8. ENERGY

GOALS:

- Encourage the efficient use of energy and the development of renewable resources.
- Support the expansion of solar, hydro, and wind as sources of electricity.
- Decrease the region's reliance on fossil fuel as a source of heat by increasing the use of efficient wood heat systems and biomass.
- Encourage the replacement of fossil fuels with electricity generated from renewable resources.

OBJECTIVES AND STRATEGIES

OBJECTIVE: MAINTAIN FOREST RESOURCES AND FOREST HEALTH AS A PREREQUISITE TO A SUSTAINABLE WOOD ENERGY FUEL SUPPLY.

- Consider a Land Evaluation Site Assessment to support and prioritize conservation efforts.
- Explore alternatives to large lot zoning that might provide more flexibility in minimizing fragmentation of working lands.
- Enlist the technical support of conservation organizations to identify and conserve lands appropriate for a town forest.

OBJECTIVE: ENCOURAGE CONSERVATION BY INDIVIDUALS AND ORGANIZATIONS IN RYEGATE.

- Establish an Energy Committee to spearhead outreach and education on efficiency improvements and fuel switching opportunities.
- Encourage the Town to adopt a policy that taxpayer financed building or maintenance projects must consider energy efficiency and future energy costs.
- Increase awareness of the benefits of efficiency and weatherization programs offered through agencies such as Efficiency Vermont, NETO/HEAT, Heat Squad, and others.
- Encourage awareness of and adherence to state and national efficiency building codes (e.g. Residential Energy Standards and Commercial Building Energy Standards).
- Explore the possibility of establishing a training program at the River Bend Career & Technical Center that allows trainees to perform no-cost or low-cost energy audits on residences.

OBJECTIVE: DECREASE THE USE OF FOSSIL FUELS FOR HEATING.

- Use the Community Energy Dashboard to crowdsource information regarding efficiency and fuel switching success stories.
- Plan for Town buildings and vehicles to transition away from oil-based energy and toward alternative fuels.
- Consider becoming a "clean energy district" and participate in the PACE program (Property Assessed Clean Energy). This would provide consumers with options to more affordably implement grid-tied renewable energy systems.

OBJECTIVE: PROMOTE THE DEVELOPMENT OF MORE ENERGY EFFICIENT BUILDINGS.

- Consider the use of innovative zoning incentives, including density bonuses or tax stabilization for mixed-income developments, universal access design, and small footprint housing.
- Encourage increased use of public transit and reduce reliance on single-occupancy vehicle trips.
- Establish additional park and rides, preferably with an EV charging station.

OBJECTIVE: PROMOTE A SHIFT AWAY FROM GAS/DIESEL VEHICLES TO ELECTRIC OR OTHER NON- FOSSIL FUEL TRANSPORTATION TO NON-FOSSIL FUEL OPTIONS.

- Promote the development of charging stations to facilitate increased use of electric vehicles.

OBJECTIVE: PROMOTE AND EXPAND THE USE OF NON-MOTORIZED INFRASTRUCTURE, SUCH AS BICYCLING AND WALKING.

- Pursue funding opportunities to promote master planning, e.g. VTrans Local Transportation Facilities, Better Connections Grants.
- Pursue Village Center Designation to become eligible for the Better Connections Grant Program.

OBJECTIVE: ENCOURAGE THE DEVELOPMENT OF ALTERNATIVE ENERGY RESOURCES IN TOWN. FOCUS ON RENEWABLE ENERGY SOURCES SUCH AS WIND, SOLAR, AND HYDROELECTRIC.

- Minimize local regulatory hurdles (zoning) for installation of such systems.
- Support solar panel safety training programs for fire fighters and first responders.

Note: Energy use estimates and energy and fuel switching targets were prepared by NVDA, with assistance from the Department of Public Service. More information about the data, sources, and methodologies can be found in Appendix B.

ENERGY USE BY SECTOR

The citizens of Ryegate are able to purchase energy for their heating and lighting needs from a variety of sources. Electric grid access is available from Green Mountain Power and the Washington Electric Co-op. Petroleum based products (propane, fuel oil and kerosene) are sold and delivered by several local distributors. Diesel and gasoline are sold at local gas stations, all located outside of town.

Firewood can be purchased from numerous local suppliers or cut on one's own land.

Currently there appears to be ample supply of these traditional energy sources.

With time the imbalance between world- wide demand for and supply of oil may affect both the price and availability of petroleum products.

According to NVDA estimates, heating (space and water) is the largest energy use in Ryegate, accounting for a little less than half of all energy use. Transportation is the second largest use. Electricity usage accounts for the smallest share.

See Table 8.1)

Table 8.1 Energy Use by Sector

Sector	MM BTUs	% of All Energy Use
All Heating	68,180	46.3%
Heating, Residential	60,955	41.4%
Heating, Non-residential	6,654	4.5%
Heating, Seasonal	571	0.4%
Transportation	60,057	40.8%
Electricity	18,952	12.9%
TOTAL	146,474	

(Source: NVDA and Efficiency Vermont)

What is a BTU?

Fuels come in a variety of measurements – by cord, by gallon, by kilowatt – so this plan converts units of measurement into British Thermal Units (BTUs) in order to compare their energy output consistently.

According to the US Energy Information Administration a BTU is the measurement of the quantity of heat required to raise the temperature of one pound of liquid water by 1° F at the temperature that water has its greatest density (approximately 39 °F.)

One BTU is a miniscule amount, so BTUs are often measured in the millions (MM BTUs).

CURRENT HEATING CONSIDERATIONS

Year-round residences are the largest contributor to Ryegate's heating costs. Collectively, total energy use for heating all occupied units in Ryegate accounts for about 60,955 MM BTUs annually at an annual cost of $826,650.

Fuel oil is the most prevalent fuel source for Ryegate residents, although home-owners also rely heavily on the use of wood.

Renters, who typically have less control over their choice of heating sources, are less likely to use wood and are far more likely to rely on fuel oil or propane.

With fluctuations in the price of oil in recent years there has been a shift towards more wood-based heat sources, including outdoor wood boilers. The State of Vermont regulates the siting and installation of outdoor wood boilers, and there are minimum required setbacks and stack heights that need to be adhered to when these are installed. Communities have the option of enforcing more stringent standards.

Compared to other towns in the Northeast Kingdom, seasonal use does not contribute significantly to Ryegate's energy consumption patterns, but it should be considered in long-range planning endeavors, particularly since the region is likely to see continued conversion of seasonal units to year 'round.

While wood is readily available in Ryegate, the age of older less energy-efficient homes might still drive up heating costs. In fact, the age of Ryegate's housing stock is probably the most significant contributor to heating energy use. According to ACS 5-year estimates, 41% of Ryegate's owner- occupied housing stock predates 1940. Older structures are likely to be "leaky" and poorly insulated, which can nearly double the average thermal use from 45,000 BTUs per square foot to as much as 80,000 BTUs per square foot.

Blue Mountain School, which is actually in Wells River, is not included in the energy use estimates, but it clearly represents a significant energy use for Ryegate, as the town supports the school and actively participates in critical decisions about maintaining the facility. Since 1998, the 77,000 square foot facility has been heated with woodchips, producing more than 39,000 net BTUs per square foot. The wood chip system, which was installed in 1998, reduces annual heating costs by roughly one-third over the cost of heating entirely with fossil fuel.

FUTURE HEATING CONSIDERATIONS

In order to meet the statewide energy goal of meeting 90% of energy needs through the use of renewables, Ryegate must pursue two strategies:

- Reduce overall heat energy consumption through aggressive weatherization and efficiency upgrades; and
- Switch from fossil-fuel heat to clean renewable sources.

Energy efficiency is, generally, the most cost-effective method of saving energy and reducing the Town's carbon footprint.

Therefore, it is recommended that residents pursue energy efficiency solutions first, such as home energy audits and energy efficiency retrofits, before investing in the installation of renewable energy systems. The 2016 Vermont Comprehensive Energy plan states that efficiency will ensure an affordable and stable cost of doing business, increase entrepreneurship opportunities, improve labor market conditions, drive production, and drive improvements in demand-side thermal and electric efficiency and conservation.

The targets in Table 8.2 provides an idea of the scale by which these strategies must be carried out if we are successful in meeting statewide energy goals.

Table 8.2: Weatherization and Fuel-Switching Targets for Ryegate

Weatherization	**2025**	**2035**	**2050**	**Fuel Switching**	**2025**	**2035**	**2050**
Estimated number of residences	474	502	532	New efficient wood heat systems in residences	244	200	145
% of households to be weatherized	20%	33%	33%	% of residences with wood heat systems	51%	40%	27%
# of households to be weatherized	95	165	177	New heat pumps in residences	72	153	194
				% of residences with heat pumps	15%	30%	36%
Estimated number of commercial establishments	13	13	14	New efficient wood heat systems in commercial establishments	3	4	6
% of commercial establishments to be weatherized	8%	13%	23%	% commercial establishments with wood heat systems	24%	29%	32%
# of commercial establishments to be weatherized	1	2	3	# commercial establishments with heat pumps	1	2	3
				% commercial establishments with heat pumps	9%	16%	23%

Source: NVDA, with assistance from the Department of Public Service. (Note: Efficiency Vermont has compiled some historic data on thermal improvements, which can be found in Appendix B. This data helps to provide an idea of the kinds of projects that will help Ryegate meet the above weatherization targets.)

WEATHERIZATION RESOURCES

Many newer and a few older Ryegate dwellings have been built with attention to conservation of energy. Among those techniques are copious insulation, maximizing southern exposure, and earth- sheltering.

NETO/HEAT has an office in St. Johnsbury, and they provide weatherization assistance.

Efficiency Vermont provides many incentives for residences and businesses to make efficiency improvements in lighting and weatherization.

NVDA has provided energy efficiency audits for municipal buildings in Ryegate. There are specific recommendations that the town can act on to save money. Their reports identified a total savings of 82.4 MM BTUs among all three buildings, with varying payback periods.

Vermont provides a tax credit that investors can claim in addition to the federal credit. Efficiency Vermont maintains an online database of rebates and incentives small- scale renewables and efficiency improvements. (http://programs.dsireusa.org/system/program/detail/2325). With regards to municipal tax, Vermont law allows municipalities to waive the property taxes for solar facilities and any land, not to exceed one-half acre, on which it is built.

Property-Assessed Clean Energy (PACE) Districts allow property owners to borrow money to pay for such things as energy efficient water heaters, lighting, furnaces, boilers, windows, programmable thermostats, and insulation, as well as solar heating, PV, wind and biomass systems. The amount borrowed is typically repaid via a special assessment on the property over a period of up to 20 years. In Vermont, local governments are authorized to create PACE Districts to provide financing. Participating property owners must agree to a special assessment and lien on the property and pay a one-time, non-refundable fee to support the reserve fund created to cover losses in the event of foreclosure of participating properties. The district may release a lien on a property once the property owner has met the terms of the loan.

The Vermont Residential Energy Code—Residential Building Energy Standards (RBES)—was passed by the Vermont State Legislature in May 1997 to establish standards to promote energy conservation in all new residential construction.

Unfortunately, there are few opportunities to enforce compliance except through zoning, if the zoning ordinance requires a Certificate of Compliance. The Town should consider ways to amend zoning to ensure that energy standards are met.

Ryegate could benefit from a local energy committee who can coordinate outreach and initiatives in pursuit of 2050 goals.

Efficiency Vermont and NVDA are available to assist in establishing and training local energy committees around the region.

FUEL SWITCHING OPTIONS IN RYEGATE

Although cord wood continues to be a popular choice in the region, wood pellets, which are cleaner burning and more efficient than cord wood, are gaining popularity among residents. Stoves and furnaces can be controlled by a thermostat. Their prices have remained relatively stable, although there have been some shortages in recent heating seasons.

Geothermal, or “ground source heat pump systems”, extract natural low-temperature thermal energy from the ground during colder months for heating, and transfer thermal energy from the building to the ground in warm months for cooling. A geothermal system in Vermont can save roughly $1,000 to $2,000 annually in heating costs and have a “simple payback time” of between 10-20 years. This technology operates much like a refrigerator, utilizing a heat pump, heat exchanger, and refrigerant. While geothermal systems do require electricity to operate the pumps, the systems generally deliver between three to five times more heat than the electrical energy they consume (depending on the type of system).

Geothermal pumps require excavation and duct work, pricing the technology out of reach for many residents. In recent years, however, manufacturers have developed similar air-sourced heat pumps that operate more

consistently over Vermont's vast temperature ranges. Also called "cold climate heat pumps" or "mini splits", these units can be two to three times more efficient than propane and fuel oils. Unlike geothermal units, they do not require excavation or duct work and can be much less expensive to install. Cold climate heat pumps have the capacity to heat about only 50% to 70% of a building, depending on the size and layout of the structure. Ryegate's older housing stock, which is characterized by multiple ells or wings, may be difficult to heat with heat pumps alone, but the pumps may be effective for boosting colder underserved zones. They also may be useful in outdoor workspaces. Despite recent improvements in effectiveness on cold days, a backup heating source is usually required for sub-zero temperatures.

Biofuels may be an option for Ryegate residents as well. These are discussed in greater length under "Future Transportation Options".

CURRENT TRANSPORTATION ENERGY CONSIDERATIONS

Energy use in transportation is most greatly influenced by the development patterns of the region. According to NVDA estimates, long commutes and incidental trips require NEK residents to drive an average of 14,000 miles per year. That means collectively, Ryegate residents drive 11.2 million miles annually, accounting for more than $1.1 million in fuel costs. Nearly all of this energy is non-renewable. Ethanol currently accounts for all renewable transportation energy usage – about 6% of total BTUs.

As of January 2017, there were no plug-in electric vehicles (EVs) registered in Ryegate. Nevertheless EVs have the greatest potential to reduce Vermont's statewide greenhouse gas emissions. "Refueling," which is as simple as plugging into an electric outlet, costs the equivalent of about $1.00 per gallon.

The nearest EV dealership to Ryegate is in St. Johnsbury, and there are dealerships in White River Junction and Barre.

The nearest public charging station is in Danville (Marty's First Stop), and it is the only fast-charging station within a 15-mile radius. A number of public charging stations have also been established around the NEK, and several exist outside of the region in Plainfield, Bradford, and Barre. Clearly more public charging infrastructure is needed, as an EV driver making a single trip to St. Johnsbury could be stranded there for at least an hour. While energy providers in pursuit of Tier III credits will likely continue to offer rebates and incentives for Ryegate residents to purchase EVs, more public charging infrastructure will be needed to support expanded EV use.

FUTURE TRANSPORTATION ENERGY USE CONSIDERATIONS

In order to meet the statewide energy goal, Ryegate must pursue two strategies:

- Reduce reliance on light-duty vehicles
- Switch from to non-fossil fuel burning heat sources.

Achieving the first strategy is a tall order in a rural community, where development patterns directly impact energy use, especially in regards to individual behaviors. With limited transit infrastructure, the region is dominated by single-occupancy light-duty vehicles. Residents typically commute to disparate labor market areas, reducing opportunities for carpooling. VTrans offers grant assistance to municipalities who wish to establish park and rides on municipal, state, or leased property on or near state highways. Mixed-use, higher density neighborhoods encourage more pedestrian use. The following land use principles encourage reduced transportation energy consumption:

Encourage the location of new development in or near traditional village and city centers to reduce both sprawl and the number of vehicle miles driven. Compact, mixed-use development can reduce residents' reliance on the automobile, vehicle miles traveled, and inherent system energy costs — including energy costs associated with maintaining roads and related infrastructure.

Targeting economic and residential growth within areas intended for more concentrated development allows people to walk to their

destinations and makes public transit services between growth centers more economically feasible. Clustering and other energy efficient development patterns should be encouraged. Alternative transportation accommodations, such as bike and pedestrian lanes, can help to reduce reliance on vehicles.

Additionally, improved telecommunications infrastructure in this region has the potential to reduce annual VMTs by allowing more workers to telecommute.

Given the vast majority of Ryegate residents are employed outside of the community, ride sharing is another opportunity to reduce transportation consumption. There is one park and ride facility in South Ryegate at the fire station. This lot is maintained by the Town of Ryegate. It is lit and available for use 24 hours a day, but there are no bicycle racks or charging outlets for EVs.

While smart growth principals are worthy goals for Ryegate, they remain in many ways aspirational, with a number of land and socio-political constraints. An analysis of long-term development trends in the region has shown that market demands favor scattered and dispersed development.

Village Center Designation, which offers tax credits to incentivize reinvestment in traditional areas of development, may be one way to reverse this trend.

Despite the lack of infrastructure and rough terrain, the majority of light-duty vehicles are expected to be powered by electricity by the year 2040.

Table 8.3: Transportation Fuel Switching Targets for Ryegate

	2025	2035	2050
Projected number of light-duty vehicles in the area, by year	900	1,013	1,139
Number of vehicles powered by electricity	109	348	749
% of vehicles powered by electricity	12%	34%	66%
Number of vehicles using bio-fuel blends	742	510	89
% of vehicles using bio-fuel blends	82%	50%	8%

Source: NVDA, with assistance from the Department of Public Service. Projected number of vehicles in the area is estimated to be roughly commensurate with projections of population and households. EV estimates assume a gradual increase in EV fuel economy from 3 miles per kWh to 4 miles per kWh by 2050. Bio-fuel estimates assume a gradual increase in fuel economy to 40 mpg by 2050.

Biodiesel is commonly made from soybeans, rapeseed (canola), and sunflowers; all of which can be grown in Vermont. Biodiesel can be blended with diesel up to 5% (B5) to be safely used for on-road vehicles. Higher blends, including pure biodiesel (B100) can be used in off-road equipment and farm vehicles. Black Bear Biodiesel, located just outside of the region in Plainfield, is a B100 fueling station.

Research has found that oilseed crops, when grown in rotation with other crops, can help to support sustainable, diversified, and profitable agricultural enterprises. The Vermont Bioenergy Initiative, a program of the Vermont Sustainable Jobs Fund, provides early-stage grant funding, technical assistance and loans to producers. Oilseed production may help existing farmers develop an additional revenue stream.

CURRENT ELECTRICITY USE CONSIDERATIONS

Efficiency measures tracked by Efficiency Customers are primarily residential, and the counts have been fairly steady (about 590 residential customers) over the most recent three-year period. Residential customers have reduced their average use in recent years – from 24 MMBTUs per customer, to 23. Similar data for commercial and industrial users is not available, but this sector has seen a 4% increase in overall use over the same period.

Vermont and VEIC indicate that Ryegate utility customers have achieved an overall reduction in 146,829 kilowatt hours and a thermal savings of 175 MM BTUs over the most recent three-year period (2014-2016).

Future Electricity Use Considerations

While electricity is currently the smallest energy use in Ryegate, its use will increase exponentially as users of fossil fuels convert to electricity generated from renewable resources, such as heat pumps and EVs.

Efficiency upgrades are therefore essential in making this transition possible.

Table 8.4: Upgrade and Efficiency Targets for Ryegate

	2025	2035	2050
Estimated number of residential customers	711	753	799
% of residential customers to upgrade electrical equipment	26%	39%	54%
# of residential customers to upgrade electrical equipment	187	293	430

Source: NVDA, with assistance from The Department of Public Service (Note: Efficiency Vermont has compiled some historic data on thermal improvements, which can be found in Appendix B. This data helps to provide an idea of the kinds of projects that will help Ryegate meet the above weatherization targets.)

GENERATION AND DISTRIBUTION

Green Mountain Power serves the major portion of Ryegate (see Attachment B, Figure B.4 Electric Utility Service Territory Map). Washington Electric Coop serves the northwest corner of community along the Peacham Road and Bayley Hazen Road. Both utilities have become increasingly involved with the issues and policies associated with renewable energy production, particularly distributed, small- scale power generation.

Ryegate currently generates upward of 180,000 MWh of renewal energy (See Appendix B, Table B.9: Energy Generation in Ryegate). The woodchip plant and Dodge Falls Hydro account for the bulk of generation. The woodchip plant uses propane as a startup fuel, but the primary source is biomass. Two smaller projects are sited on the Wells River, right on the Town's border, in Newbury.

Residential-scale net-metered projects currently generate more than 56 MWh. In addition, there are two hot water solar systems. A few homes are 'off-the-grid.' To date there have been no residential-scale wind or hydro projects

GENERATION POTENTIAL IN SUPPORT OF STATEWIDE ENERGY GOALS

Ryegate's new net generation in support of 2050 goals is 331 MWh. This is based on the town's share of the regional population.

Existing generation in Ryegate does not count toward this target, but the region already has a low net generation target, mainly because of the existing generation, such as the region's hydro facilities, the Ryegate Power Plant, and industrial wind production in Sheffield and Lowell. The region's net generation target for new solar ranges from 246 MW to 377 MW. There is no regional net generation target for wind. It is possible that the solar development proposed for the town's gravel pit – a statewide preferred location-- could make substantial progress toward meeting the municipal target.

Ryegate has sufficient land for the orderly development of solar, according to NVDA's mapping analysis. These maps, which are to be used to gauge overall siting potential rather than a definitive siting tool, identify known constraints, as well as potential constraints:

Known constraints are 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, wetlands (Class 1 and Class 2).

Possible constraints are areas that would likely require mitigation because they contain the 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, and highest priority forest blocks.

Proposed regional 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. Lands with an elevation of 2,000 feet or more merit consideration as a special class of rural lands that should be protected from any large-scale commercial or industrial development characterized by a constructed height of 100' or more, and an acre or more of permanent site disturbance, such as clear- cutting. These lands, as indicated on attached siting potential maps, contain one or a combination of factors that make them unsuitable to such development – contiguous forest cover; sensitive wildlife and plant habitat; conservation lands and recreational assets; managed forestland; and headwaters and ephemeral surface waters, which are highly vulnerable to erosion and man-made disturbance. This high-elevation forest cover must be kept unfragmented for the attenuation of flood flows, the benefit of wildlife habitat and linkage, and public enjoyment through passive recreation.

Table 8.5 Siting Constraints

Known Constraints (Statewide Layer Developed In Support of Act 174)	Regionally Unsuitable Areas (NVDA Regional Plan)	Possible Constraints (Statewide Layer Developed in Support of Act 174)	Local Constraints
Vernal pools River corridors Floodways State significant natural communities Rare, threatened and endangered species Natural wilderness areas Class 1 and 2 wetlands	Lands with elevations of 2,000 ft or more	VT agriculturally important soils Special flood hazard areas Protected and conserved lands Deer wintering areas Vermont conservation design highest priority forest blocks Hydric soils	Open agricultural fields Scenic Viewsheds (See solar resources map): Witherspoon Drive between Dickey Drive and Renfrew) Ticklenaked Pond from South Bayley Hazen to Cedar Drive Peacham Road from Mosquitoville Road to the Barnet Town Line

PREFERRED SITES

- Roof-mounted systems;
- Systems located in proximity to existing commercial or industrial buildings;
- Areas with no known or possible constraints that are near existing hedgerows or other topographical features that naturally screen the entire proposed array;
- Former brownfields;
- Facilities that are sited in disturbed areas, such as gravel pits or former quarries;
- Working farms, where more than 50% of the energy generated by the solar development is used by the farm;
- Community projects: Local group net metered solar facilities shared by multiple community subscribers who receive credit on their electricity bills for their share of the power produced; and
- Any preferred areas as mapped on Ryegate's solar resources map.

SITING STANDARDS FOR SOLAR:

All ground-mounted solar facilities shall be sited and screened so that visual impacts are mitigated when viewed from public streets, scenic viewpoints, and/or adjacent properties. Screening shall be year round. 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 then a large expanse of uninterrupted, uniform material. Plantings that die or become diseased shall be replaced within six months.

Screening for solar developments projects along the three view sheds cited above shall be held to a higher standard. Solar projects shall not be visible within a thousand feet of a passenger vehicle travelling on these roads. All mid-scale solar projects proposed this these landscape areas shall have a landscape impact analysis completed by a certified landscape professional.

Although the Town does not support the siting of commercial energy development on agricultural lands, it supports the integration of

on-farm solar generation into active agricultural uses that can help farms reduce expense, generate extra income, and remain viable. The town supports siting solar on existing farm structures, or the creation of buffers between organic and non-organic production areas, or in a manner that does not degrade soil or water quality.

All utility scale solar facilities shall be sited only on preferred sites.

Solar Classifications

Small-Scale: defined as solar electricity and transmission facilities up to and including 15 kW capacity.

Mid-Scale Solar: defined as solar electricity generation and transmission facilities greater than 15 kW capacity and less that or equal to 150 kW capacity or up to two acres of developed area including fencing, whichever is greater.

Large-Scale Solar: {also known as "utility-scale") defined as a solar electricity generation and transmission facility 150 kW or greater in capacity or more than two acres of developed site area, whichever is greater.

SITING CONSIDERATIONS FOR SOLAR

The potential of rooftop solar – now a preferred site under the new net metering rule – should not be overlooked. While not every rooftop is viable, a conservative estimate of one out of every ten residential structures could produce considerable output by 2050. There is also some limited opportunity for rooftop commercial, which might include barns and other outdoor structures.

The Northeast Kingdom has a robust agricultural economy, and there is concern over the impacts of siting ground-mounted solar in a manner that fragments productive agricultural soils, effectively removing farmland from production for decades.

NVDA encourages municipalities to explore and identify local constraints that minimize farmland fragmentation. These measures may include agricultural overlays (regulatory), as well as conservation easements (non-regulatory. A number of land exploration tools, such as viewshed analyses, land evaluation and site analyses (LESAs) can help municipalities prioritize agricultural lands for protection. NVDA encourages local planning commissions to seek technical assistance.

SITING CONSIDERATIONS FOR WIND

The regional plan does not plan for additional utility scale wind, so wind potential is calculated assuming an average output of 9.5 kW (residential), based on average capacity of existing installations in the region. Ryegate does not have a significant concentration of high elevation lands that are suitable for siting large-scale wind, and we anticipate that wind development will likely be of a farm or residential scale.

Existing small turbines in the region are sited in very low-density areas and on farmland. NVDA strongly urges municipalities to consider density in their specifications, as even small wind turbines can produce noise that is incompatible with many residential areas. This can be established through the use of noise ordinances or through required distances from nearby residential uses.

SITING CONSIDERATIONS FOR METHANE

Methane, a common gas found in the environment, can be burned to produce electricity. Large amounts of methane are produced through the anaerobic digestion of manure, agricultural wastes, and other organic wastes. Both large farms and landfills offer the best potential to utilize this resource. The only large-scale landfill in the region is already being utilized for methane generation, there is still significant potential for siting methane in the region.

The procedure also destroys harmful pathogens, reduces water quality impacts, reduces manure odors, and provides a new source of income to local farmers.

Existing on-site systems are costly, and until new technologies are available, only make economic sense for larger farms. (Central methane digestion systems do allow smaller farmers to process animal wastes, but trucking is involved, and this may be a challenge, given the

town's rural terrain and harsh winters.) If state and federal grants, tax credits, and incentives remain in place to combat the high start-up costs, manure- methane generation should be expanded in the region's energy mix. The town encourages Ryegate's farmers to work with NVDA and the region's food system leadership group to secure access to technical services, grants, and other incentives to refine and maximize digester technologies.

Even though Ryegates's generation potential exceeds 120,000 MWh, it is important to remember that these are conservative estimates that account for contingencies. For example, Ryegate has 770 acres with potential for development. About eight acres are required to produce 1 MW of solar power. Obviously, not every prime acre is actually available. Property owners may not be interested in leasing their land, interconnection costs may be too high in some areas, and certain sites may still be unsuitable due to neighbor objections or other factors. Regional estimates therefore assume a more conservative estimate of 1 MW for every 60 acres.

Table 8.6: Ryegate Generation Potential

	Total MW	Total MWh Output	Assumptions/Contingencies
Residential Rooftop Solar	.23	284.5	Assumes 1 for every 10 existing residential structures (58 residences) with a 4 kW capacity.
Commercial Rooftop Solar	.02	24.5	1 out of every 10 small commercial structures, under 40,000 s.f., with a 20 kW capacity. Ryegate does not have many commercial structures per se, but a barn could have some rooftop solar.
Ground Mounted Solar	12.84	15,747.8	1 MW for every 60 acres of prime solar acres
Wind	0.10	170.4	9.5Kw for every 25 acres of prime wind
Methane	20	105,120	20 MW per one farm digester
TOTAL GENERATION POTENTIAL	**33.19 MW**	**121,347.2 MWh**	