	88.00%

5D. Use of Renewables - Electricity	**2025**	**2035**	**2050**
Renewable Energy Use – Electricity (MWh/ann)	1424.5	2849.1	4316.8

Electrical Pathways to Implementation - Goals, Policies and Recommended Actions

Given the significant changes that residents and businesses will need to adopt to effect these changes, Ripton promotes the following Goals, Policies and Recommended Actions for itself and its citizens. Note that the policies and actions in the Sections addressing Thermal, Transportation , and Generation and Siting supporting fuel-switching and renewable generation are not duplicated here, though many are equally important to achieving these specific goals.

Goal

A. Reduce reliance on nonrenewable energy sources such as oil and gas, and shift reliance to renewable electrical generation sources, thereby reducing carbon and particulate emissions.

Policies and Recommended Actions

1. Support energy conservation efforts and the efficient use of energy by installing efficient electric equipment.
    a. Explore funding opportunities and implementation possibilities for upgrading the energy efficiency of all town buildings including the school, community house, fire station, and town offices.
    b. Discourage the use of "always-on" street lamps and other outdoor lighting, as well as indoor lighting in public spaces.
    c. Support additional "energy challenge" style events and workshops for homeowners in partnership with organizations like VECAN and Efficiency Vermont.
2. Promote energy efficiency in all buildings, especially new ones.
    a. Promote improved compliance with the residential and commercial building energy standards by working closely with the Zoning Administrator, and ensuring the distribution of code information to permit applicants.
    b. Incorporate EV ready standards into building code (beginning with changes as simple as installing a 220v outlet in garages).
    c. Consider requiring new construction to comply with the "stretch energy code" (http://publicservice.vermont.gov/sites/dps/files/documents/Energy_Efficiency/code_update/2015%20CBE S%20Proposed%20Stretch_2015-2-3.pdf).

Section IV. Transportation Use

Transportation Use Analysis

Like most Vermonters, Ripton residents (98 percent of the time) drive themselves to work and to shop, rather than carpool or take the ACTR bus. More than any other sector, the environmental impacts of Ripton's residential vehicle use demonstrate the scope of the change that will need to take place in Ripton to meet the State's energy goals. Transportation is particularly important for a hill town such as Ripton, given that its isolation means longer trips for commuting, shopping, and most other travel. Changing this paradigm will require a multi-pronged approach including a bit of social engineering, imaginative approaches to ridesharing and public transit as well as more mundane strategies like insuring that residents continue to have an in-town option for purchasing basic necessities and fuel.

Based upon the number of registered vehicles in Ripton, assumed average vehicle miles travelled, gas mileage per vehicle and assumed gas prices at their current level, the table shows Ripton residents spend over $794,000 dollars per year on residential vehicle trips. While some money will go to local gas stations, the majority of the cost per gallon leaves the local economy. Reducing vehicle miles by transforming local infrastructure to provide for other choices than single family vehicles can aid conservation and efficiency savings for individuals. Converting to different, locally produced generation sources of energy for transportation could help reinvest some of that money locally. Table 6, below, depicts Ripton's fuel usage for passenger vehicles (It does not include heavy trucks or farm vehicles).

Table 6. Current Municipal Transportation Energy Use	
Transportation Data	**Municipal Data**
Total # of Vehicles (ACS 2011-2015)	542
Average Miles per Vehicle (VTrans)	11,356
Total Miles Traveled	6,154,952
Realized MPG (2013 - VTrans 2015 Energy Profile)	18.6
Total Gallons Use per Year	330,911
Transportation BTUs (Billion)	40
Average Cost per Gallon of Gasoline (RPC)	2.40
Gasoline Cost per Year	$794,186

Dividing the number of vehicles by Ripton's 271 households (Census), reveals that, on average, Ripton's citizens have about two vehicles (cars, light trucks) per household. If we divide the $794,186 spent by the number of households, it shows the average household, with two vehicles, spends approximately $2,930 per year on gasoline alone. When one includes maintenance and depreciation, Triple A estimated that (in 2014) the cost per year of owning a single vehicle was nearly $9,000. Since the average household has two vehicles, that would be an average of $18,000 per household, per year. The nature of the markets for gasoline and diesel are volatile, and these numbers can change from year to year, but clearly the long-term trend is towards higher fuel pricing.

Given that vehicle expense is such a significant expenditure for most households, it stands to reason that consumers will choose what to drive based largely on expense, both initial purchase and operating expense, often with the former governing for households with limited resources and credit. Currently, electric vehicles (EVs) and hybrids as well (which provide a functional bridge to EVs) sell at a significant premium over conventional vehicles with internal combustion engines (ICEs). Operating expense for EVs is substantially lower than that for ICEs, however. Fuel expense is often half to a third of that of ICEs, and simpler mechanical design translates into less wear and repair expense. The higher initial purchase expense is due almost solely to battery cost. However, industry projections of rapidly decreasing battery pricing predict the differential to be erased by around 2025. At that point, EVs will have a clear price advantage owing to the operating expense side of the equation. (https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF-Lithium-ion-battery-costs-and-market.pdf)

The other significant impediment to consumer acceptance is so-called “range anxiety”. Current EVs typically have ranges of some fraction of 100 miles to well in excess of 200 miles, after which they require battery recharging. Depending on the vehicle and the charging station’s technology, and the degree of charging required, this can take up to 12 hours, which is vastly different from the five minutes it can take to fill a gas tank. Additionally, larger batteries for increased range and faster charging options can add significantly to the initial vehicle expense. However, the cost of these options is decreasing with the battery cost curve.

To date, a significant federal tax credit of up to $7500, and various smaller incentives at the state level have helped to drive consumer demand.

At the town level there is little to be done to affect the economics of EVs other than to support state and federal level programs of incentives. There is, however, much that can be done to educate residents and businesses to EVs’ advantages, and to support and promote the installation of charging infrastructure. With that in mind, we propose the following targets and pathways.

Transportation Targets

Table 7A. Transportation Fuel Switching Target - Electric Vehicles	2025	2035	2050
Electric Vehicles	48	324	632

7B. Transportation Fuel Switching Target - Biodiesel Vehicles	2025	2035	2050
Biodiesel Vehicles	10	18	25

As the Tables show, to meet the proposed targets by 2050, assuming growth, nearly all personal vehicles in Ripton will need to run on renewably generated electricity. Additionally, most commercial vehicles and what farm equipment there is will need to switch from diesel to bio-diesel.

Transportation Pathways to Implementation - Goals, Policies and Recommended Actions

Given the significant changes that Ripton will need to make to meet transportation targets, Ripton promotes the following Goals, Policies and Recommended Actions for itself and its citizens.

Goal

A. Reduce reliance on nonrenewable fossil fuels, and shift reliance to renewable energy sources.

Policy and Recommended Actions

1. Create infrastructure supporting electric vehicles within Ripton
   a. Plan for and install electric vehicle charging infrastructure on municipal property.

b. Incorporate EV ready standards into building code. (This can be as simple as requiring 220v outlets in garages)

c. Encourage Middlebury College, as well as other major employers in the region, to install (additional) EV charging stations for employees.

Goal

B. Maintain or reduce vehicle miles traveled per capita to 2011 levels by reducing the amount of single occupancy vehicle (SOV) commute trips.

Policies and Recommended Actions

1. Support regional efforts to increase access to safe everyday walking and cycling within and across municipal borders.

   a. Review municipal road standards to ensure that they reflect all "complete streets" principles applicable to our rural roads.

   b. Provide walking and biking paths in and between the village and elementary school areas

   c. Explore the possibility of a pedestrian crosswalk across Rte. 125 in the village area, and additional traffic calming approaches.

   d. Nominate a Ripton representative to sit on the *Walk-Bike Council of Addison County* to foster safe and accessible opportunities for walking and cycling as an alternative SOV.

2. Support state and regional public transportation programs serving Ripton and ask major employers to promote energy efficient commuting.

   a. Work with ACTR to explore creative approaches to service for Ripton, including small capacity ride-share, ZipCar style micro-lease, and even self-driving EVs for a connecting service between the village and the Rt. 7 corridor.

   b. Explore the possibility of seating a Ripton representative on the ACTR Board to bring issues facing smaller, more isolated towns to the table.

   c. Support use of a Park and Ride in Ripton at the town offices or at the school and encourage Ripton residents to consider ride-sharing programs.

3. Support improvement of high-speed Internet access in town and encourage telecommuting.

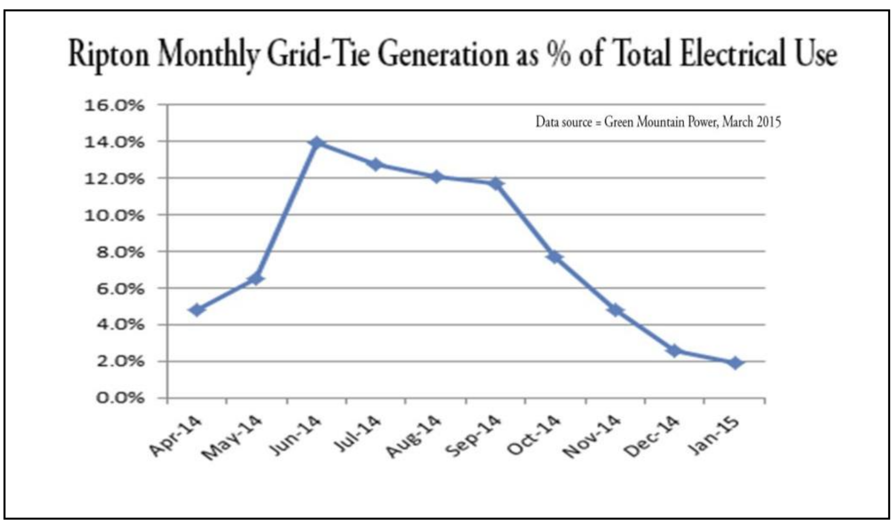
Section V. Land Uses, including Generation and Transmission

Land Use, Generation and Transmission Analysis

Ripton is a largely rural, densely forested town with some density of year-round homes located in or near its historic village. Because of its existing settlement patterns and lack of commercial and industrial facilities, Ripton residents are more dependent on their cars and light trucks, and the energy they use, than many Vermont towns. While Ripton undeniably will remain essentially rural, it can adopt land use policies that promote more transportation alternatives within the village and school areas, potentially saving some energy and promoting healthier options like walking and biking. Therefore, the Land Use Section of this Plan promotes greater density and housing options in Ripton's Neighborhood Commercial, High Density and Medium Density Residential Land Use Areas. It also promotes activities that allow Ripton's residents to reduce their trips to Middlebury or other communities, for work, or for general shopping needs. These include supporting the Ripton Village General store, allowing accessory and home-based businesses and supporting the buildout of telecommunications infrastructure throughout town. Other Land Use policies to limit energy use are listed in the Policy Section below.

Current Energy Generation

Ripton's energy supply is largely consistent with statewide patterns. Ripton does have a number of alternative energy installations that tap local energy resources. A growing number of homes have photovoltaic systems that supply at least a portion of their electrical energy. Thanks to Vermont's net-metering law, owners of these systems can sell excess power to the grid at a premium rate during periods of high solar production, and purchase grid power when needed, with accounting averaged and netted over the year up to a net zero bill. Thus, the grid serves as a kind of credit storage system for solar-produced electrical energy. The significance of this can be illustrated by the following graph of PV production for 10 months in 2014:



This graphic shows the total grid-tied PV production for the town as a fraction of Ripton's total electricity consumption for the period. It was created for the first season after the installation of the town's largest array to date. (In 2013 Ripton Elementary School installed a town-owned 198-panel 50 kW photovoltaic system on the Ripton Elementary School. In its first year the PV system produced 3/4 of the school's energy, precisely as planned, and avoided energy costs covered annual bond capital and interest for the project by year two.) The graph also illustrates the great variation of PV production by season, and by extension the importance of storage technology as we continue to build out renewables.

In the last four years, Ripton's solar PV installations have grown from 19 to 27, and the corresponding production from 173 MWh to 243 MWh according to the Vermont Energy Atlas. Table 8 depicts Ripton's existing generation resources as of mid 2019.

Table 8. Existing Generation Sites in Ripton thru 8/19			
Source	**Sites**	**Generation* (in MW)**	**Est. Actual Generation (in MWh/year)**
Solar	27	0.199	243.46
Wind	1	0.010	3.07
Hydro	0	0.000	0.00
Biomass	0	0.000	0.00
Other	0	0.000	0.00
Total	28	0.219	246.53

**Nominal (nameplate) generation*

The above table almost certainly omits off-grid power generation. While this is difficult to quantify, we note that Ripton has at least five households generating with PV arrays off-grid. At least one generates with wind, using a nominal 10kW turbine, the inclusion of which would double the wind generation indicated in the table above.

Ripton supports renewable energy generation installations sized, sited and constructed pursuant to the community Siting Standards contained later in this section. Ripton believes the best commercial/industrial solar sites in town would be in the areas Ripton has specified as preferred elsewhere in this document.

Generation Potential by Type

Solar Energy

Globally, the sun supplies energy to Earth at some 10,000 times the rate at which humankind currently uses energy. However, this energy is not distributed equally, and Ripton's location and climate mean our share of solar energy is less than the continental U.S. average, and considerably lower in the winter than summer. However, the average monthly solar energy available to a fixed solar array tilted optimally for its latitude in Ripton is still over 70% of that for its equivalent in Albuquerque, New Mexico—an excellent place for solar energy-- according to NASA data available at https://eosweb.larc.nasa.gov. Interestingly, the same data source indicates that Ripton is no worse, and may actually be a better location than the adjacent valley for PV solar.

Ripton's total electrical energy consumption currently stands at approximately 211,000 kWh per month (2.530 GWh per year), according to VEIC estimates (Table 4, p.8) This means that Ripton could meet its total *current* electrical energy demand with solar energy, using cumulative generation and usage averaged over the year, with a single nominal 2MW PV array on around 24 acres of the town's 13,952 acres. However, as indicated in Table 5D, p. 9, and again in Table 11, p.22, the scenario contemplated in this plan proposes a roughly 71% increase in electrical consumption and corresponding renewable generation from the present to 2050. This implies that the equivalent land requirement might be in the neighborhood of 40 acres (for a fixed array or arrays, using current PV design and technology). In other wordsthis rough calculation for total acreage of photovoltaics to cover the *entire* projected electricity use of Ripton represents less than one-third of one percent of Ripton's land area. Even less would be necessary, if any wind and/or hydro generation made a contribution. In any case, it's clear that the solar resource in Ripton is more than adequate for our current energy needs and can play a significant role in Ripton's future energy demand. However, solar power cannot provide baseload. The intermittent and seasonally variable nature of solar PV generation mean that without significant advances in the technology and economics of energy storage, it cannot provide consistent, reliable power. The diminished production of PV in winter months, coupled with peak winter heating demands (with electric heat pumps) makes this problem particularly acute.

Solar energy facilities ranging from 150 kW to 5MW are being constructed in neighboring Addison County towns with varying visual and other impacts. Recent GMP flagged projects at the top of that range are well sited with minimal negative impacts. They also incorporate battery storage with large lithium ion battery banks. Since the electric grid must reliably provide power to customers twenty-four hours a day, seven days a week, three hundred and sixty-five days a year (24/7/365), local solar generation—an intermittent energy source—cannot do the job alone. The electric utility must design and manage the grid for resilience. If that design properly accommodates renewable distributed generation inputs by blending it with baseload generation and *if the transmission grid itself is 100% reliable*, then the system is resilient, and the grid itself can be said to provide a kind of storage. However, it appears that we are in a long-term trend of increasingly intense weather events that damage the rather vulnerable transmission infrastructure, causing longer and more frequent outages, so the transmission side of this model fails. Another way to create resilience is with local energy storage, creating "micro-grids" and "islanding". An additional advantage of this local storage approach is that it can be used for regular "peak shaving" which tends to save electric utilities and ratepayers from the high cost of peak load generation, which tends to be expensive not only in dollars but in negative impacts, as peak load generation often comes from fossil fuel power plants.

Ripton residents are acutely aware of the fragility of the transmission infrastructure. Connection to the larger grid is made via only two transmission paths, which traverse heavily wooded areas and sometimes afford difficult access for repair. Frequent outages, often of long duration, take their toll in many ways. This would seem to make Ripton a good candidate for the microgrid/islanding approach. There may even be an option for energy storage without batteries; Ripton's ample supply of water, and significant elevation changes may afford an opportunity for pumped water energy storage.

Ripton supports renewable energy generation installations sized, sited and constructed pursuant to the community Siting Standards contained later in this section. Ripton believes the best commercial/industrial solar sites in town would be in the areas Ripton has specified, which include several locations created by clearing areas within the extensive red pine plantations scattered throughout Ripton. (See more regarding these areas in the description of Map 5 on p.19)

Biomass

Tree leaves act as solar collectors, storing solar energy through the process of photosynthesis. Vermont's large areas of forest make for a substantial rate of solar energy storage in the form of tree biomass. Although the efficiency is low, that biomass can be burned for heat or to generate electricity. Many homes in Ripton use wood either as the primary heating fuel or to supplement another heat source, usually oil but sometimes solar or geothermal. As Table 1 shows, about 59% of Ripton's households burn wood for heat, generating approximately 16 Billion BTUs. Burning wood for heat in Ripton makes a significant dent in the town's oil consumption.

Addison County and Middlebury College foresters agree that each acre of Addison County forest could sustainably yield about one-third of a cord of firewood each year. Given that about 94% of Ripton is generally wooded, if we assume that 3,000 acres (15%) of Ripton's approximately 19,855 un-conserved forested acres were sustainably harvested for firewood, that would yield nearly 1,000 cords per year, a little more than 3.7 cords per household.

Accordingly, Ripton supports the use of biomass for residential and small commercial heating applications within town, and renewable biodiesel as an alternative to diesel fuel. As a cautionary note, widespread use of wood and other biomass materials as a heat-producing or energy producing fuel might result in unacceptable levels of air-born particulates and other forms of air pollution. Therefore, while supportive, Ripton should consider biomass in the context of public health impacts in addition to whether supplies are truly sustainable to meet demands for renewable heating energy. Note that Ripton supports the use of EPA approved wood heating devices, which minimize the amount of smoke and particulates the devices produce.

Wind

Mapping of New England wind resources by the National Renewable Energy Laboratory (TrueWind Solutions, "Wind Energy Resource Map of New England," available through Massachusetts Technology Collaborative and incorporated into this plan in Map 6b) indicates that most of Ripton has average winds in the Class 1 and 2 categories, which are unsuitable for commercial-scale wind power.

In Ripton, only the iconic highest ridgeline of the Green Mountains falls in Class 6 and Class 7. However, these areas are completely within a federally designated Wilderness Area (a Known Constraint) that harbors rare alpine flora, and therefore cannot be developed. Outside of that area, there are a few spots at lower elevation that fall in Classes and 4 and 5, which might be suitable for larger-scale wind installations. These areas, indicated in Maps 6a and 6b, highlight locations that may have potential for community scale projects. Most of Ripton, in wind zones I through 3, arguably is capable of producing wind energy at the smaller scales of individual or multiple home wind turbines, and there are existing wind installations in town (See the section "Alternative Energy in Ripton" below). However, experience has proven that, at the present time, the economics of these installations are significantly less attractive than those of solar PV.

With these caveats, Ripton supports residential and community scale wind projects that meet its siting standards contained later in this chapter. ***Industrial Wind*** **projects, which have towers over 200 feet or generate over 1 MW of power, are prohibited in the Town of Ripton.**

Geothermal Energy

Energy trickles from Earth's interior to the surface at a modest average rate of about 350 watts per acre, far less than the solar input. For the Region, far from major geological activity, that number is almost certainly significantly lower. In addition, solar energy warms the Earth, especially in the summer, and some of that energy is stored as heat in the upper layers of soil and rock. Year-round, soil temperatures just a few yards deep in Vermont average around 45˚F to 50˚F year-round. Unlike the case in seismically active areas like Iceland or even Yellowstone in Wyoming, this temperature is too low for direct (conductive) heating. It can however, help with summer cooling, and there are simple designs to effect that, with, for instance, fan-driven air circulation through buried outside duct pipes, or attic and whole house fans pulling cooler air up from basement spaces.

Latent Heat--The Special Case of Heat Pumps

Air to Air cold climate heat pumps are becoming quite popular in the Region, and for good reason. They are actually able to make more energy available for heating and cooling than they consume; they perform this quasi-magical feat in the same way that an ordinary refrigerator does, by using an energy source called the latent heat of vaporization and the latent heat of condensation of a chemical refrigerant. In reality, they do not create or harvest heat so much as move it from one space to another. A refrigerator removes heat from its inside to its outside using an evaporator on the inside, converting the refrigerant to a gas, and a condenser on its outside turning the refrigerant from a gas back to a liquid. The evaporation phase absorbs heat from its surroundings and the condensation phase releases heat to its surroundings. In the case of a cold climate heat pump in heating mode, the condenser is inside and the evaporator is outside, so heat is removed from the air outside and delivered to the air inside. It can also perform as an extremely efficient air conditioner, evaporating refrigerant in the interior and condensing it on the outside. Cold climate heat pumps generally available for residential use tend to be economic down to around 12-15 degrees below 0° F using common refrigerants, so a secondary heating system is required for very cold periods. That may be a fossil fuel fired system, wood heat, or electric resistance heat, though widespread use of the latter can cause winter peak generation issues for electric utilities. Special air to air heat pumps using CO_2 as a refrigerant are useable down to around -30°F, but are not effective in reverse mode as air conditioners.

Distinct from air to air heat pumps, so called geothermal heat pumps can be more accurately referred to as ground source heat pumps. Rather than moving heat to or from outside *air*, they exchange heat with the *ground* or *groundwater*. There exist a wide variety of design types, including direct-coupled, closed loop and open loop. Open loop systems, which generally use an "open loop" of pumped groundwater to exchange heat with the refrigerant loop are most popular in the Northeast because of the relatively high availability of groundwater. The economics of this kind of system are best with relatively shallow and high flow drilled wells; they often can utilize a building's potable water well meeting those conditions. The initial cost of these types of system is higher than other HVAC systems, and they are best suited to new construction. On the other hand, they are typically more efficient than even air to air systems because the temperature differential between the inside and the ground or groundwater is significantly less than the differential for air to air systems. The payback is generally well under a decade. To date, only one property owner in Ripton has installed a ground source heat pump system, but that number may well grow.

It is worth noting that all heat pumps, like refrigerators and older air conditioning systems, use refrigerants, a class of chemicals with very potent global warming and ozone-depleting potential. Ripton strongly supports responsible management of these devices by qualified personnel and policies that promote careful dispensing, disposal, sequestration and/or recycling of these compounds.

Hydropower

Ripton possesses limited hydro resources. It has no existing facilities. However, members of the Energy Committee have discussed integrating the installation of a run of river hydropower penstock buried in the Route125 corridor in coordination with roadway repair in a future flooding disaster recovery. Such an installation might be designed to confer some flood resilience as well as produce baseload power. Additionallly, some residents continue to explore the possibility of "micro-hydro", which may hold some promise for residential power generation.

Energy Storage

Should Ripton permit commercial or industrial scale generation in its jurisdiction, it should negotiate to include some type of energy storage facility to supplement the power generated to improve its short-term resilience. Green Mountain Power has already partnered with one other town in the region to construct such a "micro-grid". Additionally, residential battery storage is decreasing in price, is commercially available to support homeowners and may work well with generation assets.

Mapping Renewable Generation Potential

As part of the mapping exercise described below, ACRPC created maps of places where resources were available to generate renewable generation resources within the Town of Ripton. The first map, **Map 1**, "Known Constraints" within this plan on page 27 depicts natural resource layers that will preclude renewable energy development. These "Known Constraints" depict places where because of the natural resources located in the area it would be prohibitive to secure a permit for energy development. **Map 2**, entitled "Possible Constraints" depicts places where natural resources exist, but may not prohibit development. Forest blocks would be an example of a possible constraint. The forest resource in Ripton is extensive, but it will not necessarily preclude wind or solar development. **Map 3** depicts the current transmission and distribution grid within the Town of Ripton. Construction of new transmission facilities to support renewable energy generation can be a substantial cost driver for the total cost of the power the facility will generate. Knowing what infrastructure is available and where is an important planning component for renewable power development.

Maps that follow show where solar resources, wind resources and biomass resources exist in quantities that might support generation. **Map 4**, shows biomass resources as identified by mapping commissioned by the State. **Map 5,** depicts solar resources as identified by State mapping and also Ripton's preferred sites (in violet). **Map 6a**, depicts wind resources as identified by State mapping and a few sites identified by the Ripton Energy Committee as possibly viable for future Community Wind sites. While **Map 6a** indicates where some wind resource exists, this is a baseline resource, not necessarily the "best" resource in the area; it indicates where the wind blows at the *minimum* velocity necessary to support wind power. Accordingly, we have added the more useful wind resource mapping from TrueWind Solutions on

Map 6b, which also shows those same few sites identified by the Energy Committee as potentially viable Community Wind sites sometime in the future.

The constraints and resources depicted in these maps are planning tools only and may not precisely indicate locations where siting a facility is acceptable. When proposing a generation facility, applicants must verify the presence or absence of the natural resources and other specific characteristics of the site as a part of the application. As noted in the wind discussion above, while many places may meet the minimum criteria for wind development, the best areas for wind development in Ripton would be the few rated as zone 4 through 7.

As noted previously, Ripton has also identified preferred areas for community scale (group net-metered) solar as well as possible sites for community-scale wind and, with the assistance of ACRPC, located those to provide further development guidance to applicants. Preferred solar sites comprise locations that members of Ripton's Energy Committee have identified as "preferred" for development. With this designation, Ripton intends to enable solar development for net-metered systems consistent with the definition of "Preferred Site" contained within Rule 5.100, Section 5.103 (7), of the Public Utilities Commission's Rules governing net-metered solar systems. As a rule, the areas identified comply with the siting conditions enumerated elsewhere in this document. Generally, these locations represent areas that are not currently forested and not highly visible. Additionally, some fall within Red Pine plantations, an artifact of depression-era forest policy, which can reasonably be considered monocultures with less value as natural resources than other forested tracts. More importantly, they are threatened by the invasive Red Pine Scale, and harvest soon appears to be the only way to salvage their value and avoid the creation of dead expanses with elevated fire potential. Most of these plantations fall within Green Mountain National Forest territory, so cooperation of the USFS would be essential.

Possible Wind locations are four locations that are conceivable community scale wind locations, imposed on both the resource map from the State Energy Planning Guidelines (**Map 6a**), and also over a basemap of 50m wind zone ratings for Ripton (**Map 6b**), according to data and mapping from VCGI, ANR, and the Massachusetts Technology Collaborative. These are virtually the only significant locations in Ripton that have wind class ratings as high as 4 and 5 and are not in designated Wilderness, and thus present the best options for development. However, it is likely none of these are economically attractive at present due to distance from transmission lines. Accordingly, while Ripton notes them as "possible" sites, they do not constitute "preferred" sites within the community at this time.

Mapping Methodology

Spatial data showing the location of potential energy resources (solar, wind, hydro, and biomass) formed the basis of the maps developed by ACRPC. “Known” and “possible” constraints were subsequently identified on the maps. Known constraints are conservation resources that shall be protected from all future development of renewable generation facilities. Possible constraints are conservation resources that shall be protected, to some extent, from the development of renewable generation facilities. The presence of possible constraints on land does not necessarily impede the siting of renewable generation facilities on a site. Siting in these locations could occur if impacts to the affected possible constraints are mitigated, preferably on-site. A full list of known and possible constraints included on the maps is located in Table 9. The known constraints and possible constraints used to create the maps include constraints that are required per the State Determination Standards from the Department of Public Service

Table 9 – Mapping Constraints

Solar, Wind and Biomass Maps - Known Constraints		
Constraint	**Description**	**Source**
Confirmed and unconfirmed vernal pools	There is a 600-foot buffer around confirmed or unconfirmed vernal pools.	ANR
State Significant Natural Communities and Rare, Threatened, and Endangered Species	Rankings S1 through S3 were used as constraints. These include all of the rare and uncommon rankings within the file. For more information on the specific rankings, explore the methodology for the shapefile.	VCGI
DEC River corridors	~~Only~~ Mapped River Corridors were depicted. ~~Does not include 50-foot buffer for streams with drainage area less than 2 square miles.~~	ANR
National Wilderness Areas		VCGI
FEMA Floodways		VCGI/ACRPC
Class 1 and Class 2 Wetlands	**Vermont State Wetlands Inventory (VSWI) and advisory layers from site specific work collected by the municipality**	VCGI
Solar, Wind and Biomass Maps - Possible Constraints		
Constraint	**Description**	**Source**
Protected lands	This constraint includes public lands held by agencies with conservation or natural resource oriented missions, municipal natural resource holdings (ex. Town forests), public boating and fishing access areas, public and private educational institution holdings with natural resource uses and protections, publicly owned rights on private lands, parcels owned in fee by non-profit organizations dedicated to conserving land or resources, and private parcels with conservation easements held by non-profit organizations.	VCGI
Deer wintering areas	Deer wintering habitat as identified by the Vermont Agency of Natural Resources.	ANR
Hydric soils	Hydric soils as identified by the US Department of Agriculture.	VCGI
Agricultural soils	Local, statewide, and prime agricultural soils are considered.	VCGI
Act 250 Agricultural Soil Mitigation Areas	Sites conserved as a condition of an Act 250 permit.	ANR

FEMA Flood Insurance Rate Map (FIRM) special flood hazard areas	Special flood hazard areas as digitized by the ACRPC were used (just the 100-year flood plain -500-year floodplain not mapped). The inclusion of this resource as a regional constraint is consistent with goals and policies of the Addison County Regional Plan.	ACRPC
Vermont Conservation Design Highest Priority Forest Blocks	The lands and waters identified here are the areas of the state that are of highest priority for maintaining ecological integrity. Together, these lands comprise a connected landscape of large and intact forested habitat, healthy aquatic and riparian systems, and a full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend. The inclusion of this resource as a regional constraint is consistent with goals and policies of the Addison County Regional Plan. (Source: ANR)	ANR

At the end of the mapping exercise, ACRPC calculated the amount of energy generation possible from renewable resources in Ripton based on the State resource mapping and some assumed values for the amount of land it would take to produce specified amounts of solar and wind energy. The results of this analysis are depicted in Table 10, Renewable Generation Potential.[3] As the table demonstrates, the amount of renewable generation potential is substantial, especially when compared to the amount of generation that currently exists in Ripton, contained in Table 8 on p. 15

Table 10. Renewable Generation Potential in Municipality

Source	Generation Potential (in MW) *	Est. Actual Generation Potential (in MWh)
Rooftop Solar	0.47	573
Ground-mounted Solar	828.00	1,015,459
Wind	7683.25	23,556,845
Hydro	0.01	28
Biomass and Methane	0.00	0
Other	0.00	0
Total	8511.73	24,572,905

**Nominal (nameplate) generation*

Renewable Generation Targets

As part of the same exercise, DPS also provided renewable generation targets that all municipalities would need to meet in the context of the State goal of producing half of its energy within the State. Those goals for Ripton, shown in Table 11, below, are based upon a combination of Ripton's population (Correlated to its potential use) and to the amount of potential resources available in Ripton.

When one compares the renewable generation targets in Table 11 with the renewable generation potential in Table 10, it is clear that Ripton's resource potential dwarfs its generation goals.[3]

3. The wind potential indicated in this table makes the methodology questionable. Perhaps the process failed to exclude the Federal Wilderness Area which encompasses most of the acreage of high wind potential. Also, although the generation potential of wind indicated exceeds the modeled 2050 Ripton energy usage to meet the 90 x 50 targets by a factor of close to 1500:1, the exploitation of that potential would be diseconomic and aesthetically problematic.

Table 11. Renewable Generation Targets	2025	2035	2050
Total Renewable Generation Target (in MWh)	1424.5	2849.1	4316.8

Since Ripton has the luxury of having significantly more area for generation potential than it needs to meet its goals, Ripton has chosen to use the following community land use standards to help guide energy projects to locate in areas it deems preferred or acceptable and to prohibit them in other areas.

Community Standards for Siting Energy Projects

Purpose:

The purpose of these standards is to promote and guide the development and use of renewable solar photovoltaic (PV), solar hydronic, and wind energy resources and infrastructure in Ripton, while preserving the character of the Town.
Solar PV, solar hydronic, and wind energy resources should be developed in an organized manner, and conform to this Town Plan.

Goals

- Encourage the use of renewable solar and wind energy in Ripton
- Develop Ripton's residential, commercial and public solar and wind power generation and related infrastructure consistent with Ripton's Town Plan
- Promote a good neighbor policy in siting solar and wind power infrastructure
- Avoid or minimize the negative impacts of solar and wind power generation and related infrastructure on the scenic and historic character of the Town, and the Town's natural resources
- Identify preferred locations for potential medium and large-scale commercial, community and public solar and possible locations for community scale wind installations in Ripton

1. General Solar Siting Standards

The Town of Ripton will support the following types of solar projects that conform to the provisions of these solar PV & solar hydronic siting standards.

- Resident-owned or leased residential hydronic solar systems
- Resident-owned or leased off-grid or net-metered residential photovoltaic systems not exceeding 15 kW that supply a single residence
- Privately owned residential scale photovoltaic systems not exceeding 15 kW and hydronic solar arrays, if either is installed as part of an "energy purchase plan"
- Net-metered solar arrays on commonly owned or leased land by Limited Liability Corporations that allow residents to pool resources and share energy production.
- Resident-owned or leased, off-grid and/or group net-metered residential photovoltaic systems not exceeding 30 KW that supply a small number of adjacent residences
- Commercial scale photovoltaic systems (defined as systems exceeding 30 KW but not so great that the anticipated aggregated real generation of all electric power facilities in the town exceeds the anticipated consumption of Ripton's user base) located outside the Historic and High Density Residential Districts

2. Specific Solar Siting Standards

The Town of Ripton will support solar energy facilities that comply with the following criteria:

- A solar system collector may be mounted on the rooftop of a conforming structure provided that it does not extend more than ten feet above the high point of the roofline.
- All roof and ground mounted solar energy facilities should meet the same setback and height restrictions as any building or facility within the land use district in which they are located
- With the exception of transmission and distribution lines, ground-mounted solar energy facilities that are not attached to existing or permitted structures may be located in Special Flood Hazard Areas (SFHAs), including floodways and floodway fringes identified on Flood Insurance Rate Maps (FIRMs) for the town, only if they meet minimum National Flood Insurance Program (NFIP) requirements.
- Ground-mounted solar facilities should not be located in fluvial erosion hazard areas as identified on Ripton FEH maps adopted as part of Ripton's Unified Development Bylaw.
- A ground-mounted solar energy facility should not be located on steep slopes with natural (pre- development) grades in excess of 25 percent unless an engineering study is done to show that the installation can be safely and securely supported throughout the expected life of the facility.
- The setback for a ground-mounted solar energy facility from surface waters and class 2 wetlands should be at least 50 feet, and 100 feet from Class 1 wetlands.
- The setback from significant wildlife habitat, as identified in the ANR Atlas, for a ground-mounted solar energy facility and the supporting infrastructure (including roads, accessory structures, etc.) should be at least 50 feet.
- Installation of any solar energy facilities within the Historic District of Ripton should be located on an existing structure so as to be out-of-view from Route 125, or, if ground-mounted, should be screened with coniferous trees planted and maintained so as to keep the facility out-of-view from Route 125.
- Except for resident-owned or leased arrays of 15kW or less, solar energy facilities located in Ripton outside of the Historic District should not be visible from traffic on the Route 125 Vermont Scenic Byway.

3. Siting of Solar Arrays for Aesthetic Compliance

- Solar structures should be located on the site so they do not appear above the horizon from public thoroughfares.
- Where solar panels may be seen by neighbors and the public, they should be arranged compactly, keeping the project as low as possible on the landscape.
- Where practical, solar installations should use existing topography, development or vegetation on the site to screen and minimize visual impacts.
- Where existing elements do not provide screening, landscaping, plantings and/or fencing should be used to mitigate adverse effects as noted in 4. below

4. Solar Siting--Adverse Effects

- Minimal Adverse Effects: When less than 20 degrees of a neighbor's view from his/her primary residence is occupied by a proposed solar project, and the project does not substantially obstruct the neighbor's vista, the visual impact shall be considered to be minimal, and screening may be recommended but not required.
- Moderate Adverse Effects: When 20 to 25 degrees of a neighbor's view from his/her primary residence is occupied by a proposed solar project, the effects are considered to be moderate. If the neighbor

requests concealment, screening will be required, provided that the act of screening does not prohibit installation of the solar facility.

- Significant or Undue Adverse Effects: When greater than 25 degrees of a neighbor's view from his/her primary residence is occupied by a proposed solar project and the neighbor expresses an objection, the effects are considered to be significantly or unduly adverse, and the Ripton Planning Commission will recommend against a proposed grid-tied project to the Public Service Board. If the project is not grid- tied the Planning Commission will not approve the project.Siting standards, policies, screening and other requirements specified in this document shall be reflected in the Planning Commission's review of a proposed project for submission to the Vermont Public Utilities Commission for its consideration of a Certificate of Public Good

5. General Wind Siting Standards

The Town of Ripton will support wind projects that conform to the provisions of these siting standards

- *Residential Scale Wind* consists of a single tower less than 120 feet high generating less than 15kW of energy, located on an individual residential property.
- *Community Scale Wind* consists of 1 or more towers all less than 200 feet high (so as not to require night lighting) and producing less than 1 MW of electricity.
- *Industrial Scale Wind* consists of wind projects with a total capacity of greater than 1MW or with a tower or towers taller than 200 feet or requiring night lighting for any reason.

6. Specific Wind Siting Standards

- Residential Wind projects shall follow the guidelines in this publication of the PSD for small turbines and using the scoring system therein, be reasonably construed to score below the "significant" zone. http://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/Resources/Wind/psb_wind_siting_handbook.pdf
- Commercial or Community Scale Wind projects:
    - Shall not exceed 200 feet in height, excepting movable blades.
    - Shall not be visible from traffic on the Route 125 Scenic Byway, excepting portions of movable blades above the hub.
    - Shall present no part visible to the naked eye above the horizon from any viewpoint in any municipality to the east or west of Ripton, excepting portions of movable blades above the hub.

The Town of Ripton prohibits industrial scale wind projects.

Land Use, Renewable Generation and Transmission Pathways to Implementation - Goals, Policies and Recommended Actions

In order to meet the energy generation targets cited elsewhere in this document, Ripton promotes the following Goals, Policies and recommended Actions for itself and its citizens.

Goal

A. Plan for increased electric demand in partnership with Green Mountain Power and Efficiency Vermont.

Policies and Recommended Actions

1. Lead by example. Encourage the use of renewable energy production in town buildings, the school and residences.
    a. Investigate and support the installation of additional municipal solar and/or wind net-metering facilities that are compliant with the standards enumerated in this plan to off-set municipal electric use.

2. Support the development and siting of renewable energy resources in the Town that are in conformance with the goals, strategies, and mapping outlined in this energy plan. Support responsibly sited and responsibly developed renewable energy projects, which shall include solar panels, wind turbines and all associated supporting infrastructure
    a. The Ripton Energy Coordinator will continue to work closely with the Ripton Planning Commission, DRB and Zoning Administrator on any proposed energy development projects within Ripton.
    b. Investigate and support installation of community-owned renewable energy project(s) that are compliant with the standards enumerated in this plan to allow Ripton's citizens to participate in the economic benefits of local energy production.
    c. Determine if the PACE program could be used as a financing and administrative mechanism to support community renewable ownership.

3. Favor the development of generation utilities in identified preferred locations over the development on other sites.
    a. Initiate a dialogue with GMNF management as soon as possible regarding the future of Red Pine plantation tracts

Goal

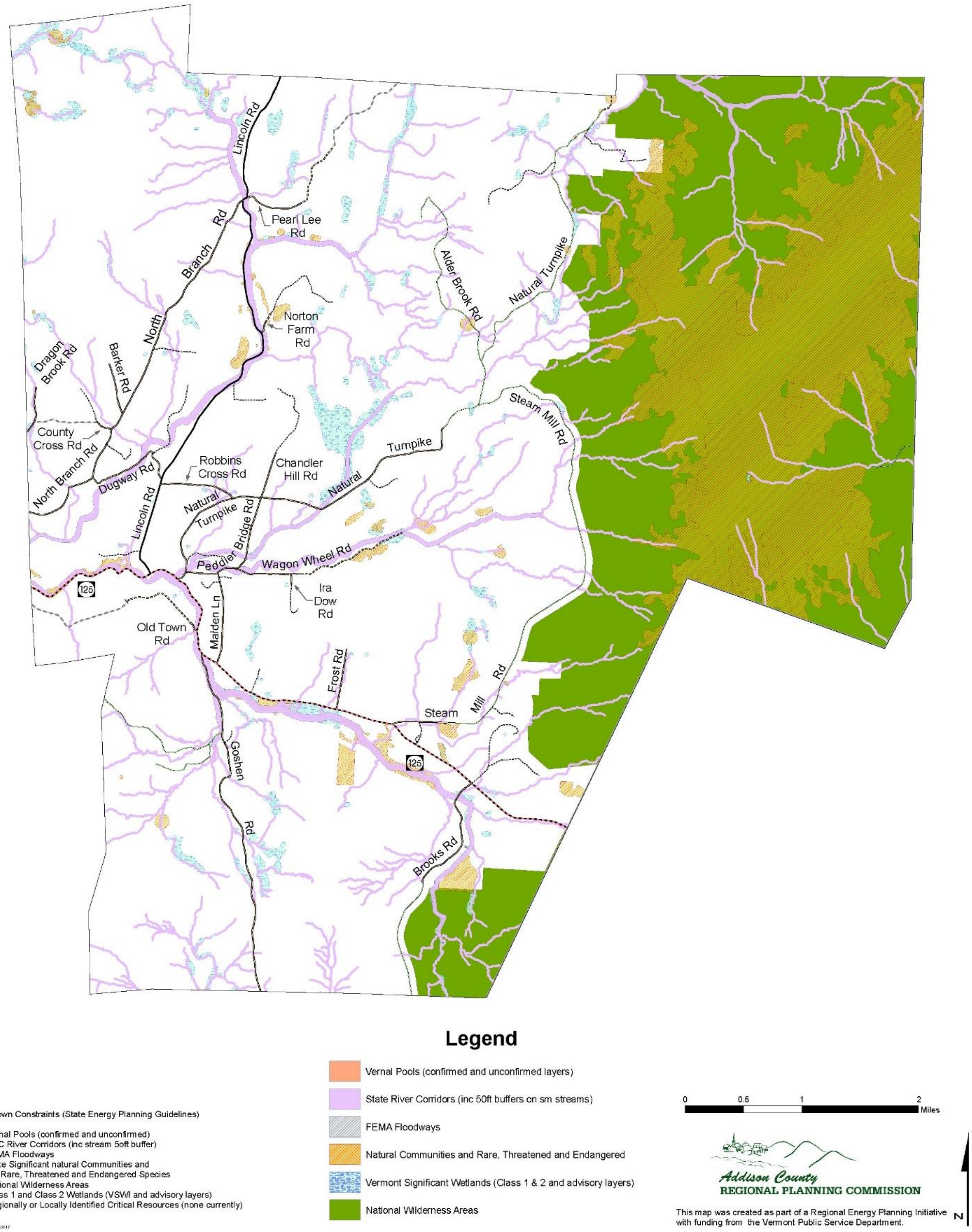
B. Promote Land Use planning that supports reducing energy usage and conserving resources

Policies and Recommended Actions

1. Encourage settlement patterns that reduce travel requirements for work, services, and recreation.
    a. Encourage development of compact neighborhoods within Ripton's Neighborhood Commercial, High Density Residential and Medium Density Residential Planning Areas.
    b. Support the general stores and other businesses in the village area.
    c. Allow infilling of existing large-lot development where higher density development is desirable and appropriate.
    d. Provide opportunities for appropriate home occupations and telecommuting.
    e. Support continued improvements in broadband connectivity and encourage telecommuting.

2. Conserve forest land as a renewable energy resource, and promote the responsible and efficient use of wood for biomass energy production.

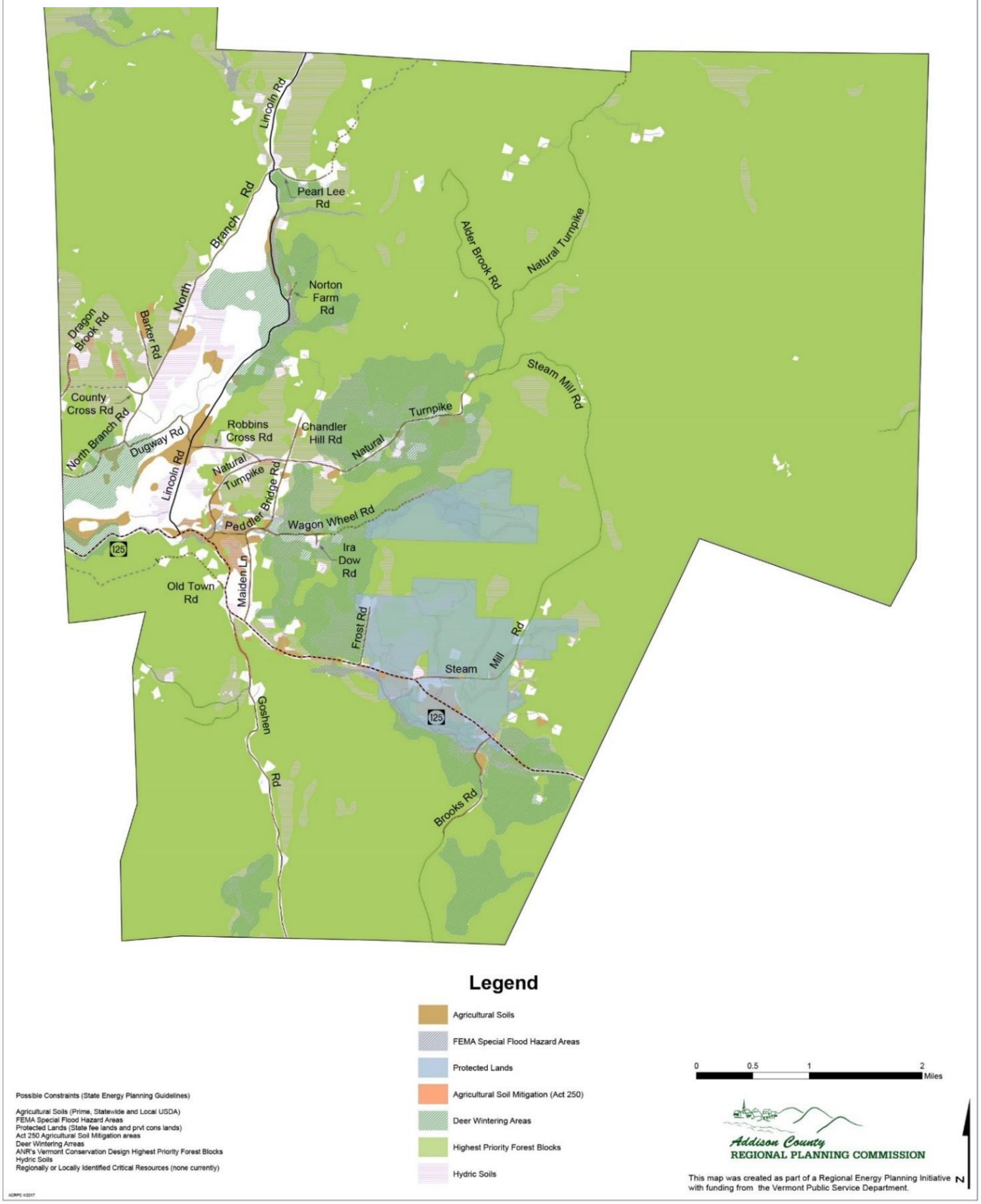
RIPTON Renewable Energy Planning: *Known Constraints per State Energy Planning Guidelines*



MAP 1

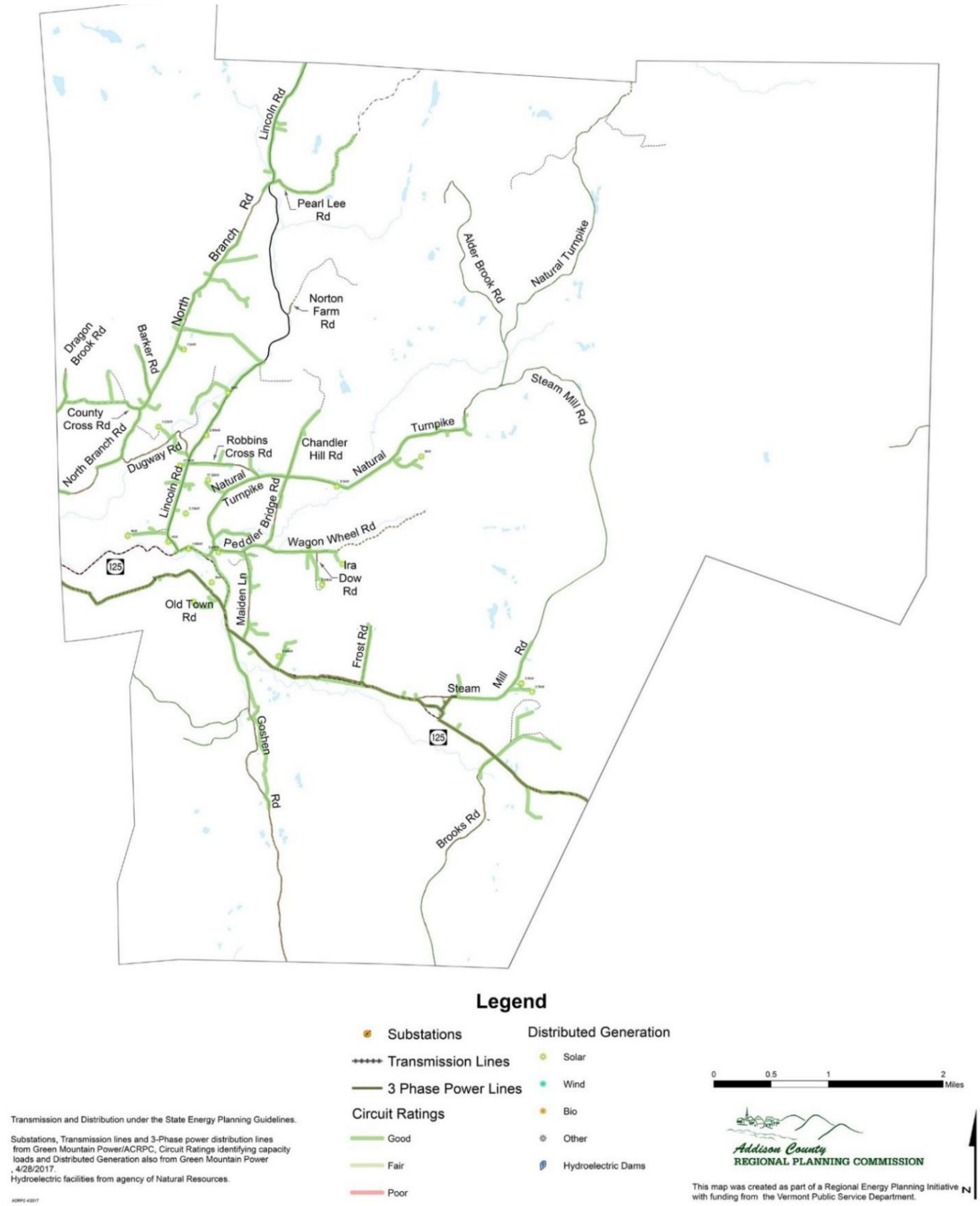
RIPTON Renewable Energy Planning:

Possible Constraints per State Energy Planning Guidelines



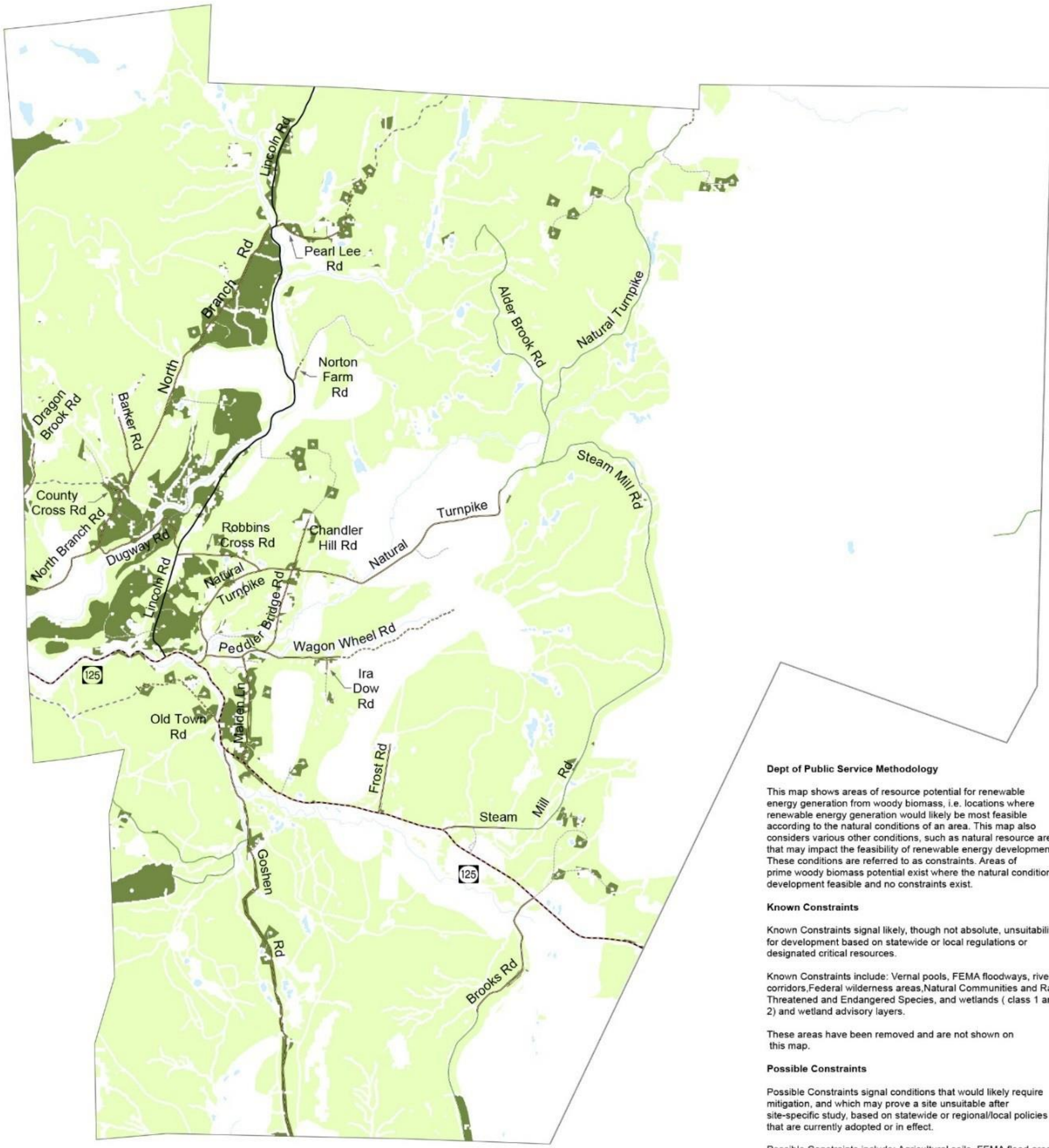
MAP 2

RIPTON Renewable Energy Planning:
Transmission and Distribution Resources and Constraints



MAP3

RIPTON Renewable Energy Planning: *Potential Biomass Resource Areas per State Energy Planning Guidelines*



Dept of Public Service Methodology

This map shows areas of resource potential for renewable energy generation from woody biomass, i.e. locations where renewable energy generation would likely be most feasible according to the natural conditions of an area. This map also considers various other conditions, such as natural resource areas, that may impact the feasibility of renewable energy development. These conditions are referred to as constraints. Areas of prime woody biomass potential exist where the natural conditions make development feasible and no constraints exist.

Known Constraints

Known Constraints signal likely, though not absolute, unsuitability for development based on statewide or local regulations or designated critical resources.

Known Constraints include: Vernal pools, FEMA floodways, river corridors,Federal wilderness areas,Natural Communities and Rare, Threatened and Endangered Species, and wetlands (class 1 and 2) and wetland advisory layers.

These areas have been removed and are not shown on this map.

Possible Constraints

Possible Constraints signal conditions that would likely require mitigation, and which may prove a site unsuitable after site-specific study, based on statewide or regional/local policies that are currently adopted or in effect.

Possible Constraints include: Agricultural soils, FEMA flood areas, Protected Lands, ACT 250 soil mitigation areas, Deer wintering areas, Highest Priority Forest Blocks, and Hydric soils.

These areas are shown on the map where they coincide with areas of renewable woody biomass potential.

Legend

- Primary Biomass Siting Areas
- Secondary Biomass Siting Areas

0 0.5 1 2 Miles

Woody Biomass Potential Analysis under the State Energy Planning Guidelines.

Statewide forest cover types from the 2006 National Land Cover Dataset (NLCD, 2006) were merged into a single file and used to calculate low-grade green tons per acre by VCGI. The forest cover areal extent was used in this analysis.

Addison County
REGIONAL PLANNING COMMISSION

This map was created as part of a Regional Energy Planning Initiative with funding from the Vermont Public Service Department.

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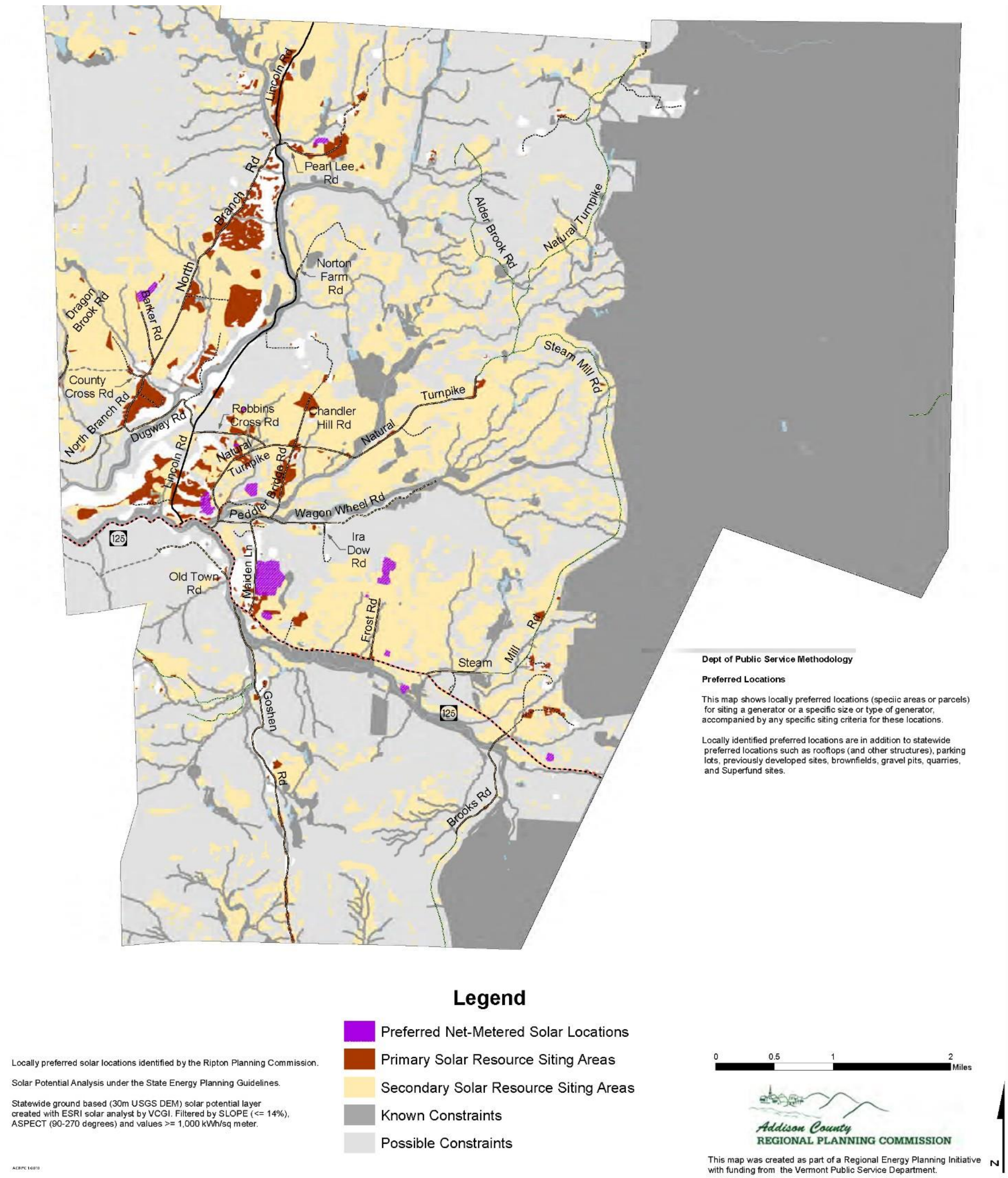
ACRPC 4/2017

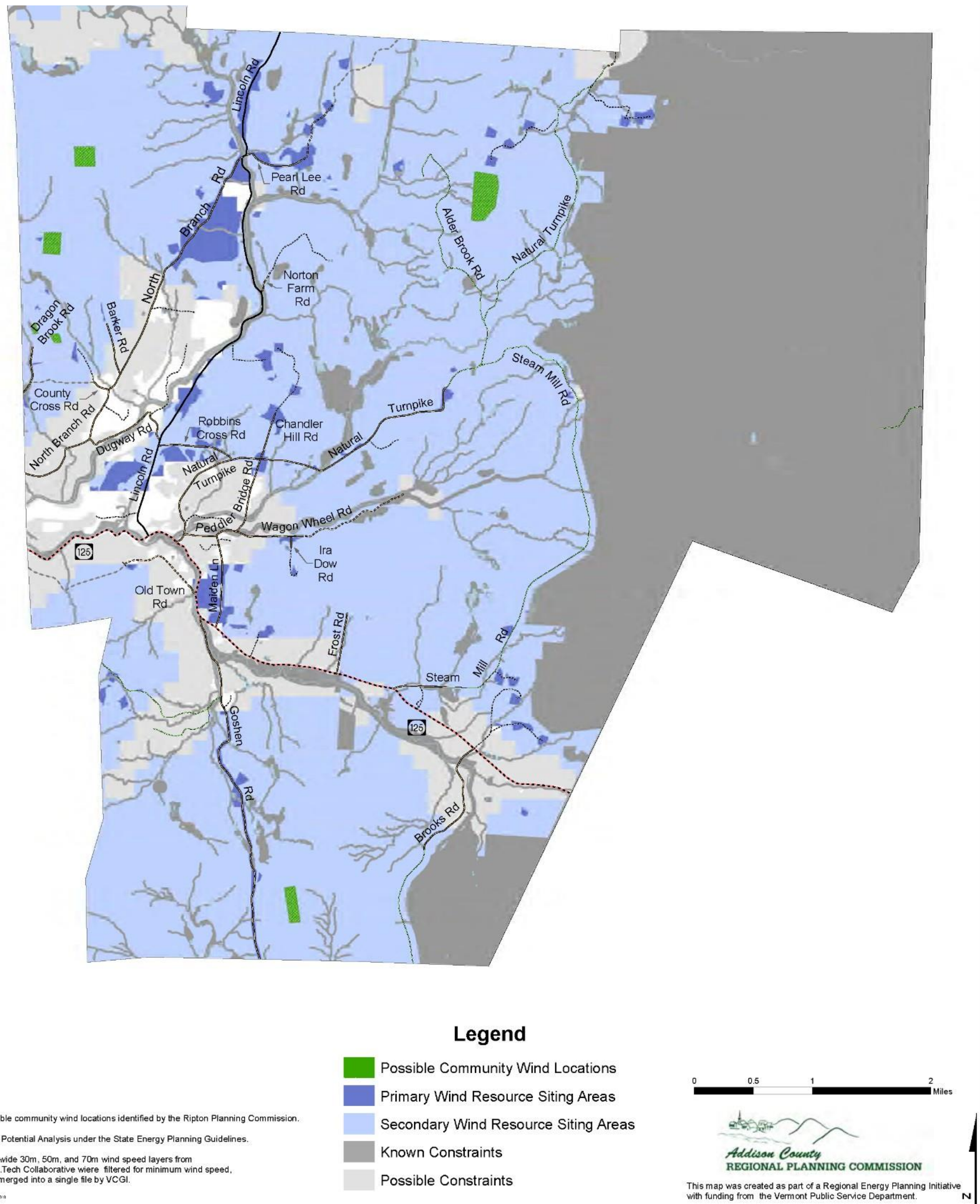
MAP 4

RIPTON Renewable Energy Planning: *Ripton's Preferred Solar Locations with Primary and Secondary Resource Locations Identified in State Energy Planning Guidelines*



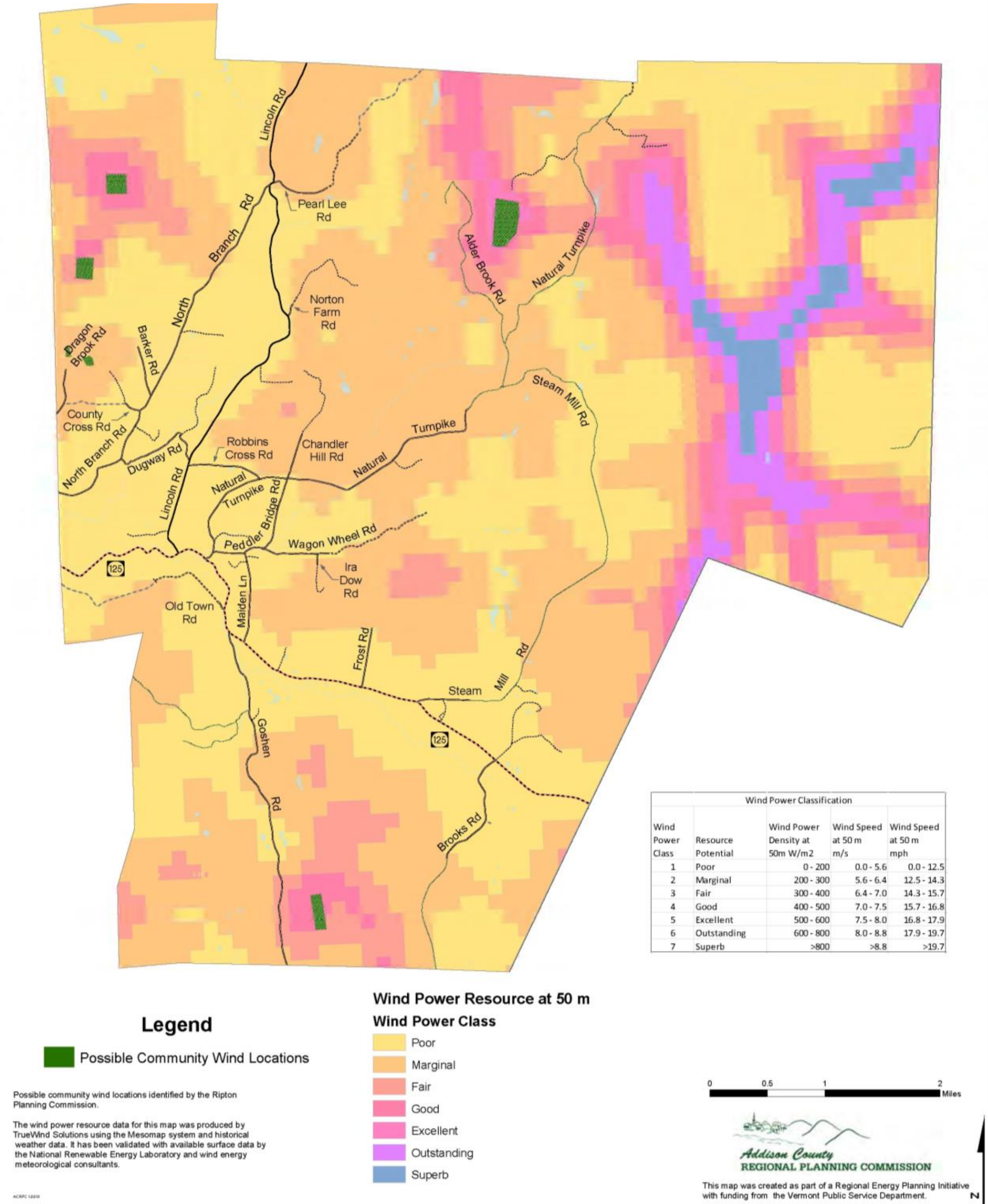
MAP 5

RIPTON Renewable Energy Planning: *Ripton's Possible Community Wind Locations with Wind Resource Mapping per State Energy Planning Guidelines*



MAP 6a

RIPTON Renewable Energy Planning: *Ripton's Possible Community Wind Locations with Wind Power Resource at 50m*



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50m W/m2	Wind Speed at 50 m m/s	Wind Speed at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	>800	>8.8	>19.7

MAP 6b