Regional Energy Plan

Windham Regional Commission

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WINDHAM REGIONAL COMMISSION

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PART I

Context / Introduction

WINDHAM REGIONAL ENERGY PLANNING

The Windham Region, which is composed of the 23 towns of Windham County; Readsboro, Searsburg and Winhall in Bennington County, and Weston in Windsor County, has a long history of engagement in energy generation and the promotion of energy efficiency through land use policy and other means. The Windham Regional Commission (WRC) was instrumental in the creation of Act 250 in response to unhindered development associated with resort development in the 1960s and early 1970s, and was an early advocate for what we would today call "smart growth" planning[1]. An early energy policy issue for the Commission was the construction of the Vermont Yankee Nuclear Power Station. The state's first major utility scale wind power development was constructed in Searsburg. All of our major river systems are or once were dammed for the purpose of hydro-power generation (the Deerfield and Connecticut have major operating hydro-power facilities; the West River once had a hydro-power dam in the vicinity of West Dummerston but is now only generating power through two hydro-power retrofits at Ball Mountain and Townshend flood control dams). Since the 1990's the Windham Regional Plan has had a major greenhouse gas emission reduction and renewable energy transition focus. To support this focus energy has been incorporated as a thread throughout all sections and topics of the plan. We emphasize compact settlement patterns, speak to opportunities to reduce energy consumed through transportation, recognize the critical role of weatherization and thermal efficiency, and encourage the transition from carbon-based fuels to renewable energy sources.

The Vermont Comprehensive Energy Plan (CEP) aims to have 90 percent of all energy consumed to be sourced from renewable resources by 2050. With high goals set for conservation, energy efficiency, and renewable energy generation, the state looks to become more energy independent, secure, and green. In 2016, Act 174 was passed which tasked Regional Planning Commissions to generate Regional Energy Plans which would facilitate the implementation of the CEP's 90-percent by 2050 goal (90x50 Goal). Three pilot regions completed their draft plans in 2016: Bennington County Regional Commission, Two Rivers-Ottauquechee Regional Commission, and Northwest Regional Planning Commission. Concurrently, the Department of Public Service created standards by which to review the Regional Plans for Compliance with Act 174. With technical support from the Department of Public Service, Vermont Energy Investment Corporation, the Energy Action Network, and these three pilot RPC's, the remaining eight RPC's developed their Regional Energy Plans.

1 The WRC celebrated its 50th anniversary in 2015. The archive of our year-long commemoration is available here, and includes discussion of our role in Vermont land use planning and Vermont Yankee: http://windhamregional.org/anniversary. The 50th anniversary booklet can be downloaded here: http://windhamregional.org/images/docs/publications/WRC_Celebrating_50_Years.pdf.

The Plans explore the regions' energy needs by analyzing current energy use, projected use from 2014 to 2050, identifying target consumption and conservation goals for the years leading up to 2050, and identifying where energy generation has potential within the Region. The data (which will be explored in depth in Part II) was gathered from the US Census Bureau, the U.S. Energy Information Administration, Vermont Agency of Transportation, Department of Labor, and Efficiency Vermont. The model used to generate target consumption data was produced by the Long-range Energy Alternative Planning System model. The plans explore energy broken out into three sectors: electrical, transportation, and thermal (hereafter referred to as heat).

The Windham Regional Energy Plan melds land use and energy planning into comprehensive energy planning by first discussing the Region's energy needs and identifying targets for the future which align with the State's 90x50 Goal. It next identifies pathways, policies, and implementation steps to reach these targets. Finally, it presents policies to guide renewable energy generation and maps which illustrate energy generation potential and constraints. The WRC solicited input from the public, municipalities, commissioners, and professionals in a series of workshops, presentations, and public meetings to ensure the plan was reflective of the Region.

KEY ISSUES AND GOALS

For the purposes of this plan, energy is defined as usable power that is derived from fuel sources such as transportation fuel, heating fuel, and electricity generation. Vermonters use a variety of fuel sources to meet their energy needs, all of which present trade-offs regarding societal and environmental concerns. Most of that energy is imported, and much of it is carbon-based. All of the petroleum that is used for transportation and space heating, for example, is imported from outside the state, and much of that from outside the United States. Most of Vermont's hydroelectric power is imported from Canada. The only fuels that are not imported to Vermont are locally grown wood used for heating, and some locally produced wind, hydroelectric and solar power.

In terms of statewide end-use energy consumption (Figure 1), the transportation sector accounted for an estimated 34 percent of the energy used in 2011, followed by the residential sector (31 percent), commercial sector (20 percent), and industrial sector (16 percent)[2]. Estimates indicate that fossil fuel-based energy sources account for approximately 57.9 percent of the energy used in the State[3]. Renewable energy

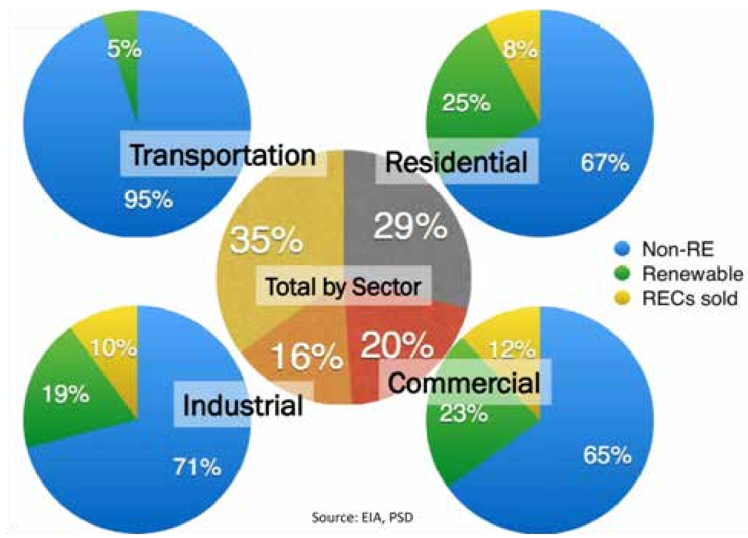

Figure 1: Vermont end-use energy consumption by sector.

NOTE: Figure identifies non-renewable (Non-RE), renewable, and renewable energy credits (RECs) sold. See Figure 3-1 in the Energy Chapter for a breakdown of Vermont energy consumption by fuel source.

2 U.S. Energy Information Administration, Table 30: Total Energy Consumption, Price, and Expenditure Estimates, 2011. Accessed March 24, 2014. http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_te.html&sid=VT

3 Estimates are based on 2011 non-electric consumption and 2016 projected electric consumption estimates. This combination offers a good overview of the near-future energy mix for planning purposes.

sources accounted for 26.8 percent, while nuclear and market energy sources accounted for 15.3 percent[4]. These percentages vary from year-to-year based upon a number of factors, such as winter and summer temperatures, building weatherization, pace of natural gas adoption, and economic growth.

Though Vermont's energy transformation may take years to implement, it has the potential to enhance the vitality of the state and local economy by reducing money spent on fuels pumped, mined or generated elsewhere, improve our health through reduced emissions and increased bicycle and pedestrian mobility options, and improve the quality of our local and global environment through reduced greenhouse gas emissions. This robust energy plan is a tool to advance the economic and environmental well-being of the Region, thereby improving the quality of life for its residents. Pursuing the energy goals will reduce the Region's vulnerability to energy-related economic pressures and, in the long-term, climate change-related natural disasters, and promote long-term community resiliency in a variety of contexts.

From an environmental perspective, petroleum and other hydrocarbon-dependent energy is a significant cause of localized environmental damage where those fuels are produced and refined, and the emissions from their use is responsible for human-induced climate change, related climate-change disasters, and ecological degradation. Efforts to shift away from a fossil fuel dependent energy economy will result in a healthier, more resilient environment with greater energy independence within the State and Region. There is a societal cost in consuming conventional fuels. Factoring these "societal costs" into the price of energy accounts for: society paying for health costs associated with pollution, environmental clean-up, military protection of petroleum sources, and the continued failure of the Federal government to address the disposal of radioactive wastes. And in the long-term, communities who depend on fossil-fuels are vulnerable to risks associated with their price and production volatility.

The Region seeks to establish reliable energy resources for townspeople and municipal operations, to hedge against the increasing volatility of hydrocarbon prices, and to reduce the environmental impact of our energy use. The role of clean, alternative energy sources will be expanded and supported. We are also committed to land use policy that results in energy efficiency and conservation.

A set of regional goals has withstood the test of time for relevance and importance to the Windham Region. These goals evolved from prior plans and they continue to be the subject of on-going dialogue between the WRC and its member towns. They correspond generally to the State's planning goals, and they guide the development of our regional energy plan policies.

- To plan development in order to maintain the region's land use and historic settlement pattern of compact villages and urban centers separated by rural countryside;
- To encourage the availability of a reliable, sufficient, and economical energy supply, to support energy conservation and efficiency, to encourage the development of appropriately scaled and sited energy generation resources, and to facilitate conversations between towns where different interests exist;
- To provide for safe, convenient, economical, and energy efficient transportation systems including options such as public transit and paths for pedestrians and bicyclists, where appropriate;
- To provide a vital and diverse economy with rewarding job opportunities and high environmental

4 Vermont Public Service Department and U.S. Energy Information Administration.

standards for the region's citizens;

- To encourage and strengthen agricultural and forest enterprises;
- To maintain and improve the quality of air, water, wildlife, and land resources in the region;
- To identify, protect, and preserve regionally important natural and historic features of the Vermont landscape;
- To provide for thoughtful and efficient use of the region's natural resources, including the prevention of surface water and groundwater pollution, the protection of fragile natural habitats and endangered or threatened species, the avoidance of agricultural and other land-use practices that lead to soil erosion, the management of woodlands on a sustainable basis, and the sensitive treatment of scenic resources. Mineral extraction should have minimal adverse effects on aesthetics, water quality, air quality, and special community resources (such as historic sites, recreation, or scenic areas), and effective site rehabilitation plans should be provided and implemented;
- To plan for, and to educate the public about, natural and other hazards in the region, the prevention and mitigation of these hazards, and for preparedness, response, recovery, and resilience.
- To educate the public about the inherent risk to life and property associated with development within river and stream corridors, including fluvial erosion hazard areas, and to continue to develop actions and policies that prevent and mitigate these risks wherever possible.
- To promote the development of housing suitable to the needs of the region and to ensure the availability of safe and affordable housing for all citizens of the region;
- To broaden access to education and training for all citizens;
- To maintain and enhance recreational opportunities for both residents and visitors in keeping with the carrying capacity of natural resources and public facilities;
- To plan for, finance, and provide an efficient system of public facilities and services (such as schools, water and wastewater facilities, highways and bridges) to meet future local, regional, and state needs; and
- To support affordable access to high-quality health care services for all citizens.

CURRENT WINDHAM REGION ENERGY GOALS OVERVIEW

A reliable and affordable supply of energy is critical to our society and to our way of life. While energy issues are often national or global in reach, local land use decisions have a direct, lasting impact on the energy requirements needed to sustain the function of development. The Windham Region can lead by example by increasing the efficiency of its energy-dependent systems, identifying critical areas of improvement, and supporting local energy options that benefit its communities. The Windham Region actively supports partnerships, strategies, and state and federal legislation that will ensure the affordable and reliable production and delivery of energy to the region, in conformance with regional goals and objectives. It is our intent to work with the State, utility providers, our member towns, and neighboring regions to plan for energy demand and future shifts in primary energy sources.

The following are existing energy goals contained within the Windham Regional Plan:

- Energy conditions are rapidly changing in Vermont, in part due to volatile energy prices, new technologies, and the 2014 closure of Vermont Yankee Nuclear Power Station. The State has adopted aggressive goals to create a renewable energy future including the CEP's 90x50 Goal. During the 2011-2012 legislative session, the State of Vermont amended the Sustainably Priced Energy Economic Development (SPEED) goal (adopted in 2005) with the Total Renewable Energy Goal which states that starting in 2017, 55 percent of each retail electric utility's annual sales must be met by renewable sources, increasing by 4 percent every third year until 2032, when 75 percent of sales must be met by renewables (see Act 170). **The WRC will support state energy goals provided they comport with the provisions contained within this plan, including the protection of significant natural and cultural resources and human health and welfare.**

- Energy conservation and energy efficiency are among the best energy investments, providing opportunities for significant reductions in energy use and costs.[5,6] While there are social and ecological impacts associated with all energy production, energy conservation and energy efficiency help reduce these impacts by reducing demand. Lowering demand makes energy more affordable for all by reducing infrastructure requirements. Reducing energy demand reduces the impacts associated with all forms of energy, both renewable and non-renewable. In October 2011, The State of Vermont adopted Residential Building Energy Standards (RBES) and Commercial Building Energy Standards (CBES), which establish a minimum standard of energy efficiency for nearly all new residential construction, including building additions, renovations, and repairs statewide. Meanwhile, utility companies are actively installing Smart Grid technology, which allows consumers to monitor and to make more informed choices about their daily energy use. **The WRC supports improved energy conservation and efficiency strategies as a preferred alternative to the construction of new energy generation and transmission capacity.**

- Energy conservation and efficiency should be a primary consideration in all development projects, with a primary land use goal of locating significant projects adjacent to or within existing developed areas. Scattered development increases the need for vehicular traffic, requires further extension of public infrastructure and utilities, and consumes a higher percentage of open space, all of which increases the overall energy demand of the project. There is also a direct relationship between development patterns and the subsequent transportation energy needed to sustain that development, which is especially significant in this State where the greatest end-use consumption of energy occurs in the transportation sector. **The WRC will encourage development in the region that meets the highest State and regional standards and exhibits best practices in terms of energy conservation and energy efficiency.**

- The cost of energy in Vermont, across all sectors, is the third highest in the nation, averaging $27.77

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5 "Energy conservation" - Using less energy to perform the same functions and tasks. This applies to measures, such as the use of new technologies (e.g., LED lights, more energy efficient appliances) that use energy more efficiently and reduce waste.

6 "Energy efficiency" - Reducing energy use. This applies to measures such as building weatherization and changes in personal habits (e.g., turning off lights, driving less) that reduce the amount of energy consumed.

per million BTUs[7]. Only Hawaii and Connecticut have higher average costs[8]. The high cost of energy in the state and in the region means that residents and businesses are paying more for the energy they use relative to the surrounding States and the country on a per-unit basis. This is partly due to the fact that natural gas prices nationwide have fallen to historic lows, allowing many residents and businesses across the country to take advantage of this economically priced fuel source. However, there is no natural gas pipeline currently serving the Windham Region, and delivery of compressed natural gas is only available to industrial users. In order to remain economically competitive, the region will need to look for diverse options to reduce energy costs. **The WRC will continue to provide educational materials and workshops to inform towns, businesses, and residents how to reduce their overall energy costs, and will support development of energy facilities and sources that will provide competitively priced energy to the region.**

• Dependence on both external sources of energy and large-scale infrastructure places the region in a vulnerable position with regards to energy security. While it is acknowledged that these sources are integral parts of a much larger and complex energy system, it is prudent for the region to consider options to increase energy security and stability during times of shortages and outages. **The WRC will support diversification of energy sources in the region, redundancy of systems to support critical functions in times of supply interruptions as well as net-metering, off-grid, and community-scaled, distributed generation projects to enhance self-sufficiency and resiliency.**

• The combustion of carbon-based fuels releases greenhouse gas (GHG) emissions into the atmosphere contributing to alteration of the climate. The region's current energy demand relies heavily upon fuel combustion. Energy consumed for transportation, space heating, and electricity generation accounts for more than 80 percent of Vermont's annual statewide GHG emissions. Increases in energy conservation and efficiency in the region, coupled with a greater reliance on low GHG-emitting energy sources and renewable energy, will help reduce overall GHG emissions. **The WRC will encourage a shift away from GHG–intensive energy sources and towards socially and ecologically sensitive energy sources that have zero or low GHG emissions.**

NOTE ON ENERGY TERMINOLOGY

A significant technical note should be made here, and that is the distinction between energy measured at the point of consumption, called "end-use," and energy measured as generated, called "primary-use." End energy use is measured at the point of use, as it enters—or is delivered to—the consumer's home, building or vehicle. Primary energy use includes the delivered energy plus the energy that is lost in generation, transmission and distribution. This is especially important in the case of electric generation because thermal power plants can shed up to two units of heat energy for every one unit of electric energy that is produced. End-use consumption is the measure most often used in reports of energy use because it provides a better baseline for comparison. It will be referenced here when that data is available.

• Methane is both a valuable renewable energy source as well as a potent GHG that is 21 times stronger than carbon dioxide when released directly into the atmosphere. In this region, methane is

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7 A BTU is the amount of heat required to raise the temperature of 1 pound (0.454 kg) of liquid water by 1 °F (0.56 °C) at a constant pressure of one atmosphere. It is the common unit used to compare energy use across the various types of energy use (heat, electricity, etc).

8 U.S. Energy Information Administration, 2011 Estimates, http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_te.html&sid=VT

primarily a byproduct of the livestock industry, particularly from dairies. Methane digesters have been developed to burn methane to create useful electricity. **The WRC will encourage the deployment of methane digesters.**

• Renewable energy is generally defined as any energy resource that is naturally regenerated over a human time-scale, including sources derived directly from the sun (such as thermal, photochemical, and photoelectric), indirectly from the sun (such as wind, hydro-power, and photosynthetic energy stored in biomass), or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). The "renewable" characteristic of these energy resources means that they are not as vulnerable to supply disruptions and the increasing costs and volatility associated with a finite fuel source like fossil fuels. Although all energy sources create negative environmental impacts, renewable energy technologies are comparatively clean sources of energy that can have a much lower environmental impact than conventional energy technologies. **The WRC will support the development and use of renewable energy resources that enhance energy system capacity and security, promote cleaner, more affordable energy technologies, increase the energy options available locally, and avoid undue adverse impacts of energy development on the local community and environment.**

• Every energy facility, including renewable energy systems, has varying social, economic, and environmental implications, some of which may impact the greater community. As with any development project, there are a variety of public perspectives and values leading to differences in opinion regarding how the region is best served. In some cases, concerns have been raised regarding location suitability and installation practices of energy generation. The WRC will encourage developers to use sound siting practices when installing energy facilities, support opportunities for public participation, and will facilitate inter-town conversations where differences exist. **The WRC expects projects to comport with the vision and intent articulated in this plan and those of municipalities.**

The Windham Regional Plan also incorporates the Windham Regional Transportation Plan that was adopted in 2013. The Transportation Plan also speaks to energy consumption, protection and improvement of air quality, and reduction of greenhouse gas emissions. The following is excerpted from the Transportation Plan (page 13):

The transportation sector's contribution to green house gas (GHG) emissions must also be considered when evaluating air quality because of climate change concerns. The transportation sector accounts for 74% of Vermont's GHG emissions, and since 1990, the carbon dioxide emissions from the transportation sector have increased by 21.4% in Vermont, as compared to 16.8% nationwide. Suggested measures for reducing mobile source emissions have been recommended by the Federal Highway Administration (FHWA) and are included in Chapter 2 Energy and Air Quality. These same recommendations would also help reduce the GHG emissions released by the transportation sector, and should be considered in development of strategies for improving air quality in the Region. Among the suggested improvements, the most relevant to this Region are the following:

• Improved public transit

• Park and ride/fringe parking

• Ride-sharing programs

- Pedestrian and bicycle facilities
- Programs to promote non-automobile travel to major activity centers such as shopping centers, special events and other centers of vehicle activity; and
- Programs for new construction and major reconstruction of paths or areas solely for use of pedestrian or other non-motorized means of transportation

Local and regional strategies include providing more public transportation, managing regional transportation demand, locating industrial parks where future links to the rail network would be feasible and encouraging land use patterns that reduce the need for individual private transportation. Additionally, with the passing of high fuel efficiency standards and increased pressure to develop alternative fuels for vehicles, the Region needs to be mindful of the developments taking place in vehicle alternative fuel vehicles will require. Electric and natural gas vehicles in particular have different range and refueling requirements than typical gasoline vehicles, and these needs must be met in order to support their inclusion into the fleet of Vermont vehicles. Finally, given the new requirements of Complete Streets, transportation design should more adequately address the needs of transit dependent populations, pedestrians and cyclists as well as other traditional forms of transportation.

The Regional Transportation Plan included the following energy-related policies.

- Support emissions standards that reduce regionally generated air pollutants from transportation related activities.
- Promote alternative fuel vehicles and the infrastructure necessary to fuel those vehicles.
- Require all development projects to incorporate elements that reduce reliance on single occupancy vehicles, such as providing access to public transit, installing pedestrian and bicycle network links, or providing access to ride-sharing programs.
- Support efforts to minimize energy consumption, especially non-renewable energy resources, and explore expanded use of alternative fuels.
- Integrate traffic designs in designated downtowns and village centers that limit idling and calm traffic.

PART II

Current Energy Use

BACKGROUND

Too often, we as a society take for granted how energy is used and to what ends until a event occurs that impacts supply, availability, access, and price. Sometimes these events are highly visible and reported, such as armed conflict, an energy cartel agreement, an oil spill, gas explosion, mine collapse, or radioactive leak. Other events such as changes in exploration technology, market structure and competition, global demand and supply, or regional supply chains, are less apparent. The local, regional and global environmental effects associated with energy exploration, development, refining and production, transportation, transmission and distribution, and end-user consumption are similarly at times obvious and at other times subtle. Understanding what energy is used in the region, how that energy is used, where it comes from, and what it costs establishes a baseline understanding of our energy present and what changes will be necessary for the Windham Region to achieve its desired energy future.

ENERGY CONSUMPTION AND DEMAND

In this plan, energy is divided into three sectors: electricity, transportation, and heating. This chapter explores current energy usages along with the amounts used in total units. The numbers presented are the

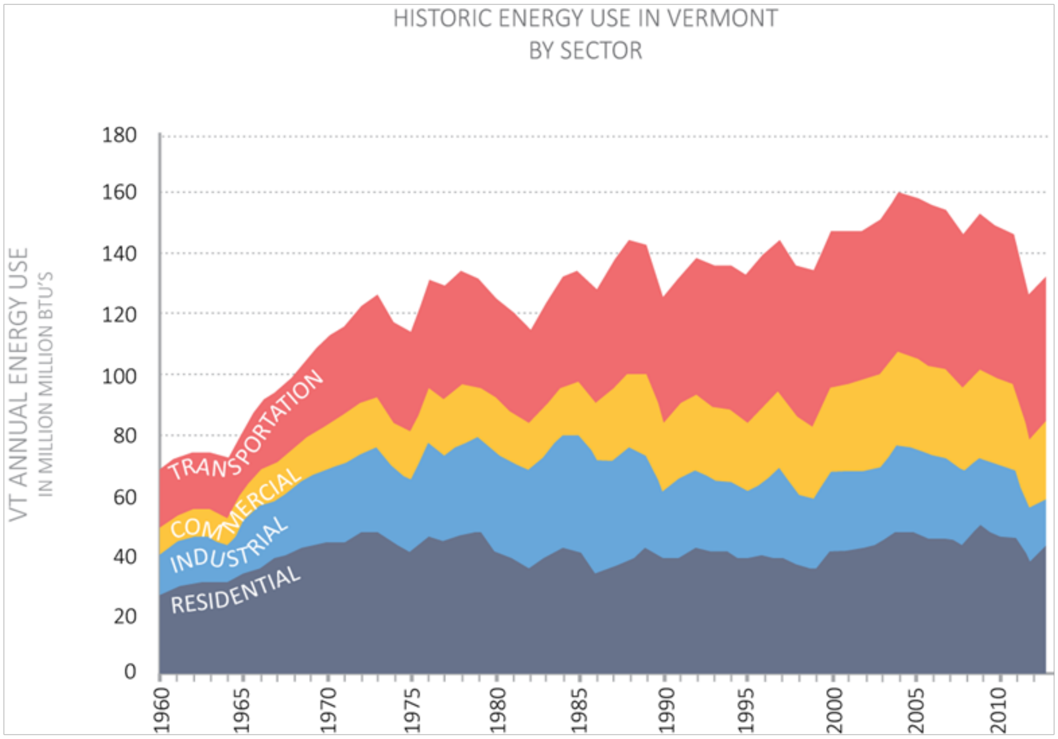


Figure 2: Historic energy use in Vermont, by sector.

most accurate estimates available based on current information sourced from the American Community Survey, the U.S. Department of Labor, the Vermont Agency of Transportation, Efficiency Vermont, and the U.S. Energy Information Administration. The discussion of this data provides the context for this energy plan; it is the starting point from which the Region will plan to achieve the goal set out in the Vermont Comprehensive Energy Plan (CEP) of 90% renewable by 2050 (90x50 Goal).

GROWTH AND ENERGY USE

Over the last 80 or so years, Vermont and Windham Region have drawn energy from multiple sources, primarily gasoline, liquid petroleum gas, electricity, and wood. Overall consumption throughout the 20th century increased dramatically, with some decline around the advent of the "Great Recession" of 2008 (see Figure 2). Energy consumption has generally tracked with population.

While still a rural state, Vermont's population and economy are not as agrarian as they were at the turn of the last century. Vermonters were on the move by the mid-1800s, driven at least in part by the consequences that European settlement exacted upon the land. Many hill farms were abandoned by their owners after years of clearing, grazing, and cultivating took their toll on the thin soils and steep slopes. Some people moved west, heading for more fertile land, encouraged by the opening of the Erie Canal in 1825, the California gold rush in 1849 and the Homestead Act of 1862. Other hill farmers moved to larger, nearby towns for jobs in growing industries. In the smaller villages, businesses that relied on hill farmers subsequently failed, and in some cases the villages themselves were abandoned. The Civil War also contributed to Vermont's population decline, as soldiers who had seen more fertile lands in the Ohio Valley and other areas emigrated after the war. While the period of 1790 to 1830 had seen significant growth within the Windham Region, that growth then leveled off for more than a hundred years until around the 1950s when resort development in the led to a boom in population growth through the 2000 Census. During the time period between 1850 and 1930, 77% of the region's towns saw steady declines in population. The only towns to see relatively steady growth during this time period were Brattleboro, Rockingham, and Readsboro. Figure 3 below shows Windham County's population, along with a projection of what the population is expected to be in the coming decades.

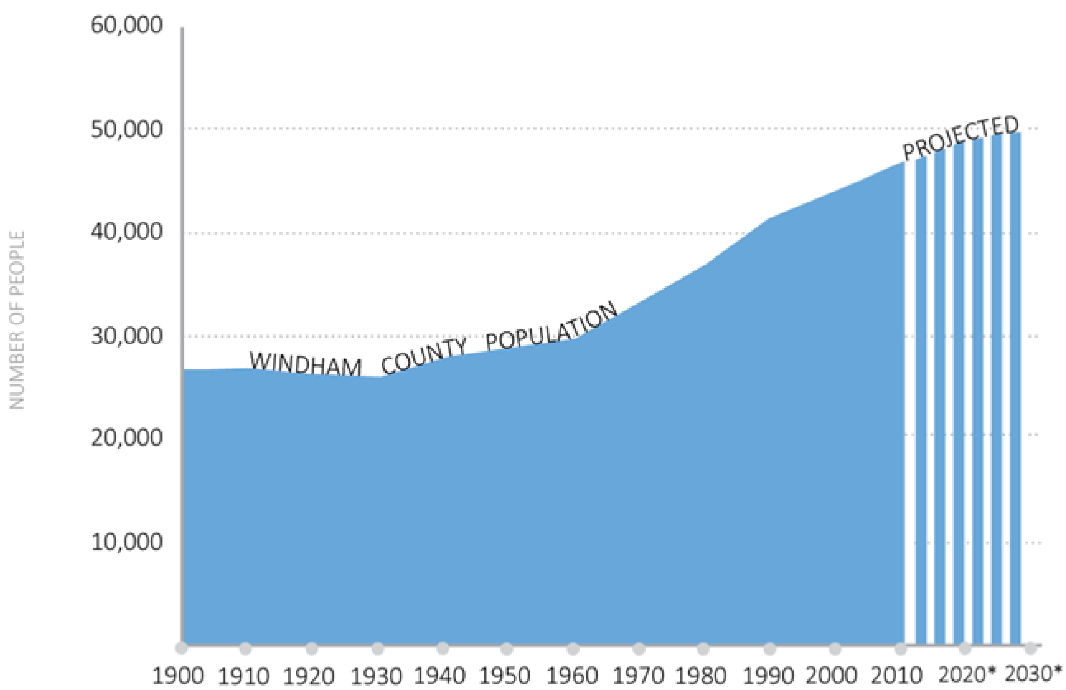


Figure 3: Windham county population, both measured and projected.

Economic activity in the Region has mirrored the population trends and is another indicator of energy consumption within the Region, in terms of energy efficiency in producing goods and services.

Vermont's inflation-adjusted economic growth (Real GDP, 2005 dollars) increased 51 percent between 1990 and 2009. Additional employment, industrial output, and higher wages typically increase the demand for energy resources; however, the Vermont economy has been able to accommodate additional (real) economic growth with relatively steady energy input. Over the same period of time, energy consumption for all end uses increased by only 17 percent. Figure 4 illustrates the trending relationship between Vermont real GDP growth and the total consumption of energy (in Btu). This figure also demonstrates how energy consumption responded to the Great Recession, noted by th clear dip in energy consumption in 2008.

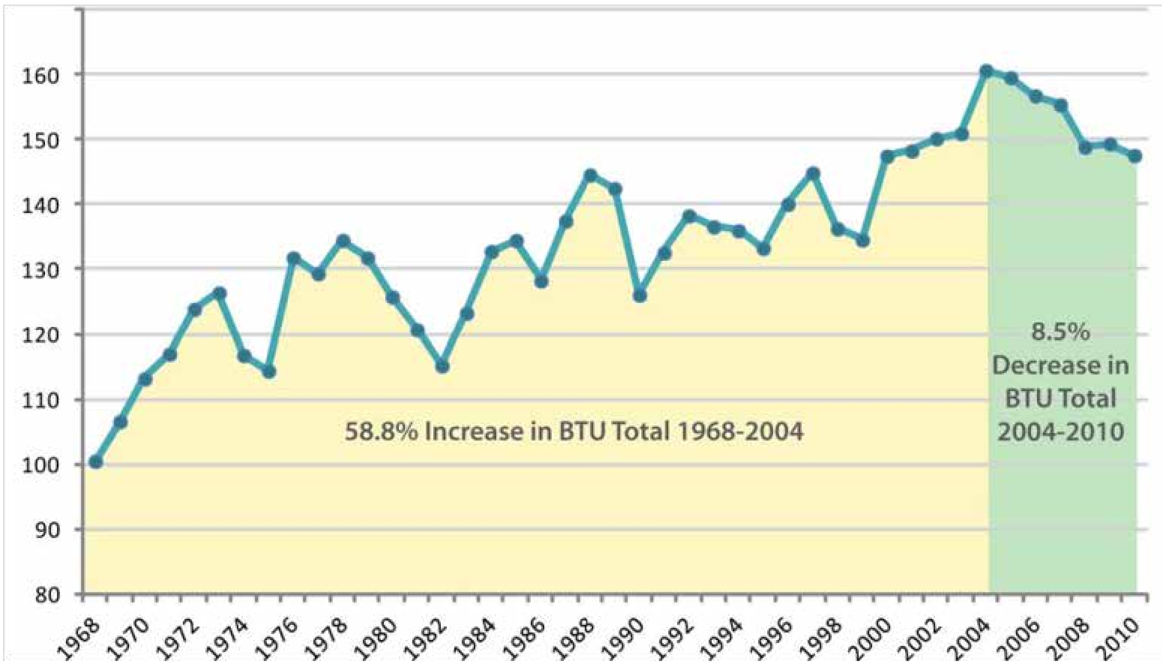


Figure 4: Total end-use energy consumption estimates in Vermont, 1960-2010.
Source: U.S. Energy Information Administration,
http://www.eia.gov/states/seds/data.cfm?incfile=/state/seds/sep_use/total/use_tot/VTcb.html&sid-VT

Overall energy demand in Vermont grew to 158.1 trillion Btu (British thermal units) in 2009 from 135.4 trillion Btu in 1990, a 17 percent increase. Meanwhile, the leading drivers of energy demand—real gross domestic product, population, and vehicle miles driven—grew by 51 percent, 10 percent, and 31 percent, respectively. During this 19-year period, changes in annual energy use ranged from a drop of 4.9 percent during the recession year of 1990 to an increase of 8.7 percent in 2004, a year of above-average economic growth.

REGIONAL ENERGY USE & EXPENDITURES

From 1990-1999, energy demand increased at a 1.8 percent rate of growth, but has been close to 0.0 percent for the following 10 years. The year 2010 end-use energy consumption levels were about equivalent to 2000 levels. This is a result of a steady decrease in energy use since 2004, as shown in Figure 4. The combination of both state energy efficiency programs and the recession impacted energy demand across most end-use sectors.

In total, the Region consumes 7,369,088 million Btu annually across the electricity, heating and transportation energy sectors (Figure 5). This computes to an annual energy cost for the region of $194,000,000 (Figure 6). With each of the three sectors depending heavily of fossil fuels for the main source of fuel, a majority of these dollars leave the state and local economy. Each sector is discussed in greater detail below. For an overview of estimated energy use by town, see Appendix 5 on page 84 of this plan.

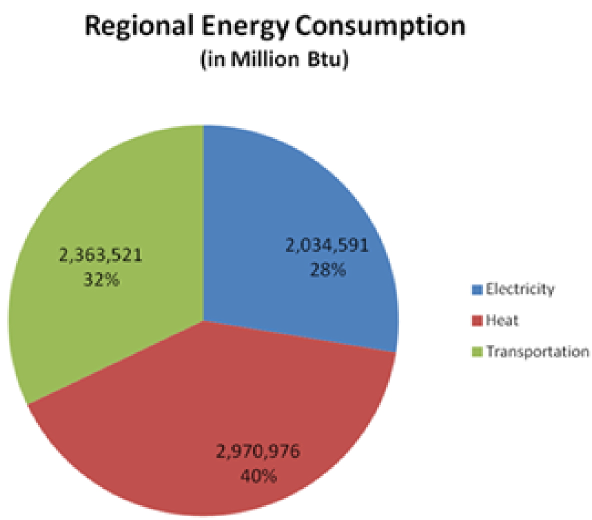


Figure 5: Energy consumption in Windham Region, per sector

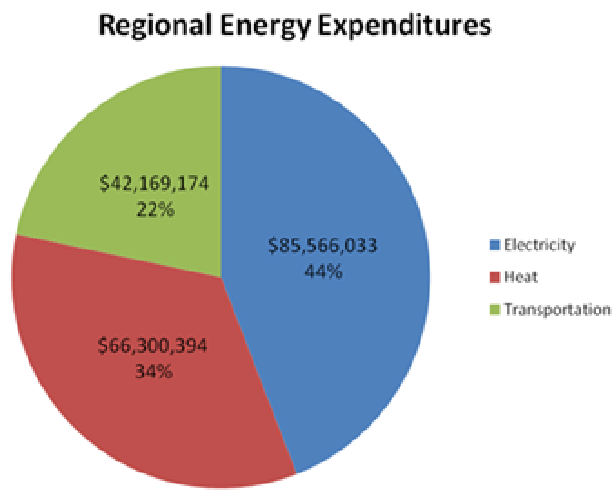


Figure 6: Energy expenditures in Windham Region, per sector

ELECTRICITY

Electricity usage has increased slightly since 2014, as is portrayed in Figure 7, which shows data from Efficiency Vermont that was compiled usage from distributors. In 2016, the total amount of electricity used in the Windham Region was 502,864,000 kWh; 296,732,000 kWh for commercial and industrial use (C&I), and 206,132,000 kWh for residential use (RES)[9].

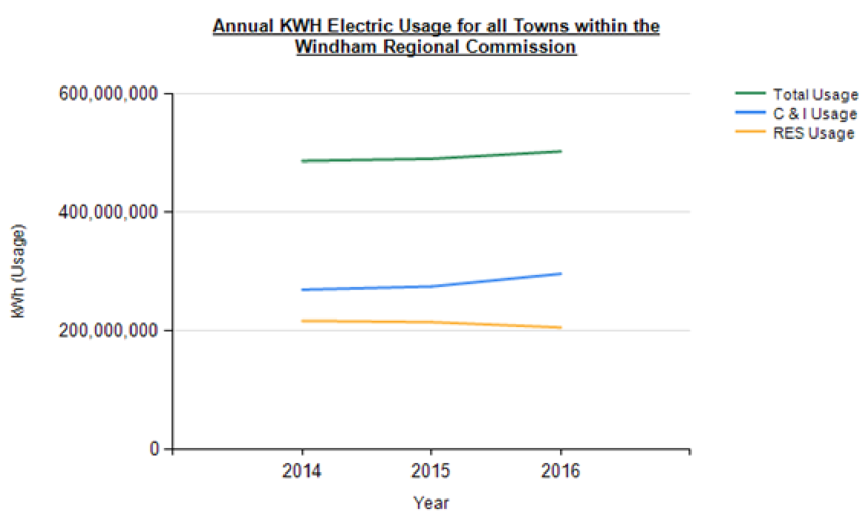


Figure 7: Measured electricity consumption in the Windham Region, 2014-2016. From Efficiency Vermont.

9 The estimated electricity consumption data shown in Figures 5 and 6 was calculated based on reasonable regional averages for electricity consumption per Windham municipality. Figure 7 shows a relatively slight difference in electricity consumption, since it is measured from meter data, compiled and delivered to RPCs from Efficiency Vermont.

In 2014, 73% on the Region's electricity needs was sourced by renewable energy, including renewable energy imported from beyond the state's boundaries. Note that this refers to electricity only, and does not does not include heat or transportation energy demand, which have much lower rates of renewable energy use due to reliance upon petroleum-based products.[10]

System Energy Loss

As described by the EIA, these losses are "incurred in the generation, transmission, and distribution of electricity plus plant use and unaccounted for electrical system energy losses."[11] According to the EIA, annual national electricity transmission and distribution losses average about 7 percent of the electricity that is transmitted in the United States.[12] For Vermont in 2010, the estimated transmission and distribution losses were 4.92 percent.[13]

The remainder of electrical system energy losses are attributed to energy consumed through generation and to unaccounted for electrical system energy losses. One measure of the efficiency of power plants that convert a fuel into heat and the heat into electricity is the "heat rate," which is the amount of energy used by an electrical generator or power plant to generate one kilowatt-hour (kWh) of electricity. For 2011, the efficiencies for coal, petroleum, natural gas, and nuclear power plants were estimated at 32.7 percent, 31.5 percent, 41.9 percent, and 32.6 percent, respectively.[14]

TRANSPORTATION

As Vermont is a rural state, dependency upon single-occupancy, petroleum-powered vehicles is not only a social norm, but a necessity in most cases. The dispersed settlement patterns of the Windham Region and the state encourage car usage by creating long distances between destinations. In Windham County, the average travel time to work from 2009-2014 was 21.1 minutes.[15] Most of these trips are by motor vehicles with a single occupant. Figure 7 shows the State's overall petroleum consumption since 1960. Transportation consumes a large portion of the total petroleum used, and has steadily increased since the 1960's, though the trend is now leveling off.

In 2009, 79% of Vermont's source energy for the transportation sector was motor gasoline, followed by distillate fuel at 16%, and jet fuel at 5%.[16] In 2010, 98.5% of the registered vehicles in Vermont used gasoline or diesel as their fuel source. Because transportation-related energy use is mainly determined by the individual vehicle miles traveled by residents and visitors to Vermont, addressing fuel consumption

10 Vermont Community Energy Dashboard, http://www.vtenergydashboard.org/my-community/windham-regional-commission/progress

11 U. S. Energy Information Administration, http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_btu_res.html&sid=VT

12 U.S. Energy Information Administration, http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3

13 U.S. Energy Information Administration, "To calculate T&D losses as a percentage, divide Estimated Losses by the result of Total Disposition minus Direct Use. Direct Use electricity is electricity that is generated at facilities that is not put onto the electricity transmission and distribution grid, and therefore does not contribute to T&D losses." https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

14 U.S. Energy Information Administration, http://www.eia.gov/tools/faqs/faq.cfm?id=107&t=3

15 Regional Transportation Plan, 2013: http://windhamregional.org/images/docs/trans-plan/2013_WR%20Transportation%20Plan_complete.pdf

16 Department of Public Service, Comprehensive Energy Plan, 2011

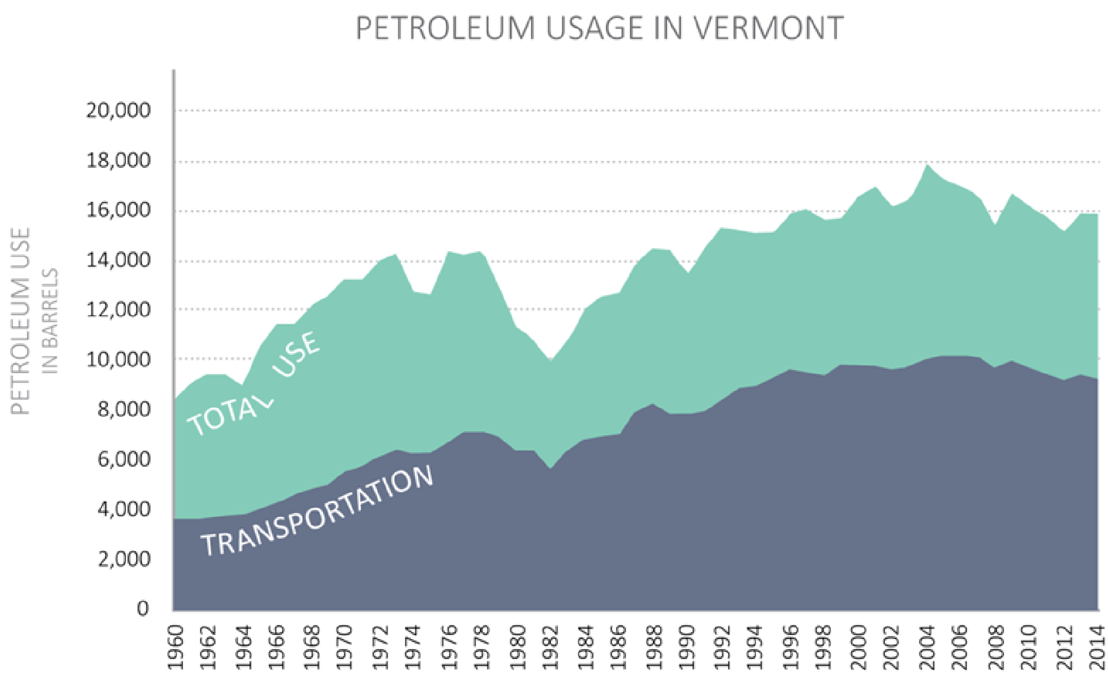


Figure 7: Petroleum consumption in Vermont, total and by transportation sector.

via the personal vehicle is a priority. Recently, the fuel efficiency improvements have gained traction as a public policy issue. But these gains in fleet efficiency may be offset when total vehicle miles traveled increases faster than the population grows, since total petroleum consumption is still increasing.

As such, other factors contributing to increased energy use in the transportation sector must also be addressed.

Factors Contributing to Transportation Energy Consumption

Fuel efficiency has increased over time, but the overall average miles per gallon (mpg) rate in the U.S. peaked in the late 1980's and then began declining. This downward trend should see an upswing in response to the [Federal fuel efficiency standards] of 2011. The standard requires a 35.5 mpg average for the U.S. auto industry by 2016. The majority of the vehicle fleet in Vermont fell within the 21-30 mpg efficiency range based on the vehicles registered in 2010. Less than 10% of the fleet fell within the 31-40 mpg range. In theory, newer, more efficient vehicles should improve the overall mpg of the Windham Region and Vermont vehicle fleet. However, the recent general decline in gasoline prices may encourage drivers to purchase less-efficient and larger vehicles, or defer the replacement of older, less-efficient vehicles with newer, more-efficient vehicles.

As seen in Figure 8 (also Figure 2-4 from the Windham Regional Transportation Plan), the Windham Region has a wide

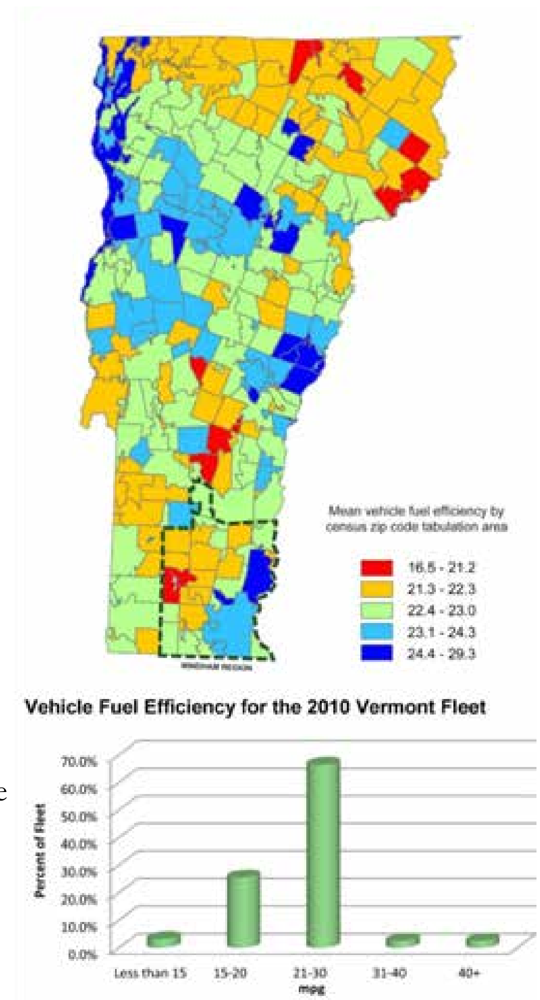


Figure 8: Mean vehicle fuel efficiency for Vermont, 2010.

array of fuel efficiency ranges within its border. The highest fuel efficiencies for registered vehicles are located around Brattleboro and Bellows Falls, following along the Connecticut River. Lower average fuel efficiencies are found throughout the western portion of the Region, with the towns of Stratton and Somerset containing some of the vehicles with the lowest average fuel efficiency.

Fuel/Vehicle Type	2007	2008	2009	2010	% Change 2007-2010
Hybrids	3,651	4,565	5,473	6,335	73.51%
Electric	106	101	94	77	-27.36%
Propane	93	75	69	40	-56.99%
Diesel	31,648	32,140	30,724	25,025	-20.93%
Gasoline	583,568	578,881	528,930	514,894	-11.77%
Total	621,073	617,770	567,299	548,381	-11.70%
Gas/Diesel Cars as a % of Total Fleet	99.06%	98.91%	98.65%	98.46%	

Figure 9: All vehicles registered in Vermont by fuel type, 2007-2010.

The total number of registered vehicles in Vermont (Figure 9) saw a decline from 2007 to 2010 (Figure 2-5 Windham Regional Transportation Plan).[17] The only vehicle fuel type category to see an increase in registered vehicles over this time period was the small number of hybrid vehicles registered in the State, seeing an increase of 73.5% since 2007. However, the overall small percentage of this vehicle type does little to offset the substantial percentage of vehicles fueled by non-hybrid gas and diesel. Fuel efficiency of these classifications of vehicles has a direct impact on the amount of fuel used by the residents of this Region.

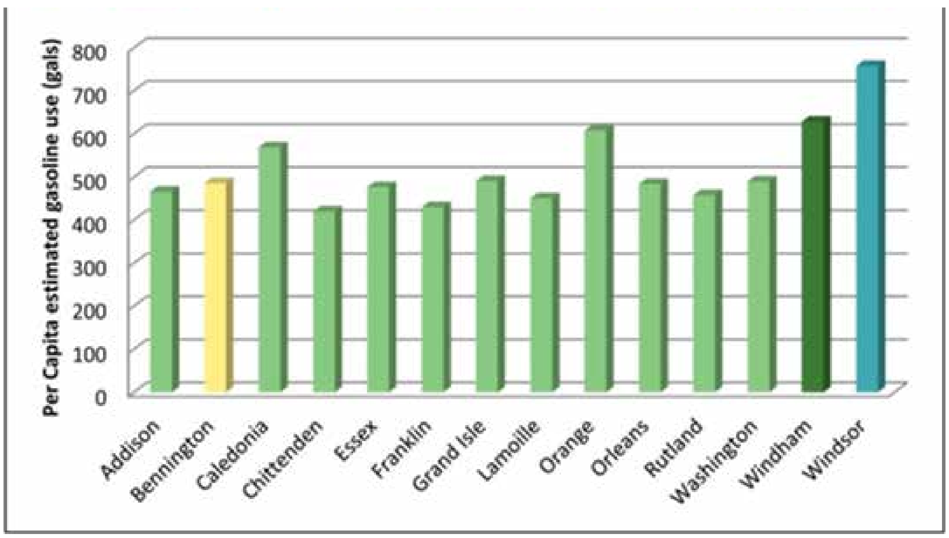


Figure 10: Estimated gasoline usage by Vermont county, 2009.

Figure 10 (2-6 from the Windham Regional Transportation Plan) shows estimated gasoline usage by county as calculated by the University of Vermont's Transportation Research Center. Windham and Windsor counties have the highest per capita estimated gasoline usage. This could result from a number of factors, including ownership of older, less-efficient vehicles, commuting to points beyond Vermont's borders to and from places of employment and services, and distances to regional economic and service hubs in general.

Settlement patterns and vehicle choice play major roles in high per-capita fuel consumption, and the rural landscape of the Windham Region has led to homes being built far from downtown and village centers, where services are accessed. The result of separated residential areas is that trips to market, schools and work tend to be only possible with the use of an automobile. In the Windham Region, rural residential sprawl has occurred where homes located along rural roads have been separated from all other aspects of daily life. Concentration of retail in pedestrian-unfriendly, auto-dependent strips also contributes to single-trip automobile use.

17 Windham Region Transportation Plan http://windhamregional.org/images/docs/trans-plan/2013_WR%20Transportation%20Plan_complete.pdf

Another factor affecting fuel consumption is the dispersion of employment in our rural area of western New England where Vermont borders New Hampshire and Massachusetts. Figure 11 (also Figure 2-28 from the Windham Regional Profile)highlights the commuting links between major employment centers in and around the Windham Region. [18] This dispersion and related commuting pattern helps explain commuting trends (see Figure 12, or 1-6 from the Windham Regional Profile).

To estimate the total amount spent on transportation-related energy consumption in the region we began with an estimation of the number of vehicles per household. Based on number of households in the region, it is estimated that the Windham Region has a total number of 34,800 vehicles. Based on VTrans average miles traveled per vehicle in the state, these cars drive 395,327,000 miles total in a year, consuming 17,999,000 gallons of fossil-fuel (both gasoline and diesel). This yields an estimated total of $42,169,000 spent on transportation-related fuels. Electric vehicles make up a fraction of the fleet in the region with an approximate number of between 50-100 vehicles.

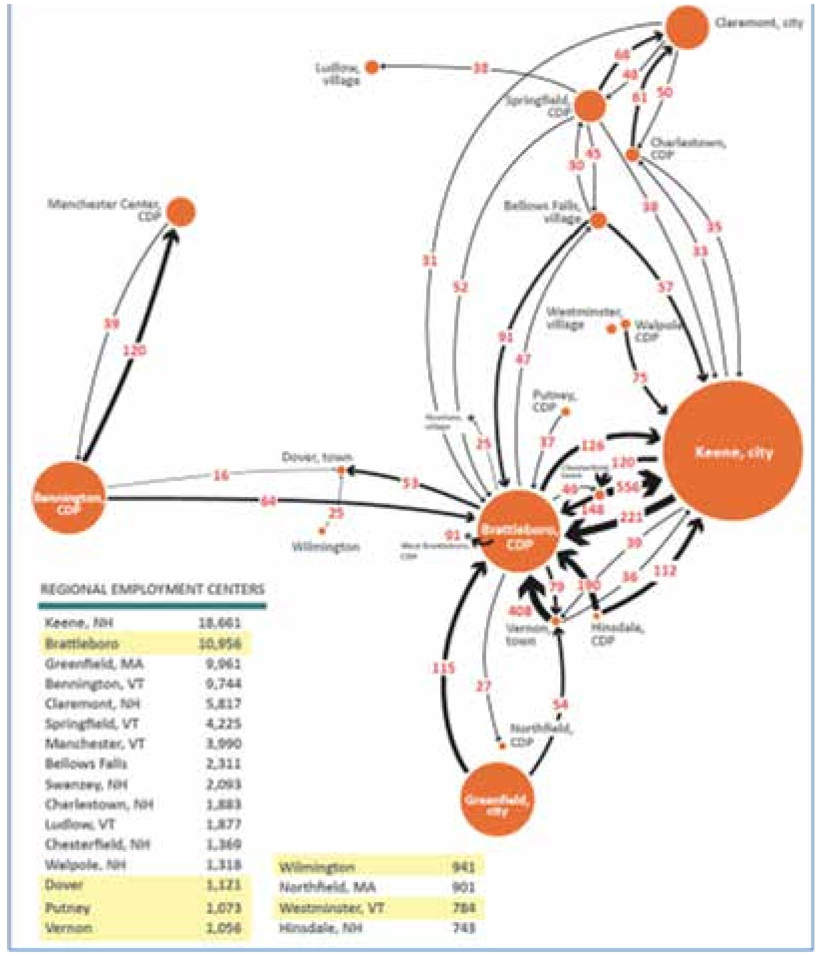
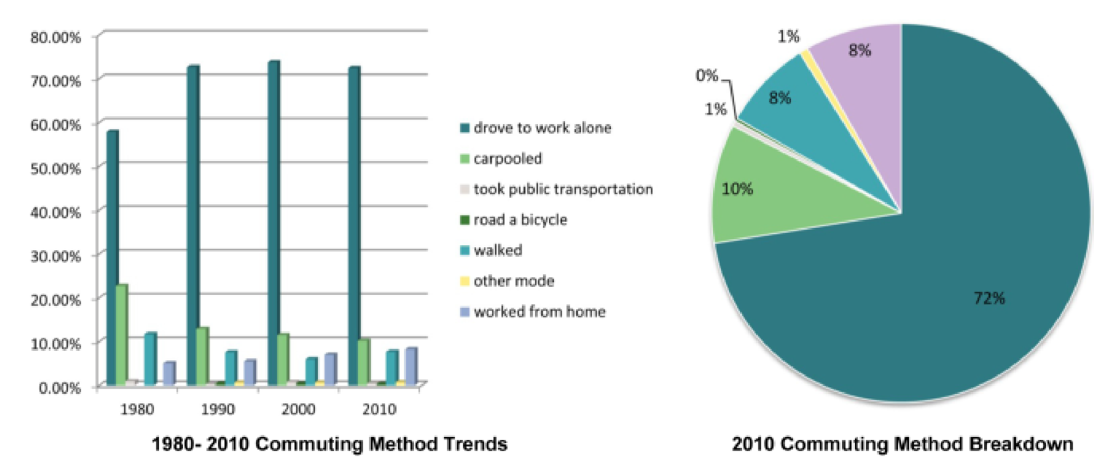


Figure 11: Commuting links between the major employment centers in and around the Windham Region, 2013.



2010 Census, U.S. Census Bureau
http://www.census.gov/

Figure 12: Windham Region average commuting method.

18 Windham Regional Profile http://windhamregional.org/images/docs/regional-plan/2014_Windham%20Regional%20Plan_profile%20updated.pdf

HEAT

Energy consumed for heating is estimated based upon the average square footage for residential space by fuel type. This was calculated using data from American Community Survey and the 2011 American Housing Survey. The region spends approximately $25,256,000 on commercial and $49,770,500 on residential heating (these figures were found by using an average rate of $22.32 spent per million Btu each year, based on the 2016 Vermont Fuel Price Report). To account for the different building types and their respective uses, the following estimates divide thermal (industrial building thermal demand is not included). For residential buildings, it was assumed that the average annual heating load of area residences is 110 million Btu, for both space and water heating (the Vermont state average). With 20,275 primary housing units in the Region, this arrives at an estimated 2,230,250 MMBtu annual total heat consumption.

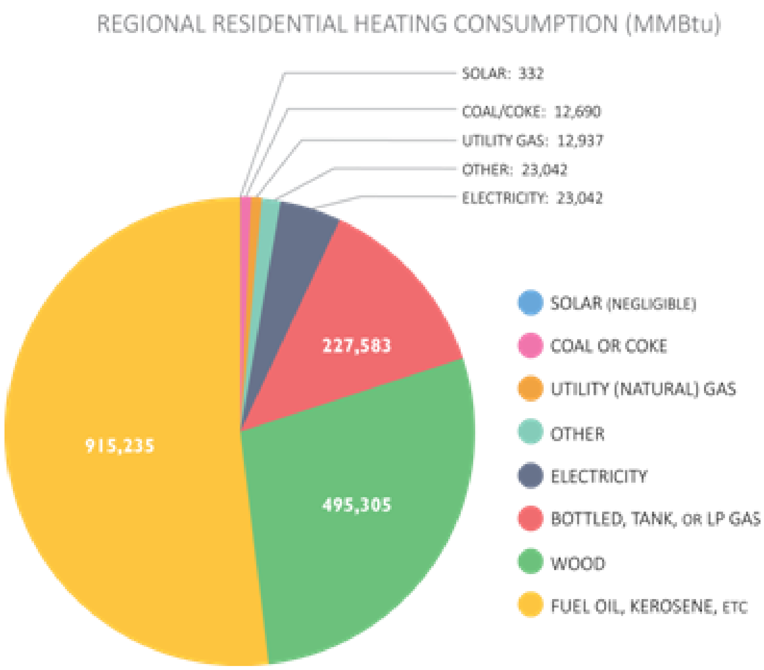


Figure 13: Regional residential heating fuel sources, as a percentage of BTU consumed.

Figure 13 illustrates this energy consumption by fuel type. The Region depends heavily on fuel oil and kerosene with this fuel source supplying over 50% of the residential heating needs. As most of the fuel types are not locally produced (fossil fuel sourced), the funds going to this supply are funneled directly out of the state and Region.

In the Windham Region, there is also a high percentage of seasonal homes at 33.4% of the total housing stock (Table 1). Based on the energy model projections from the state (created by the LEAP, or Long-Range Energy Alternatives Planning model assumptions discussed in Appendix 1, page 52), it can be assumed that seasonal homes only use about 15% of the energy of a primary home, due to more occasional use and presumed higher energy efficiency as they are assumed to be of more recent construction or renovation. As such, seasonal homes in the Region are estimated to consume about 180,114 MMBtu annually, and therefore spend about $4,019,500.

Total housing units	**32,638**	**100.0%**
Occupied housing units	20,275	62.1%
Vacant housing units	12,363	37.9%
For rent	615	1.9%
Rented, not occupied	43	0.1%
For sale only	309	0.9%
Sold, not occupied	23	0.1%
For seasonal, recreational, or occasional use	10,916	33.4%
All other vacancies	457	1.4%

Table 1: Windham Region housing tenure status, 2010.

Wood fuels over a quarter of the residential heating needs for the Region. The Windham Region has an abundance of forest resources. A study completed by Innovative Natural Resources Solutions (INRS) revealed Windham County has the largest volume of standing trees of any Vermont county at 1.6 billion cubic feet and grows over 20 million cubic feet per year (approximately 250,000 cords). The forests in Windham County are more productive than other Vermont counties because they are found at lower elevations characterized by richer soils [19]. With this abundant resource, the Region has the ability to support a significantly higher percentage of the heating needs with advanced wood heating options while supporting an important local economy if wood fuel processing and distribution can be developed at an economical scale. The Windham Regional Commission is currently working to support this opportunity with the Windham Wood Heat Initiative funded through the Clean Energy Development Fund helping municipal buildings, schools, and public serving institutions convert to advanced wood heating systems (discussed further in Part IV of this plan).

For commercial establishments, it can be assumed that estimated that the total heating load is about 725 MMBtu each year per establishment (the estimated commercial heating demand per municipality will vary depending on the types of commercial establishments in the area, but this state average can be used as a regional approximation). With 1,509 commercial establishments in the Region, there is an estimated thermal energy demand of 1,094,025 MMBtu annually. Together these businesses pay an estimated $24,414,000 each year total in heating expenses.[20]

19 INRS, An Initial Wood Supply Analysis for the Windham Wood Heat Initiative, 2015.

20 Based on Windham County averages for fuel types consumed overall, and costs per fuel type from the 2016 Vermont Fuel Price Report. http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Fuel_Price_Report/2016/June%202016%20Fuel%20Price%20Report.pdf

PART III

Future Energy Use & Targets

LEAP MODEL OUTPUT DISCUSSION

In order to effectively plan for the renewable future outlined in the Comprehensive Energy Plan of 90% renewable energy by 2050 (referred to as "90 x 50"), the state and its regions are faced with the challenge of how to contribute to the achievement of that goal. Studying the current energy consumption patterns of the Windham Region, large gains are necessary in energy conservation and efficiency, as well as renewable energy generation, to meet the stated goal.

The Long-Range Energy Alternative Planning-System (LEAP) is the model the Vermont Energy Investment Corporation (VEIC) used to identify pathways to achieve the 90 x 50 goal. VEIC was retained by the Vermont Department of Public Service to model scenarios for those pathways for use by the state, the regional planning commissions, and municipalities. The model is driven by assumptions discussed in the Total Energy Study (TES) [21] using their TREES scenario (Total Renewable Energy Efficiency Standard). The TREES Scenario accounted for policies requiring energy distributors to source an escalating percentage of their supply from renewable resources over time. The LEAP model was run with two scenarios to

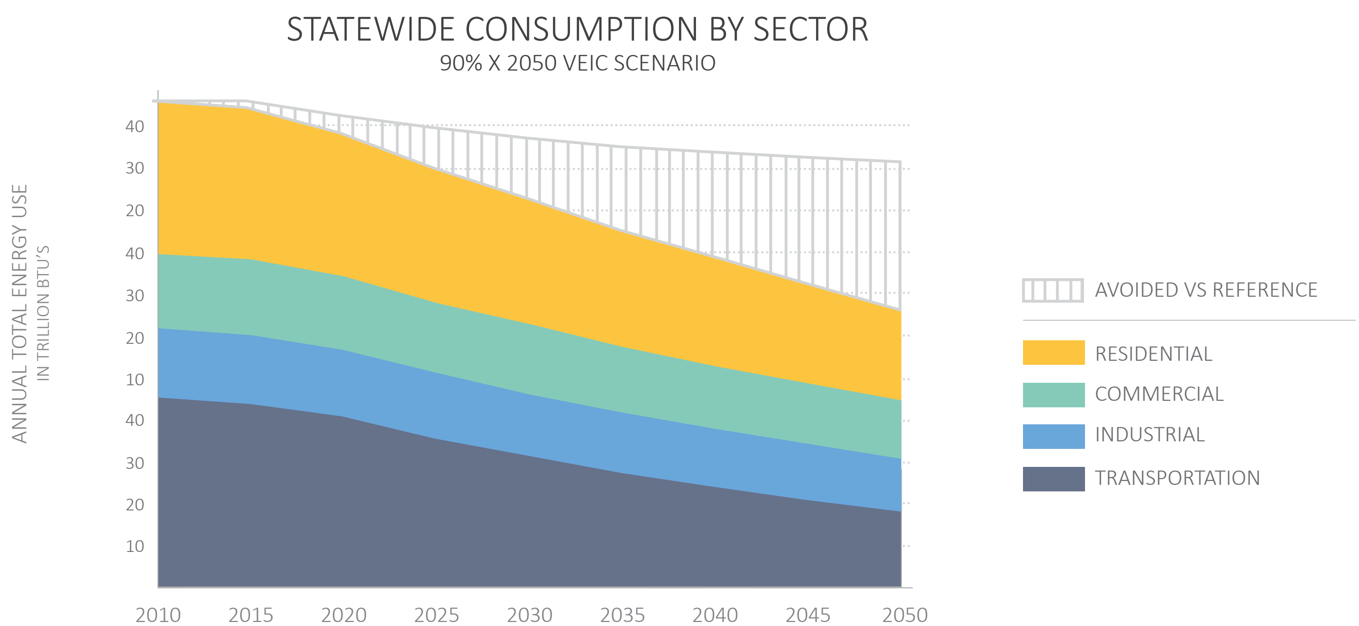


Figure 14: Statewide energy consumption by sector, 90% x 2050 VEIC scenario compared to the reference scenario.

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21 The Department of Public Service's Total Energy Study: http://publicservice.vermont.gov/publications-resources/publications/total_energy_study

illustrate the pathways to 2050. The first is the "Reference Scenario," which assumes business as usual not accounting for current state policy and goals, on reducing greenhouse gas emissions and renewable energy consumption. The second is the "90 x 2050 VEIC Scenario," which illustrates the changes needed in consumption from 2015 to 2050 in order to achieve the 90 x 50 goal. For more discussion on LEAP assumptions, see Appendix 1: Windham Regional LEAP Model Output, VEIC on page 52 of this plan.

At the state and regional levels, energy demand is depicted as decreasing substantially by the year 2050. Figure 8 below illustrates total state consumption by sector. The Reference Scenario is the upper curve of the barred area. This barred area illustrates the difference between the energy consumption of the Reference Scenario verses 90 x 2050 VEIC Scenario. Much of this difference is accounted for by assumed conservation and efficiency measures across all energy sectors (transportation, heating, electricity) due to gains in technological efficiency and decreased demand due to conservation measures.

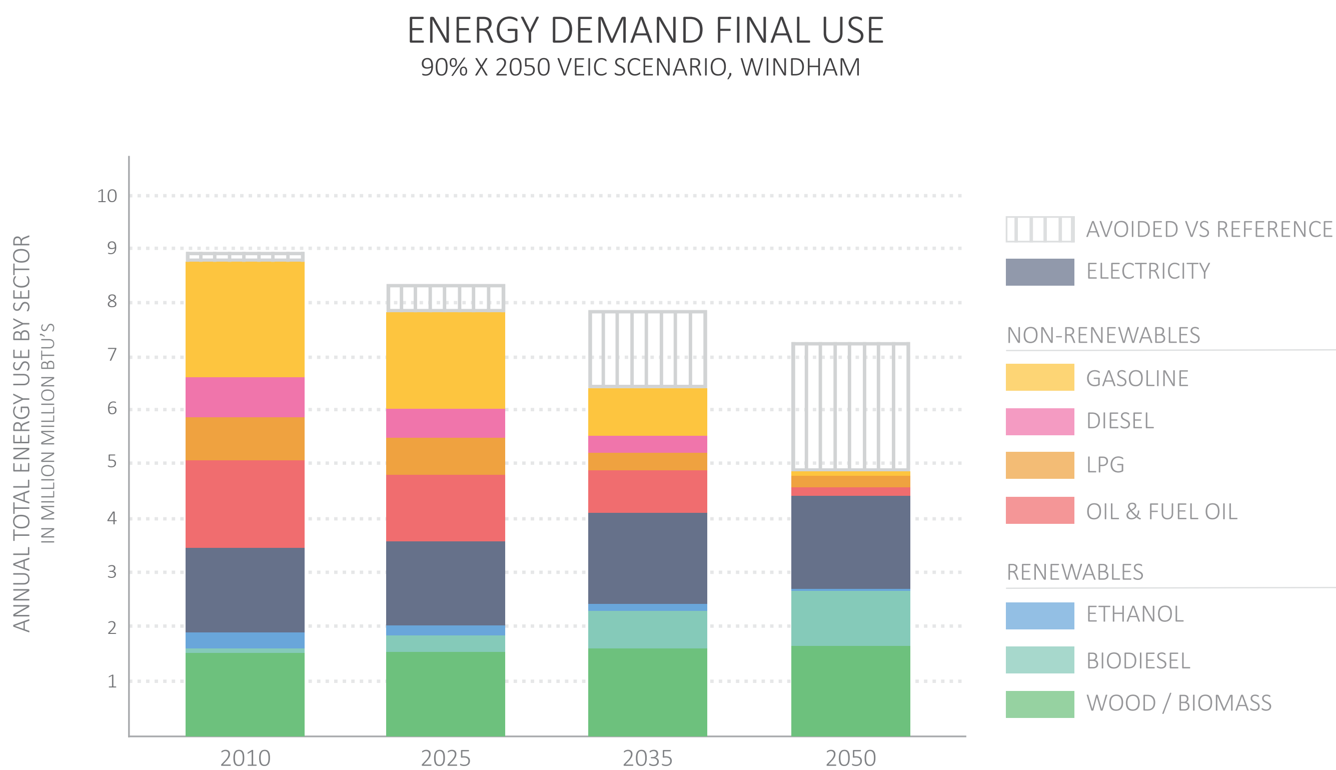

Figure 15: Regional energy consumption by fuel, LEAP scenario.

The Windham Region's energy consumption by fuel type over time is depicted in Figure 9. Throughout the benchmark years, the model assumes fossil fuel consumption is phased out and replaced by more renewable resources. The total volume of fuel decreases due to assumptions about advancements in efficiencies across all sectors.

LEAP ELECTRICITY SCENARIO

The electricity sector is where much of the change will occur over time. Despite the flat rate of electric energy consumption over time depicted in Figure 9, the model assumes electrification of the light duty vehicle fleet will call for a dramatic increase in electricity, along with an assumed electrification of heating and cooling systems. The model also assumes increased efficiency of these technologies over time. In the year 2050, electricity is the assumed to be the primary source of fuel for the region and accounts for almost half of the total fuel consumed.

LEAP TRANSPORTATION SCENARIO

Transportation currently accounts for more than a third of the Windham Region's energy consumption. To achieve the goal of 90 x 50, the transportation sector will need to radically transform its fleet efficiency and fuel sources. The model assumes consumption of fuels by the light duty vehicle fleet will drop by 80% from today's estimates and the makeup of the energy mix will change from predominantly gasoline to electricity. Figure 16 below illustrates the change over time in the transportation sector. The LEAP model separated light duty vehicles and heavy duty vehicles and applied separate fuel switching assumptions in the data. The notable increase in biodiesel is driven by the assumption that the heavy duty fleet will convert from diesel to biodiesel, though biodiesel consumption in light duty vehicles is expected to rise as well.

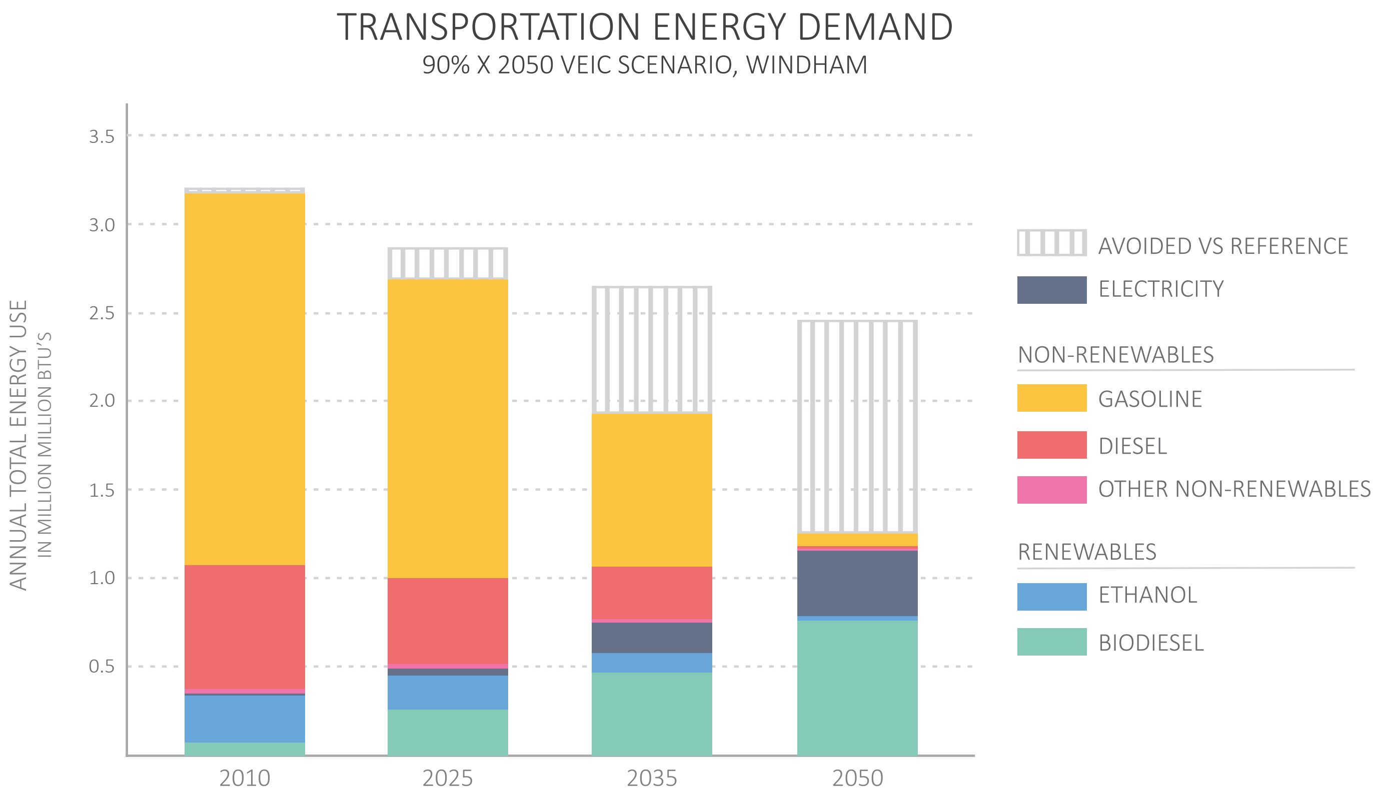

Figure 16: Regional transportation energy consumption by fuel, LEAP scenario.

LEAP HEATING SCENARIO

Today the heating sector consumes approximately one third of the energy in the region. Over 41 million dollars are spent on meeting home heating needs within the Windham County. The LEAP model shows a dramatic decrease in home heating consumption between 2015 and 2050. In Figure 11 below, the Reference Scenario is accounted for on the upper limit of the lined bar. Comparing the Reference Scenario to the 90 x 2050 VEIC Scenario, both assume decreased consumption over time. The decrease in consumption reflects the Total Energy Study's assumptions that underlie the Reference Scenario accounting for more houses heating with heat pump technology and wood pellet systems. They also account for assumed technological advances in the efficiency of the heat pumps and increased weatherization and building envelope efficiency work. Collectively these assumptions account for the negative trend in the Reference Scenario graph in Figure 17.

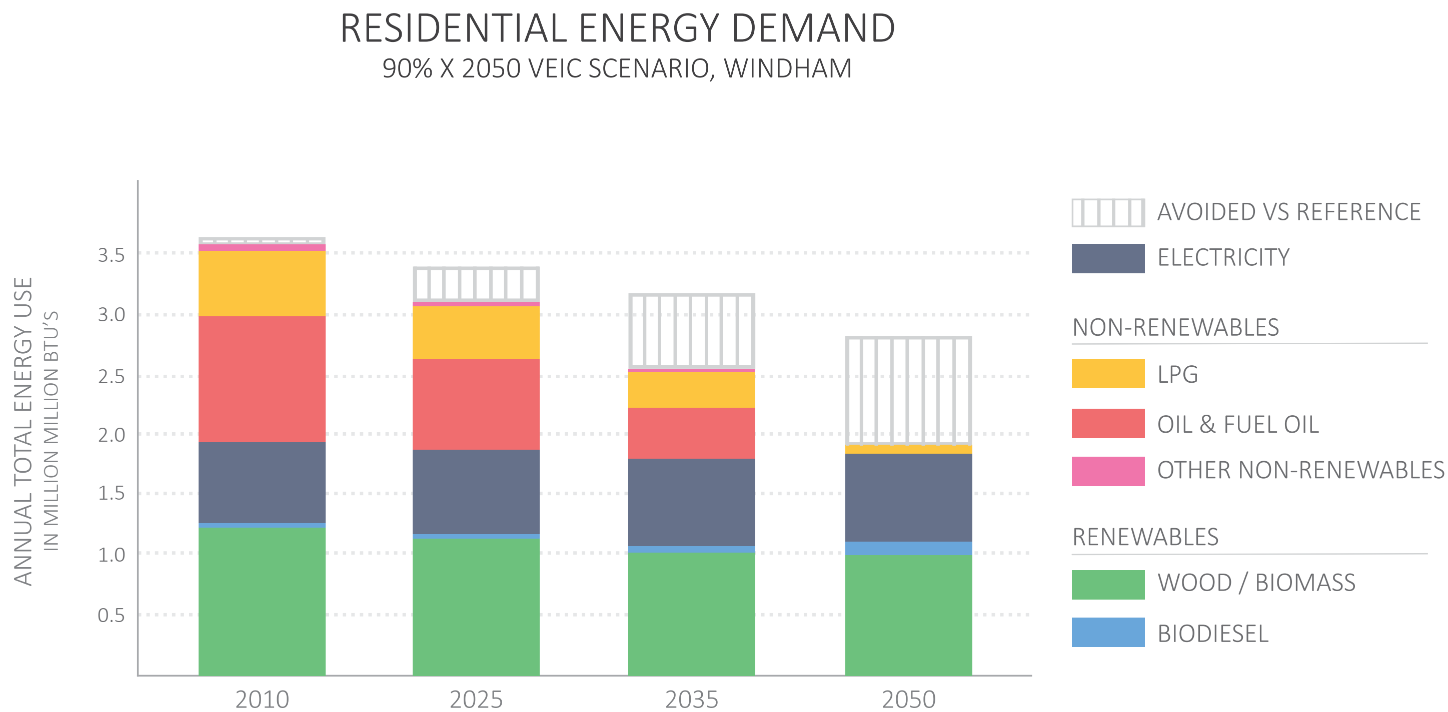

Figure 17: Regional residential heat energy consumption by fuel. LEAP scenario.

Underlying the negative trend in the data for the 90 x 2050 VEIC Scenario are many of the same assumptions. In Figure 11, a notable trend in the graph is that almost none of the fuels seem to increase in volume by 2050. Some, such as wood pellets and cord wood, decrease. This is where efficiency plays into the equation. Although the volume of these sources is decreasing, that decrease assumes weatherization and building envelope conservation measures. Therefore a decreasing volume of fuel is assumed to be capable of heating more space (houses) overall.

Second Homes

Approximately one third of the housing stock in The Windham Region is second homes[22]. The model accounts for second home energy consumption by assuming that these homes use 15% of the heating fuel used by a single family home.

COMMERCIAL AND INDUSTRIAL LEAP SCENARIO

The model assumes that the least amount of change in energy consumption and fuel mix is within the commercial and industrial sectors. This is due to assumed growth in these sectors over time. Figure 18 illustrates industrial consumption in the region. In total energy units, there is very little difference between the Reference Scenario and with the 90 x 2050 Scenario. There are, however, two noticeable trend assumptions underlying the fuel mix ratio: that electricity consumption decreases substantially over time, and that wood is increasingly used as a fuel source. Residual fuel oil and liquid petroleum gas (LPG) both remain more or less constant over time as they are denser fuels with no efficient substitute as of yet. These results are directly from the Total Energy Study.[23]

22 Windham Regional Plan, 2014.

23 We note that when heating oil prices were rising the region saw a significant switch towards compressed natural gas by some of the major industrial facilities in the region. It is possible that if natural gas remains

Commercial energy demand, as portrayed in Figure 19, also varies little between the Reference and 90 x 2050 Scenarios. However, the 90 x 2050 scenario does assume that residual fuel oil and oil are

competitive that the region will see an increase in use of natural gas.

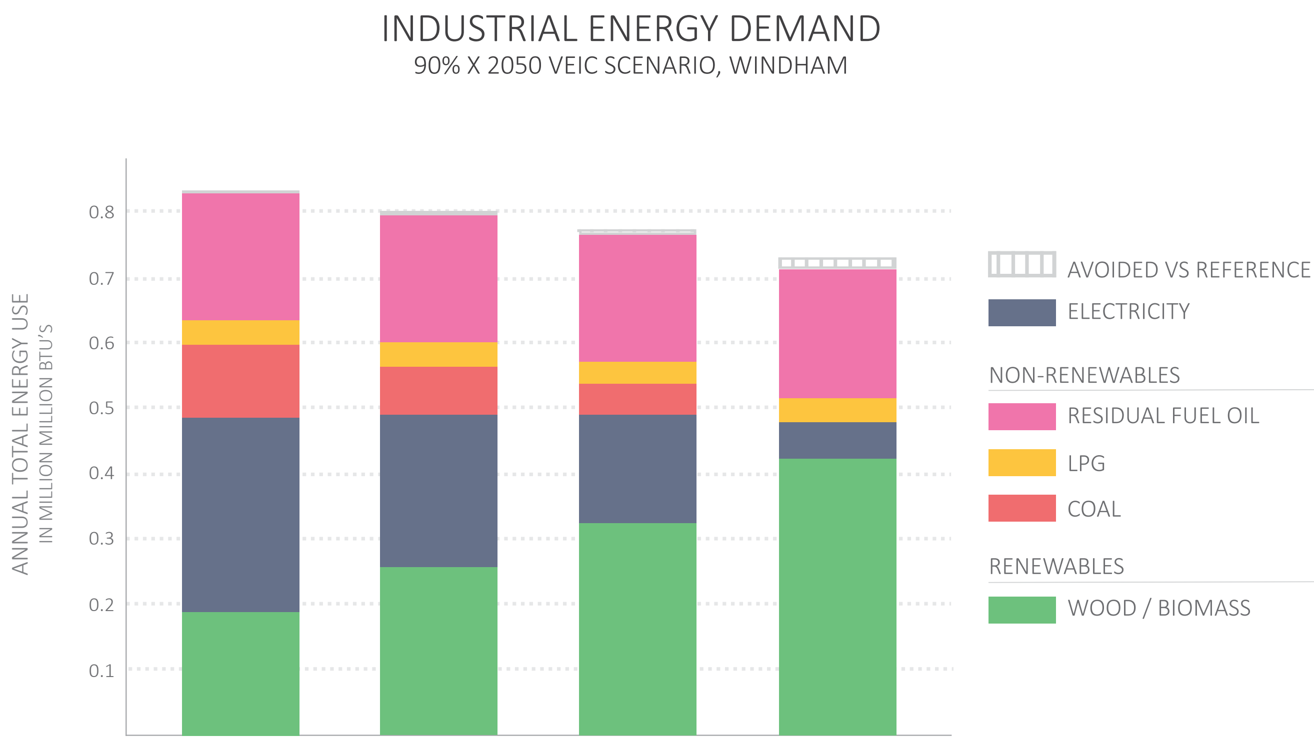

Figure 18: Regional industrial consumption by fuel, LEAP scenario.

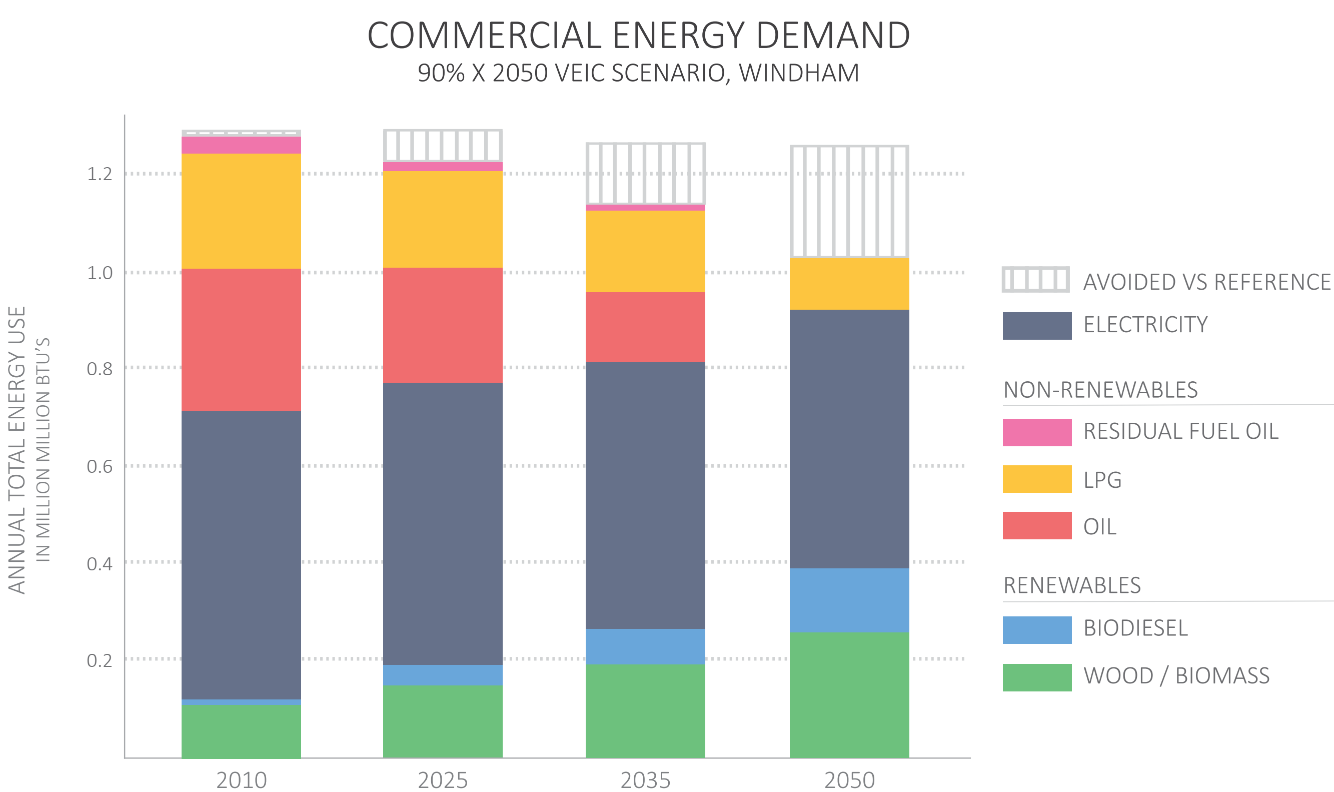

Figure 19: Regional commercial consumption by fuel, LEAP scenario.

replaced by an increase in wood chips and biodiesel, and that overall energy consumption decreases by 20%. The sector itself is assumed to grow over time, accounting for only a moderate decline in total energy consumption.

TARGETS

These projections illustrate one possible pathway to meet the 90x50 state goal. Though the actual pathway is likely to divert from what is depicted in the above graphs, the model allows for the Region to plan for the upcoming years with targets in conservation and efficiency and energy generation. Because the model and underlying assumptions are being used statewide by all regional planning commissions, each regional energy plan is being built upon a common understanding intended to both meet the goals of the current CEP and inform future iterations of the CEP.

CONSERVATION AND EFFICIENCY TARGETS ACROSS THE SECTORS

Thermal/Heat

As discussed in the Current Energy Use section (Part II of this plan), the heating sector accounts for a large portion of the Region's energy consumption budget. For the 90x50 goal to be attainable, efficiency must be actively pursued. Based on the outputs of the LEAP model and calculation guidance from the Department of Public Service, Windham Region has ambitious goals in weatherization and in switching to renewable heating fuels. With a projected population growth of 0.34% (based on the LEAP Model output), very little increase to the housing stock is assumed.

Weatherization upgrades building envelopes to become more energy efficient so as to retain interior temperatures rather than leak heated or cooled/conditioned air through leaking roofs, doors, windows, as well as walls. Much of the housing stock in the Region does not meet a high standard of efficiency because of its age[24].

Out of the residential buildings which are primary residences, the targets for weatherization is as follows:

Percent of residential buildings to be weatherized	LEAP benchmark year
24%	2025
46%	2035
94%	2050

This equates to 19,254 of primary residences weatherized by 2050. As approximately a third of the housing stock is "vacant housing units" this number will be just under 67% of the total housing in the Region. We will note here that the funding and necessary organizational partnerships to make this target possible do not yet exist, though programs such as the NeighborWorks Heat Squad do provide a model.[25]

24 Windham County's housing stock is relatively old; Over 40% of all units were built before 1959, making them over 45 years old, and over half were built before 1970. Only 5.1% of all housing units have been constructed since 1995. See the Windham County, Vermont Successful Aging Community Study at: http://www.vermontel.com/~coasevt/images/word_documents/WC%20Successful%20Aging%20Community%20Study%20-%202007.doc

25 For more information about the NeighborWorks Heat Squad see https://heatsquad.org/

For commercial buildings, the targets are:

Percent of commercial buildings to be weatherized	LEAP benchmark year
4%	2025
7%	2035
12%	2050

The number of commercial establishments is anticipated to grow by 17% by 2050. As this anticipated increase is greater than the housing stock, the percentages are smaller.

The scenarios discussed above illustrate the extent to which the fuel sources in these buildings are anticipated to shift. The target numbers for residential and commercial are quite different and are separated below. The five target areas within this portion are: the share of biofuels in biofuel-blend fuels, the percentage of fuels using biofuels, the percentage of fuels using wood, the percentage of fuels using heat pumps, and the percentage of fuels that are petroleum-derived.

Residential fuel switching targets are as follows:

Percent of biofuels in biofuel-blend heating fuels	LEAP benchmark year
4%	2025
10%	2035
100%	2050

Percent of homes using biofuel-blend heating fuel	LEAP benchmark year
40%	2025
27%	2035
6%	2050

Percent of homes using wood-based heating fuel	LEAP benchmark year
55%	2025
53%	2035
57%	2050

Percent of homes switching exclusively to heat pumps (electrification)	LEAP benchmark year
18%	2025
39%	2035
64%	2050

Percent of fossil fuel use in residential heating	LEAP benchmark year
19%	2025
14%	2035
4%	2050

Commercial fuel switching targets for heating sources are as follows:

Percent of biofuels in biofuel-blend heating fuels	LEAP benchmark year
13%	2025
31%	2035
99%	2050

Percent of businesses using biofuel-blend heating fuel	LEAP benchmark year
26%	2025
19%	2035
10%	2050

Percent of businesses using wood-based heating fuel	LEAP benchmark year
13%	2025
15%	2035
20%	2050

Percent of businesses switching exclusively to heat pumps (electrification)	LEAP benchmark year
5%	2025
9%	2035
12%	2050

Percent of fossil fuel use in residential heating	LEAP benchmark year
17%	2025
13%	2035
8%	2050

Transportation

The LEAP model assumes the light duty vehicle fleet (passenger vehicles) will transform substantially by 2050. By 2050 the Region's fleet is targeted to be fueled by 76% electric and 8% biofuel-blend. The targets are listed as follows:

Percent of vehicle fleet to be converted to electric	LEAP benchmark year
5%	2025
37%	2035
76%	2050

Percent of biofuels in biofuel-blend	LEAP benchmark year
11%	2025
14%	2035
52%	2050

Percent of vehicles fueled by biofuel-blend	LEAP benchmark year
90%	2025
50%	2035
8%	2050

The heavy duty vehicle fleet is assumed to switch almost entirely from diesel to biodiesel by 2050.

Electricity

Residences to be upgraded with electricity efficiencies	LEAP benchmark year
7,885 (39%)	2025
12,885 (63%)	2035
18,845 (96%)	2050

GENERATION TARGETS

The Windham Region has long been home to energy projects. European settlement of the state was largely organized around the ability to harness water power for industry. Hydro-power was developed in the early 1900s on the Connecticut and Deerfield Rivers. The 620 megawatt Vermont Yankee Nuclear Power Station located in Vernon began operation in 1972 and ceased operation in 2014. This plant was a significant source of earned income and employment for the region and is now the focus of decommissioning, site restoration, and spent fuel and high-level nuclear waste storage discussions.

The region is now a leader in diverse renewable energy generation, with 480 solar sites generating 10,314,024 kWh, 13 wind sites generating 18,561,564 kWh, 2 anaerobic digesters generating 2,706,840 kWh, 1 landfill site generating 3,679,200 kWh, and major hydro-power facilities on the Connecticut and Deerfield Rivers, and smaller facilities elsewhere, produce 536,976,000 kWh. As of December 2016, the Windham Region currently has 36.06 MW capacity of installed wind projects, and 15.70 MW of installed solar capacity. This includes a number of large-scale projects permitted and being developed in the Region, such as the Deerfield Wind Project (at 30 MW capacity).

The Region currently generates 304,450 MWh. In order to achieve the 90x50 goal, a targeted total for the Region is 58,493 MWh. This equates to about 45 MW capacity needed in new renewable energy generation (this name-plate capacity figure may change depending on the range and types of energy generation technology installed). This generation target can be met with a variety of different technologies, though solar and wind generation have the highest viability in the region and state. However, as will be discussed below, the Windham Regional Commission is adopting a policy that would preclude additional utility-scale beyond that currently being developed in the towns of Readsboro and Searsburg, and that the new capacity be developed through solar generation and appropriately-scaled biomass generation (digesters and combined heat-power generators as well as wood fuel production), small hydro (run of river facilities on existing safe and stable dams), and residential- or community-scale wind (community-scale referring to a wind development developed by a municipality to serve its residents).

Table 2 below shows the name-plate capacity (in MW) for each supplemental technology, and its actual annual generation capacity (in MWh) for the state.

Farm Digesters:	20 to 25 MW	capable of producing:	125,000 to 150,000 MWh per year
Food Digesters:	2 to 5 MW	capable of producing:	5,000 to 25,000 MWh per year
Small Hydro:	100 to 200 MW	capable of producing:	400,000 to 900,000 MWh per year
Biomass:	100 to 200 MW	capable of producing:	600,000 to 125,000 MWh per year

BIOMASS

Biomass is unique from the other renewable energy generation technologies as the generation capacity is not inextricably linked to the site. Biomass resource is harvested from a location then transported to a generation facility.

Approximately 516,000 acres (86 percent) of the Windham Region is forested. The region's forestry industry is one of the state's leading producers, especially of high-quality northern hardwoods and white pine. Windham County also has the most standing timber, 3.46 billion board feet, in the State. This yields well over 100,000 green tons of low-grade wood material (see Figure 20). With the forests producing significantly more than what is being harvested, this number is projected to increase in the future. Seventy-two percent of the region's forests are in private, non-industrial ownership, with industrial forestry operations and Federal, State and local governments sharing the rest.

The Region is already working on becoming a hub for biomass by tapping into this abundant resource and applying it to the heating sector. The Windham Wood Heat project, funded through the Clean Energy Development Fund, is working with schools, municipalities, and public serving institutions converting to advanced wood heating and building the market, the Region will be

Figure 20: Total estimated net available low-grade growth (NALG) wood by county.
Source: Biomass Energy Resource Center, 2010 Update to the Vermont Wood Fuel Supply Study, http://www.biomasscenter.org/images/stories/VTWFSSUpdate2010_.pdf

funneling much of the resource into heat rather than electricity generation though is likely to develop co-generation facilities which would contribute to the generation targets. We will continue to work with the forest industry in the region to develop pellet and chip production to reduce dependence upon wood-based fuel brought in from beyond the Region.

METHANE DIGESTERS

One of the nation's first commercial landfill gas to electricity projects was constructed in Brattleboro in 1982. Vermont Energy Recovery Systems uses the methane produced at the Windham Solid Waste Management District's Brattleboro landfill to generate and sell electricity to Green Mountain Power (GMP). The project generates approximately four million kilowatt hours annually.

Methane is also emitted from volatile solids or animal waste. Anaerobic digesters produce electricity from the methane recovered from cow manure and/or other organic matter. In addition to producing energy and reducing the amount of methane emitted into the atmosphere, this process also reduces water pollution and produces a high quality fertilizer as a by-product. As of 2013, there was only one methane digester facility in the Windham Region at Westminster Farms, Inc. The Windham Solid Waste Management District is considering several other potential sites that have been identified throughout the region.

Green Mountain Power's (GMP) Cow Power™ program has been a deciding factor in a number of farm methane installations in the state. For every kilowatt-hour requested by customers and provided by a Vermont farm, GMP will pay the farmer the market price for energy plus the GMP Cow Power™ charge of 4 cents for the environmental benefits of the energy.

Environmental impacts must also be considered with biomass power. The combustion of wood produces heat and emissions including hazardous air pollutants (HAPs), fine particle pollution (ash), and volatile organic compounds (VOC). The pollutant of greatest concern to human health is fine particles (10 microns or less in diameter), which may be inhaled and cause a number of respiratory illnesses. Several other emissions are also of concern to air and water quality, including carbon monoxide (CO), carbon dioxide (CO2), sulfur oxides (SOx), and nitrogen oxides (NOx). Emissions of NOx (if kept below 1300 Celsius) and SOx from burning wood are significantly lower than coal and petroleum and are comparable to those of natural gas. Particulate levels in wood emissions are similar to those from burning coal and petroleum and substantially higher than the levels in the emissions from natural gas. Particulate emissions can be controlled to acceptable levels with smoke stack equipment such as scrubbers, bag filters, and electrostatic precipitators; however this equipment is only cost effective on large commercial-sized combustion systems. Particulate emissions from smaller equipment, especially residential-sized units can be a concern.[26]

The CO2 in wood combustion emissions is considered by some to be "carbon-neutral" because it is basically equivalent to the amount of CO2 trees need to grow the same quantity of wood. Hence the combustion of wood does not contribute to the net increase in atmospheric levels of CO2 (a greenhouse gas) as does the combustion of fossil fuels. However, because this concept is not universally accepted, the impacts of this power source must be considered as carefully as those of other combustion fuel sources. In order to promote the highest possible efficiency of wood-based biomass energy production, it is our policy to support combined heat-power generators rather than stand-alone power generators.

26 Extension, http://www.extension.org/pages/43735/what-are-the-air-emissions-of-burning-wood

HYDRO-POWER

It is estimated that following Vermont Yankee's 2014 closure, hydroelectric power accounted for approximately 10.8 percent of the total energy consumed in Vermont in 2016, equivalent to an estimated 27 percent share of all renewable energy consumed that same year. A total of 21 percent of Vermont's in-state electricity generation in 2011 was from conventional hydroelectric power.[27] As of May 2012, Vermont had approximately 676 MW of installed hydroelectric capacity. Windham County ranked second in the state for installed capacity.[28]

The major supplier of hydro-power for Vermont is Hydro Québec (HQ), a Canadian company. The Public Service Board approved the previous HQ contract in 1990; a 30 year agreement between a group of eight Vermont utilities, known as the Vermont Joint Owners (VJO) to purchase long term base-load power from HQ and to make it available at wholesale to the rest of Vermont's utilities. In 2010, 20 Vermont utilities signed a 26-year power contract with HQ to purchase up to 225 MW of electricity from January 2012 through 2038. In addition, HQ and the Vermont utilities agreed to share any future revenues related to environmental attributes of HQ power generation flowing into Vermont.[29]

Vermont has 46 utility-owned hydro sites and approximately 35 independently owned hydro sites. In the Windham Region, Great River Hydro (formerly TransCanada) operates hydroelectric stations and associated storage reservoirs and dams on the Connecticut and Deerfield Rivers.[30] The Bellows Falls Dam and Vernon Dam are located on the Connecticut River. The Bellows Falls Dam has a generating capacity of 49 MW. The Vernon Dam is the oldest dam, in service since 1909, and has a generating capacity of 37 MW. The Searsburg Dam and Station, located on the Deerfield River, is rated at 5 MW. The Harriman Dam and Station, located in Wilmington and Whitingham, VT, includes three generating units capable of producing 41 MW of electric power. Sherman Reservoir lies mostly in Vermont but its electric generation occurs in Massachusetts, with a capacity of 6 MW. Smaller, privately owned facilities also exist around the region. Two small generators have been installed at the Ball Mountain and Townshend U.S. Army Corps of Engineers flood control dams.

All hydro facilities of significant size are licensed by the Federal Energy Regulatory Commission (FERC). New projects may also require a permit from the U.S. Army Corps of Engineers. These federal permits trigger state review delegated under the federal Clean Water Act. The FERC permitting process can take two to seven years to complete. Periodically these plants have to renew their licenses. Generally, the re-licensing process results in permit conditions that require plant owners to sacrifice some operating flexibility in order to mitigate the environmental impacts of their facilities. For some hydro facilities, this has resulted in a 10-20 percent loss of energy production. [31]

The current licenses for each of the Wilder, Bellows Falls, and the Vernon Hydroelectric Projects

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27 U.S. Energy Information Administration, http://www.eia.gov/state/?sid=VT

28 Vermont Energy Atlas, http://www.vtenergyatlas.com/

29 Vermont Department of Public Service, Biennial Report July 1, 2006 - June 30, 2010, July 2011, http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Biennial_Reports/2010%20Biennial%20-%20Publication%20Draft.pdf

30 Transcanada, Connecticut River and Deerfield River Hydro Facilities, http://www.transcanada-relicensing.com/wp-content/uploads/2012/10/HydroFacilities1.pdf

31 Vermont Department of Public Service, Biennial Report July 1, 2006 - June 30, 2010, July 2011, http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Biennial_Reports/2010%20Biennial%20-%20Publication%20Draft.pdf

(Great River Hydro) and the Turners Falls Hydroelectric Project and Northfield Mountain Pumped Storage Project (FirstLight) are set to expire in April, 2018. All projects utilize water from the Connecticut River to generate hydroelectric power. The licenses were issued by the FERC for terms of 30-50 years, and Great River Hydro and FirstLight are seeking relicensing for these dams using FERC's Integrated Licensing Process (ILP).

According to assessments completed by the State, it is clear that the best hydro-power sites have already been developed. There are very few undeveloped sites that could support capacity greater than 1 MW, and relatively few in the 500 kW to 1 MW range. There are many potential smaller community and residential-scale sites sized below 200 kW. Incentives such as net metering, group net metering, and the Standard Offer Program are necessary to facilitate the development of smaller sites. The Agency of Natural Resources (ANR) has recently approved sites with generation capability as low as 15 kW.[32]

According to ANR, the hydro resource is already heavily developed in Vermont. Further development would likely result in intermittent manipulation of stream flows and water levels, a possible increase in flood hazards resulting from the disruption of natural river processes, some loss of riverine aquatic habitat, and barriers to movement of fish and other aquatic life. ANR's 2008 Report *The Development of Small Hydroelectric Projects in Vermont* identified the following criteria as necessary for any new hydroelectric generator to have acceptable environmental impacts:

- No new dam or other barrier to aquatic organism movement and sediment transport.
- Run-of-river operation.
- Bypass flows necessary to protect aquatic habitat, provide for aquatic organism passage, and support aesthetics.
- Fish passage where appropriate.
- No change in the elevation of an existing impoundment or in water level management.
- No degradation of water quality, particularly with respect to dissolved oxygen, temperature, and turbidity.
- No change in the upstream or downstream flood profile or fluvial erosion hazard

Because there are few undeveloped sites that are candidates for new hydroelectric plants, three effective ways to increase capacity by improving efficiency and output at existing hydroelectric facilities include: installing more efficient turbines, installing small turbines at the dams that utilize bypass flows, and installing new turbines that can operate efficiently over a wider range of flows. These upgrades are often possible without changing current operating requirements, i.e., power production can be increased without additional environmental impacts. In addition, existing municipal water supply and wastewater treatment pipelines could capture the energy in these systems by installing hydro turbines to the pipelines without otherwise altering the regular operation of the system. Such in-pipe hydroelectric systems have minimal environmental impact.

SOLAR

Solar energy is categorized by the U.S. Energy Information Administration (EIA) as an "other

32 Vermont Department of Public Service, Comprehensive Energy Plan 2011, http://publicservice.vermont.gov/publications/energy_plan

renewable," a category that provided only about 0.2 percent of the energy used in Vermont in 2010, almost entirely in the residential sector. Solar energy can be used either to generate electricity or to generate heat. As of December 2016, Vermont had approximately 115 MW of installed photo-voltaic capacity. Windham County ranked seventh among Vermont's fourteen counties for installed capacity.[33]

In 1998 the Legislature enacted a Net Metering law (30 V.S.A. § 219a), requiring electric utilities to permit customers to generate their own power using small-scale renewable energy systems of 15 kW or less. The excess power generated by these systems can be fed back to the utility, basically running the electric meters backwards. Since then, legislative amendments to this statute in 2008, 2011, and 2014 lifted certain restrictions, increased the permissible size per installations, established a simplified permitting process for certain small systems, and raised the ceiling on total system installed capacity from one percent to two percent of peak load. This was all done in a effort to facilitate smaller net metering projects, especially residential-scale work. Recently, the January 2017 revision to 5.100 "Rule pertaining to construction and operation of net-metering systems,"[34] made even more revisions to prioritize small solar installations. Among other things, it also identifies state-wide "preferred" solar installations sites, which have implications on regional and municipal energy policies.

A potential drawback of PV power is cost. When compared to the current market price forecast for electricity, the price of PV remains high. There is data that suggests that state and federal incentives have served as major drivers in the rate of solar facilities installation. In 2004-2006 there were only 329 permitted net-metered systems in Vermont, with an installed capacity of net-metered systems of 749.3 kW. From 2007-2010 the number of installed systems has climbed to 1319 systems with an installed capacity of 10,923 kW. Despite cost issues, PV power has several advantages that make it a power source that the state should continue to support and it is a priority for the Windham Region, including its relatively low impact (the most common complaints the WRC has heard relate to aesthetics rather than permanent landscape alterations, noise, and emissions). PV is largely a peak electric load–following resource, meaning that during peak summer loads, the PV systems are at their highest production, resulting in peak shaving and grid reliability benefits. In addition, PV power is generated without noise, requires low levels of maintenance, emits no pollution, and is extremely distributable.

While there is relatively little controversy about solar energy as a source of power, potential conflicts arise with the siting of solar installations. Ground-mounted systems tend to be larger in scale that roof mounted systems, and generally are sited on undeveloped or agricultural land. More recently, there have been concerns about large utility-scale installations being built on land designated as industrial or commercial. This is a legitimate concern in the Windham Region as geography significantly limits the availability of land that is appropriate for such intensive use. We are asking towns to pro-actively identify preferred sites for solar generation where these preferred use conflicts might exist. These systems are relatively benign once installed; however the region has relatively little prime agricultural soil. Installations covering large acreage should provide mitigation in the form of retained agricultural soils on site, or conserved agricultural land of equal value elsewhere in the region. Roof top systems have the advantage of requiring zero additional development of open land, though conflicts can arise if these systems are installed in areas with historic district overlays, or where neighboring trees may shade out the system for a substantial period of the day. Towns should consider these issues and address them in their plans and zoning codes.

33 Vermont Energy Atlas, http://www.vtenergyatlas.com/

34 Refer to Public Service Board's document: http://psb.vermont.gov/sites/psbnew/files/doc_library/rulemaking-5100-attachment-a-on-reconsideration-08292016.pdf

WIND

Wind energy is categorized by the U.S. Energy Information Administration (EIA) as an "other renewable," a category that provided only about 0.2 percent of the energy used in Vermont in 2010. Wind energy is used primarily to generate electricity, but not as a source for heat. As of December 2016, Vermont had approximately 123 MW of installed wind capacity.

In 1997, Green Mountain Power developed Vermont's first modern, commercial wind-generating station in Searsburg, consisting of 11 turbines with a combined total power rating of 6 MW. The Vermont Public Service Board approved the project, despite its relatively high cost due to its perceived value as a demonstration project. In 2009 the Public Service Board granted a Certificate of Public Good permitting Deerfield Wind to construct a 30 MW facility, consisting of 15 wind turbines, in Searsburg and Readsboro, currently being constructed by Avangrid Renewables.[35]

Small-scale net metered installations that serve homes, businesses, and communities are also located throughout the region. Small-scale wind facilities are most often represented by a single turbine, which can generate from less than 1 kW up to 100 kW for a small commercial machine. A number of factors affect the success of a small wind project. To harness the best wind spectrum, turbine siting is absolutely critical within the micro-climate of the landscape. Turbines must be positioned so they extend as high as possible above obstacles like trees. Technical expertise to maintain the system is also essential.

Wind power is considered a complement to solar in a renewable energy portfolio. When solar power is low or unavailable, during cloudy days or at night, the wind is often more potent. For example, during Vermont's winter, when sunlight is diminished, average wind speeds measure at their annual high. Wind power is intermittent in nature, like many other renewable sources of power; thus, resource planning for effective power grid integration is essential.

Wind power is clean and renewable, but turbine placement can be difficult and controversial because of natural resource impacts, aesthetics, noise, and the need for turbine placement elevations between 2,500-3,300 feet, locations in Vermont that tend to be sensitive with thin soils and steep slopes. The windiest areas in the region are most often on the higher-elevation ridge lines that are sensitive habitats for plants and wildlife, and are the source of the region's most pristine headwaters. In areas where road access does not exist, new permanent roads must be built to service the wind facility. Other potentially negative environmental impacts include bird and bat mortality, habitat disruption and fragmentation, erosion, pollution from facility maintenance, turbine noise, and visual flicker.

35 http://www.avangridrenewables.us/deerfield.html

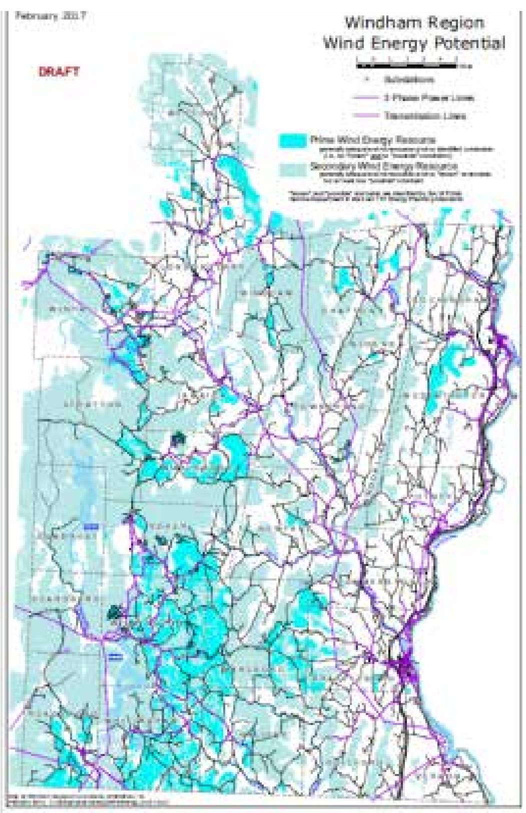
RENEWABLE ENERGY GENERATION POLICY

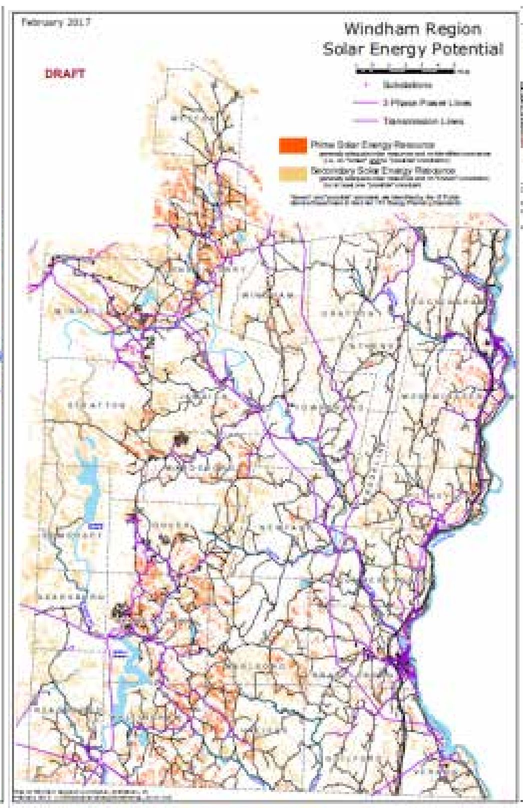
For the development of an Act 174-compliant regional energy plan, the most challenging policy considerations for the Commission are the appropriate mix of renewable energy generation sources to meet the state's 90 percent renewable energy target by 2050, and the siting of those renewable energy generation facilities. The renewable energy generation target established for the Windham Region by the Public Service Department standards is approximately 58,000 MWh (megawatt hours). Please see the attached Windham Region's Energy Generation Targets summary for more information.

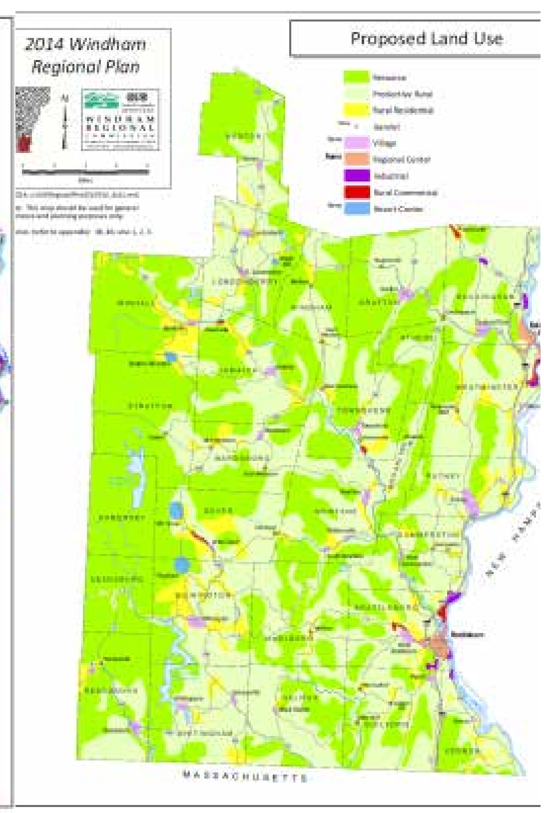
The question of the appropriateness of utility-scale wind has been particularly contentious within and among some towns in the Region. Concern over the appropriateness of solar energy generation installations has generally been more site-specific. Appropriateness in the context of this regional discussion relates to the compatibility of energy generation with the land use goals, objectives and policies contained in the 2014 Windham Regional Plan, as well as compatibility with adjacent and near-adjacent land uses.

Energy Generation Potential & WRC Land Use Policy

Below are maps that identify where wind and energy generation potential are strongest within the region. These same maps are provided as attachments, as is a description of what these maps represent and what they do not, in Appendix 4 on page 78 of this plan. When these maps are compared to the Proposed Land Use Map[36] of the Windham Regional Plan, one will note that the majority of the prime and secondary wind and solar resources fall within areas identified as Resource Lands or Productive Rural Lands.







36 Note: Staff has proposed that as part of this update of the regional plan it is time to revisit the boundaries as drawn on the Proposed Land Use map. The last major update to these boundaries was over 10 years ago. These boundaries should reflect the best information and data that are now available.

The Regional Plan says the following about these respective land use area designations. (Follow this link to the Regional Plan and maps for more information: http://windhamregional.org/publications.)

Resource Lands

- Strongly discourage all development in Resource Lands for purposes other than forestry and agriculture. Any development proposed within critical resource areas shall provide evidence as to why the development cannot be avoided, and shall provide mitigation for natural resources impacted by the development (p. 14).
- Resource lands are dominated by lands requiring special protection or consideration due to their uniqueness, irreplaceable or fragile nature, or important ecological function. As a subcategory of Resource lands, this plan recognizes critical resource areas as key sites that are particularly sensitive and should be given maximum protection (p.9).
- Use open space plans and resource protection techniques to protect agriculture, forest, mineral, and Resource Lands from development and fragmentation. Encourage town open space planning and help coordinate those planning efforts through the development of a regional Open Space Plan (p. 13).
- Resource lands require special protection or consideration due to their uniqueness, irreplaceable or fragile nature, or important ecological function. Resource lands include lands over 2,500 feet in elevation, identified bear travel corridors, areas hosting significant plants, animals and ecological communities as designated by Vermont's Non-game and Natural Heritage Program, or by federally identified endangered and threatened species, unique and fragile natural areas, riparian areas and their buffers, wetlands, floodplains, shore lands, steep slopes over 25 percent, and finally, scenic corridors or vistas as identified in town plans. Resource lands should be preserved and protected to the greatest extent possible. Any development or land use in these areas should be designed to have a minimal impact on natural resources and should include effective mitigation measures that will protect natural resource values. The most appropriate uses for Resource lands are conservation and management of natural resources and limited, low impact, very low-density rural uses (p. 78).

Productive Rural Lands

- Productive rural lands include forestlands, active agricultural lands, sand/gravel/mineral deposits, and high-value forest and agricultural soils that, when in productive use, contribute to the working landscape and have significant economic value (p. 8).
- Productive rural lands are low density and very low density residential areas containing land-based resources that, when in productive use, contribute to the region's working landscape and have significant economic value. These productive resources include forestlands, active agricultural lands, sand/gravel/mineral deposits and high-value forest and agricultural soils. Productive rural lands contribute significantly to rural areas by providing open space and lands suitable for rural occupations and lifestyles. These lands are the traditional rural working landscape of the region, and for this reason require a high level of stewardship. Generally, they are not located near municipal sewer and water. Low density mixed use development can be appropriate, but it must be compatible with traditional land uses, in scale with its surroundings and sensitive to the limitations of the land. Certain small-scale industries, especially those related to the region's agricultural and forest resources (e.g., dairy production, saw mills), may be compatible with, and most appropriate in, outlying rural areas. However, an essential quality of the rural landscape is that the land has the capacity to be worked or used, and preserving the

"working landscape" helps to protect its components (p. 77).

- Provide guidance and training on regulatory and non-regulatory tools for open space and resource protection available to towns for use in town plans and regulations. Encourage implementation of tools such as conservation subdivision, clustered development, and variable lot size in all subdivision development, and especially within rural residential and productive rural lands (p. 13).

Discussion of the Experience with Utility-Scale Wind and Solar to Date

As noted above, within the Windham Region there has been some site- and project-specific concern with large solar projects. But as a category, utility-scale ridge top wind energy has been the focus of the most vigorous debate and division. Support for or opposition to utility-scale wind is not uniform within the region. There seems to be general official town support for, or limited opposition to, utility-scale wind in Readsboro and Searsburg. The recently-proposed utility-scale wind development in the towns of Grafton and Windham has been divisive. Windham has taken a clear stance against wind in its town plan. [37] The Grafton plan takes no strong stance one way or the other. [38] Both Grafton and Windham held special votes on the proposed Iberdrola project that would generate approximately 70 MW of electricity. In Grafton the wind project was rejected by a vote of 235 to 158. In Windham voters rejected the project 181 to 101. Both towns reported voter turnout of greater than 75 percent. [39] The recent Townshend planning commission hearing draft town plan includes language similar to that in the Windham Town Plan in opposition to wind. These are the more recent developments and debates about which we have knowledge. Overall, we are not aware of towns in the region that have expressed significant support for utility-scale wind power generation within their respective borders either as a matter of plan policy or as a formal town position that has been communicated to the WRC.

As a matter of public opinion and town policy, utility-scale solar power generation has been less-controversial. There has been opposition to specific projects where major solar development has been proposed for and/or built on lands designated for industrial or other commercial development. In these cases land designated as such was limited not only as a matter of policy, but also as a matter of local geography. Solar was felt to be inappropriate as it does not generate jobs or contribute to the tax base as much as commercial or industrial development would. In other cases concern has related to solar installations proposed or built in very close proximity to existing residential development with limited or no screening, impacts to local view sheds, and proposed development in a mapped floodplain. The WRC Project Review Committee has typically agreed with the town concerns in these cases.

37 http://windhamregional.org/images/docs/towns/Windham/Windham_TownPlan_2015-01-05.pdf

38 "Grafton does not have sites that are commercially viable for wind development within the present technological and economic conditions. However multiple sites exist where future wind development might take place. Most promising are locations along Grafton's western border with Windham and the southern border with Athens. Several small peaks within town could also be suitable. Many more sites exist where residential turbines might be erected. Wind is a resource located above trees and at high elevation, thus it is always in someone's viewshed. Aesthetic appearance is a subjective issue of personal preference and thus cannot be used to rule for or against wind development. Ecological impact is, however, quantifiable and should be considered in conditions permitting installations of wind turbines." Grafton Town Plan, 2013, p. 19. http://windhamregional.org/images/docs/towns/Grafton/grafton_townplan_2008-05-26.pdf

39 http://digital.vpr.net/post/windham-and-grafton-reject-controversial-wind-project#stream/0

Overarching Policy Recommendations

Based on the discussion, comments and engagement thus far in our Act 174 regional energy planning process, experience with the aforementioned projects and project proposals, and what we know about town policy positions, the WRC is adopting the following overarching policy positions regarding renewable energy siting.

Utility-Scale Wind

- Most areas within the region that are identified as being a prime or secondary wind resource fall within the Productive Rural Lands and Resource Lands areas identified on the Proposed Land Use map of the Windham Regional Plan. Given the nature of utility-scale wind development, which involves considerable blasting, road building, and other permanent alterations of the landscape and surface hydrology, it is deemed to be incompatible with the two aforementioned land use designations.

- Beyond the utility-scale wind project currently under development in Readsboro and Searsburg, as a matter of policy utility-scale wind is deemed incompatible with the land use policies contained within the regional plan. Instead, we would encourage the development of solar energy generation that is compatible with our regional plan land use policies. This would not preclude the development of all wind projects. Community-scale wind (i.e., wind energy generation scaled to serve a defined community such as a village or town) that is supported by towns could be appropriate, as could residential-scale wind (i.e., a project that would serve an individual residence or business).

- The WRC will revisit its policy position on utility-scale wind when the regional plan is next revised (after this revision) to determine if new wind technologies could mitigate problems that currently make it incompatible with land use policies.

Utility-Scale (150kw or greater) Solar[40]

- While utility-scale solar may require clearing, its operation is virtually silent and its development impacts are decidedly less-permanent. Once constructed, solar may create visual impacts but it does not have the noise, vibration, flicker or ice-throwing concerns associated with large wind turbines. Solar would also seem to be more easily adaptable to changes in panel technology. In short, solar is a more compatible land use within the context of our overall land use policies and their intent.

- Utility-scale solar development should be precluded from Resource Lands unless it can be demonstrated that the development of such would provide beneficial habitat diversity that would be endorsed by ANR Wildlife Biologists. This would be similar in approach to other strategic clearings created by the U.S. Forest Service or non-governmental organizations (i.e., Ruffed Grouse Society) for upland birds or other species. Such developments should be no greater than 2 acres in size. There may exist some already impacted areas within Resource Lands boundaries that may be suitable for utility-scale solar power development because of their close proximity to existing power lines. These areas would include former quarries and power line corridors themselves where the agricultural and

40 NOTE: What we define as "utility scale solar" is a subject of ongoing debate. Our inclination is to tie the definition to a recognized threshold of regulatory review, though the real issue is the land use impact. This threshold may be modified in the final plan.

forestry value of the land has already been compromised. In these circumstances, encroachment into non-impacted lands for access roads and other accessory uses shall be avoided or minimized.

• Utility-scale solar development in areas designated as Productive Rural, as well as other land use designations other than Resource Lands, would be limited only by regional plan policies that apply to all other types of development of lands that fall within this designation. Screening should make use of native trees and shrubs that provide habitat and forage for wildlife. In cases where the area around the panel installations will not be grazed by livestock or otherwise used for agricultural production, solar developments should be planted in native perennials that have a high forage value for native pollinators, birds and mammals. In addition to providing habitat, this approach will contribute to the continued building of soils.[41]

• Towns that wish to preclude utility-scale solar development on lands designated by their plans as commercial or industrial, or defined as aesthetically valuable (e.g., scenic corridors or view sheds), are encouraged to establish policies to that effect, and should direct solar development to lands deemed appropriate as a matter of town policy.

• Utility-scale solar developments should have an escrowed decommissioning fund to ensure they are decommissioned after they permanently cease operation.

• Other types of renewable energy development, such as methane digesters or properly-scaled and sited biomass-based generation, specifically combined heat and power projects such as that recently proposed by Allard Lumber for which the WRC awarded a grant, could be appropriate. There may be additional hydro-power opportunities as well, but these would likely be small, run of river installations that make use of existing dams with sound and viable structural integrity.

41 For reference see the following:
http://eanvt.org/wp-content/uploads/2017/04/Pollinator-Friendly-Solar-Summary-03-30-17.pdf;
http://www.audubon.org/news/can-solar-plants-make-good-bird-habitat;
http://www.solarpowerworldonline.com/2017/05/pollinator-friendly-solar-vegetation/;
http://www.beeculture.com/can-solar-sites-help-save-bees/

PART IV

Adaptation & Strategies

WINDHAM REGION ADAPTATION STRATEGIES AND PATHWAYS

Regional energy planning is both relevant and important. While many energy issues are national or global in reach, land use decisions and the way in which the Region develops has a direct and lasting impact on the types of energy needed and the amount of energy input necessary to sustain the function of that development. The Windham Region can lead by example by increasing the efficiency of the region's energy dependent systems, analyzing its current energy usage, looking for critical areas of improvement, and supporting local energy options that benefit its communities. A reliable supply of energy is critical to our society and way of life.

A key premise underlying this energy discussion is the need for significant progress on several fronts:

1. ***Greater diversification of energy sources***, in order to reduce dependency on foreign sources and to increase stability in the event of supply interruptions or cost fluctuations;

2. ***Reduced environmental impacts***, especially regarding greenhouse gas emissions, other air quality impacts and subsequent impacts on water quality and other natural resources[42];

3. ***Increased conservation and efficiency*** in all energy uses in order to reduce costs and environmental impacts, and to reduce the region's vulnerability to energy disruptions;

4. ***Ongoing public education*** regarding the region's energy future and what individuals and towns can do to influence it; and

5. ***Enhanced local self-sufficiency*** in all public policy areas so that the region's quality of life will be resilient to potential supply disruptions or significant cost increases.

INTRODUCTION

Energy has become a global commodity and, as we have learned from human-induced climate change, the combustion of hydrocarbons strongly linked with energy consumption has the capacity to alter the planet in profound and potentially irreversible ways. But energy issues can also be on a local-scale, and has both positive and negative impacts depending upon how it is explored, developed, transported and used. State and local governments, businesses and individuals can best prepare for the future by taking action to

42 Some impacts originate elsewhere, such as acidification and mercury deposition in surface waters from electric power plants to the west of New England, and some locally, such as air impacts of carbon monoxide and soot from gasoline and diesel engines and the inefficient combustion of wood.

diversify energy sources, to improve the efficiency of energy use, to stimulate the use of renewable energy resources, and to implement land use strategies that foster and support sustainable energy.

Vermont's Comprehensive Energy Plan (CEP) lays out an ambitious task for the state: to source 90% of its energy from renewable resources by 2050 (90x50). In order to attain that goal, Vermont and its regions are faced with a considerable challenge; in order for this goal to be practical, every conservation measure must be considered. Future iterations of the CEP are to be informed by regional plans and the experience associated with their implementation. The development of policies, the regulatory and non-regulatory implementation of those policies, and candid, unvarnished assessments of the effectiveness of the policies and their implementation at all levels of government will be essential going forward.

There are a series of intermediate goals which being met, work towards the end goal of 90x50:

- Greenhouse gas reduction goals of 50% from 1990 levels by 2028 and 75% by 2050.
- 25% of energy supplied by renewable resources by 2025 (25 x 25).
- Building efficiency of 25% of homes (80,000 units) by 2020.

These progressive goals require more than the siting of renewable energy generation to accomplish. With an assumed increase in population and growth in commercial and industrial sectors, decreasing our total energy consumption to two thirds the consumption of 2015 by 2050 will require substantial shifts across all sectors (transportation, heating, and electricity). Regional planning commissions, as well as municipalities, need to identify what changes they can directly effect, and what changes are primarily aspirational and which will require effective advocacy at the household, business, and institutional levels as well as in the realm of local, state, federal and international policy and policy administration. For instance, regional planning commissions have no final permitting or decision-making authority with regard to the implementation of their policies, but they must be strong advocates for those policies in permitting processes as well as in legislative and policy promulgation discussions.

The Comprehensive Energy Plan lays out a series of strategies to reduce overall energy consumption across the state (see Appendix 2: Attachment A, on page 64 of this plan). To have this plan applicable to the Windham Region specifically, the Windham Regional Commission gathered its town-appointed Commissioners, stakeholders from professional fields, volunteer organizations, town committee members and managers and administrators to discuss and explore energy saving measures in our Region in three broad policy areas: land use, transportation, and conservation and efficiency (Attachment B lists the Windham Region's adopted policies, see Appendix 3 on page 67). These three policy areas are drivers and indicators of energy consumption and bring the conversation to a more comprehensive perspective than focusing solely on technologies.

The challenges the Windham Region faces with energy consumption relate to each policy area and sector of energy. Because of the rural nature of Vermont and the Windham Region, efficiency in transportation is a seemingly insurmountable obstacle. Personal vehicles have expanded the range of what is considered local. Land use patterns, though traditionally more centered on compact settlements leaving the rest of the land to agriculture, have developed into more dispersed, linear patterns. Some choose to live beyond the "compact settlements" of our downtowns and villages because of preferences related to living in the countryside. But a major challenge we face when it comes to concentrating development in and around these compact settlements is the absence, in many cases, of municipal or community water and wastewater infrastructure to support that settlement pattern. Indeed, in many villages the small lot sizes and septic system "shadows" would preclude the development of any additional dwelling units, as well as the modification or expansion of commercial operations. Conservation and efficiency face challenges in technological advances, affordability, and education. Through the stakeholder discussions, strategies to address these challenges were discovered and resulted in a wealth of innovative ideas and implementable action steps (listed in the "Policy and Implementation Steps" section).

STRATEGIES

Introduction

In discussing strategies for the Region, several themes were recurring across all the policy areas (land use, transportation, and conservation and efficiency). These recurring themes are important as they can inform broad brush policies which could target large impact change across the sectors. These cross-sectional themes were as follows:

- The positive correlation between low density settlements and increased energy consumption.
- The regional infrastructural limitations to compact settlements.
- The role zoning could have on restricting impacts across the sectors.
- The need for increased dependency on shared transportation.
- The need for advances in efficiency technologies to meet the demand and affordability of the Region.
- The importance of education and knowledge sharing while moving towards the long-term goals.

Policies which reflect these needs and target these challenges will have the greatest impact on lowering over-all energy consumption as they touch on all of the sectors. We recognize that while the WRC has a policy, leadership and advocacy role to play associated with each of these themes, it is at the town and state permitting levels where the final decisions get made.

Education was the theme which came up consistently and held the most importance among the stakeholders. As the 90x50 is a long term goal with challenges and opportunities across all sectors, it is important to share strategies and success stories across the region between professionals, town officials, and volunteers and also equally (if not more so) as important to include schools and students. Not only will this instill the knowledge of the importance of becoming more energy independent, but the students and schools act as another means of information dispersal by becoming vectors from their hubs (the schools) into their homes and communities.

Each subject area had themes, policies, and implementation steps towards reducing energy consumption in innovative ways. Below, each subject area is highlighted with solutions and strategies discussed. The implementation steps, policies, and action steps are compiled into one list following this strategy discussion section.

LAND USE

Land use is an important driver and indicator of energy consumption. The two are inextricably related therefore addressing challenges in land use can result in lowering energy consumption. From beginning the discussion on a broader scale, it's important to explore the question "how do we interact with the land and what impacts or implications does that have?" This section addresses this question through discussion on settlement patterns, community design, zoning, natural habitat health, and the food and agriculture sectors.

As discussed briefly above in the Introduction section, dispersed settlement patterns typically result in higher energy consumption, especially when mobility is dependent upon driving. This is due to the lack of efficiency in space, inability for efficient heating distribution, increased energy input to delivery essential services to businesses and residents, and a lack of shared modes of transportation. For future development, a policy of the Region is to encourage infill and compact growth ("smart growth"). However, it is important to note the juxtaposition of stressing a need for compact settlement patterns while being prohibitively limited in municipal facilities for water and sewer. In acknowledgment of this challenge, the stakeholders discussed living machines to treat grey water, constructed wetlands, composting toilets, and nutrient recapturing programs as alternate strategies to this challenge while citing work already being done in the Region by organizations such as the Rich Earth Institute.

THE RICH EARTH INSTITUTE

Rich Earth Institute engages in research, education, and technological innovation to advance the use of human waste as a resource in order to conserve water, prevent pollution, and sustain soil fertility.

Municipal infrastructure was not the only challenge to compact settlement discussed. Discussants felt there is a pervasive ideology amongst Vermont residents to prefer living in isolation, off the land, or secluded from the bustle of society. How can compact settlement patterns become more attractive for residents (and second home owners)? The opportunity lies in design and downtown revitalization. With settlements and downtowns that have thriving mixed use buildings, residents have to travel less to reach amenities (targeting transportation consumption) and also reap the benefits from strong communities while leaving space outside the centers for agriculture, open space, forestry, diverse habitats, and recreation. These communities, in order to cater to those pursuing a more classically rural lifestyle, also pose an opportunity for innovative design of space. With the designed sense of space mirroring that which one would achieve in a more isolated area but with immediate access to amenities and community, compact settlements have the ability to be attractive.

It is a noted trend of the population gravitating to more rural living is reversing as millennials, and increasingly retirees, are choosing to live in closer proximity to amenities. With this general movement, implementing compact settlements may become more achievable over time especially with thriving, mixed use centers.

Zoning is a powerful land use tool that can be employed by towns. Zoning is the regulatory tool by which towns can directly implement their plan policies. In the absence of zoning, towns must rely on the decisions of District Environmental Commissions for projects which fall within the purview of Act 250 (land use) and Section 248 (energy). Strategies for decreasing energy consumption using zoning include: zoning development for more compact settlements and zoning regulations on buildings that enforce a standard of energy efficiency (LED light bulbs, weatherization, passive solar, low flow, composting, and/or urine diverting toilets, etc.).

Though these strategies have thus far targeted reducing the Region's overall energy consumption, it is important to explore how an increased amount of renewable energy generation within the Region will impact the natural communities. Can renewable energy generation sites encourage a diverse range of habitats? Windham Region, though rich in its forestry resources with 86% of the land forested, is lacking in a diversity of habitats. Though generally viewed as a limiting factor to habitat encouragement now, solar fields could serve as a tool in addressing this need. Encouraging biodiversity in the natural communities in the fields can support a variety of species and ecosystems while fostering the health of the soil bringing an added benefit of increased carbon sequestration. This stacking of the land function encourages efficiency in land use as well as the general health of the land. Solar installations also have the potential to provide farmers with a means by which to generate ongoing income from land that is better suited to not being cropped or grazed; an approach that would combine solar generation with habitat and soil conservation and regeneration benefits of programs such as the Conservation Reserve or Wildlife Habitat Improvement programs.

A large portion of energy consumption can be attributed to the food sector. Although not broken out specifically in the current use data discussion, the food system in the United States and Vermont is remarkably energy dependent. The food system depends on high energy inputs from fertilizers, to fuel to run machinery, to energy to process and package the products, to transportation to ship the food from place to place often from far reaching locations. Though Vermont is ahead of the curve in comparison with other areas in the country, seasonality and financial challenges have become roadblocks to local food production and consumption. The stakeholders identified these two areas of agriculture to focus on to support increased efficiencies in the food system.

With Vermont's distinct seasons, agriculture production is generally confined to nature's timeline. Season extension offers the lengthening on that constrained timeline by using technologies like greenhouses to extend the season into earlier spring and later into the fall. By increasing the land's ability to produce longer, the region is able to glean more local food for a greater portion on the year thereby decreasing food miles for imported products.

Agriculture in the Region has been shifting over the years. Following a state-wide trend, the number of dairy farms has significantly decreased and, more recently, the farms have transitioned to smaller diversified agriculture. Stakeholders identified local agriculture as key to addressing inefficiencies in the food sector as it supports the local economy as well as reducing energy inputs into product transportation. Local agriculture takes the market support off of globally sourced products and funnels it into farms within a certain radius. By putting an emphasis on more locally produced food and consumption, it dramatically cuts the fuel input used to transport the product from production to the plate. The Farm to Plate Initiative in Vermont focuses on planning for and supporting this connection. We also recognize, however, that local producers are somewhat dependent upon sales beyond the local region. The goal should be a food system that is more energy efficient in all aspects, and which promotes stewardship of the land and a decent living for all of those who work it.

VERMONT FARM TO PLATE INITIATIVE

Farm to Plate is Vermont's food system plan being implemented statewide to increase economic development and jobs in the farm and food sector and improve access to healthy local food for all Vermonters.

TRANSPORTATION

Transportation, closely tied to land use, is the greatest challenge rural communities face with energy consumption. The Windham Region is not unique in having a rural development pattern in which personal transportation is regarded as a necessity. There is a lack capacity for practical and dependable shared transportation, seasonal changes pose challenges to all types of transportation, the majority of roads are designed for automobiles exclusively, broadband internet access is not reliable in many areas eliminating the possibility of telecommuting (which would still not resolve demand for other non-work related trips), and the convenience of controlling one's own schedule of commuting and other travel demands is highly valued. The Windham Region spends approximately $57 million on fuel alone and as the vast majority of the fleet is powered conventionally, these funds are getting channeled directly out of the Region and State. In order to achieve the 90x50 goal, the light duty fleet is assumed to convert to electric vehicles while, simultaneously, a decrease in single occupancy vehicles is necessary. This plan recognizes the financial barrier in the assumption to convert the fleet to electricity. As electric vehicles have become increasingly more affordable with the increased demand, the state assumes the continuation of the trajectory to make the conversion more viable.

As discussed in the land use portion above, Vermont's as well as Windham Region's settlement patterns are low density and dispersed. Of the 27 towns, there are two regional centers within the Region drawing most of the local traffic within their spheres of influence due to the amenities available there. With few hubs of population confluence, public transportation efficacy is challenged. Though the Region does have several bus services and a train, the schedules are restrictive and not all communities have access to them leaving them underutilized.

Reducing the rate of growth in energy consumption for transportation, our primary energy use, will also have positive economic and environmental effects. The relationship between the use of transportation resources on one hand, and land use decisions and subsequent development patterns on the other, are undeniable, yet trends over time have tended toward less efficiency. Sprawl, discussed in the Land Use section of this plan, is scattered development that increases traffic, increases pressure on local resources and consumes open space, turning farms and forests into rural subdivisions that serve cars better than people. The automobile-based American culture has made this possible. To the extent that society has continued to allow and, in some cases, even encourage sprawl development, society is forcing itself and future generations to spend more money and consume more energy for automobile transportation than would otherwise be necessary. Conservation and efficiency measures may present the greatest—and closest to home—new energy "sources," and interact with transportation policies in many ways, including:

- the extent to which people drive private motor vehicles instead of using public transportation or walking or cycling;
- the extent to which people design and develop communities to favor automobiles over other modes of transportation; and
- the extent to which people choose energy-efficient vehicles when driving.

Though addressing these challenges is a daunting task, several strategies are applicable. Working in tandem off the land use policies and strategies above, an increased emphasis on compact settlement patterns and thriving, mixed use downtowns, transportation energy use can decrease substantially because of the opportunities for public transportation, shared transportation options, and walk-ability. But we must also recognize the development that has already occurred, as well as the fact that residential (primary residences) and commercial development has been relatively static in the region for nearly two decades. As there are 27 towns and existing settlement patterns will continue to be relevant in the years to come, the region can increase the number of park and rides or satellite parking lots with access to public transportation, car share, bike share, and other shared modes of transportation.

Electric Vehicles

As single occupancy vehicles will continue as a necessity for a portion of the population, incentivizing and encouraging that population to invest in electric vehicles (EVs) is paramount. This can be accomplished by increasing access to charging stations (as the demand for EVs increases with the lowering prices, the market will respond by introducing more charging opportunities) and offering free parking for charging EVs.

Alternative Transportation

Alternative transportation options such as shared transportation (carpooling, public transportation, car share) or active transportation (walking and biking) will becoming increasingly relied upon. These two types of transportation face challenges in today's infrastructure and transportation system which accommodates primarily for single occupancy vehicles. These challenges can be addressed by planning for and designing infrastructure which supports these modes.

Shared transportation is a broad term covering carpooling, collectively owned vehicles, car share organizations, bike shares, and others. The website Go! Vermont supports carpooling by providing matches for individuals with similar schedules and destinations. The website is Vermont's agency of Transportation's official site for distributing information on alternative transportation. Boosting the user base, visibility, and accessibility of this site will encourage people to engage in shared transportation. By having shared transportation available and reliable, the commuting population has the option to not invest in a personal vehicle.

Active transportation is one of the easiest ways to reduce energy consumption in the transportation sector. With the only fuel input of human force, the means of transportation is the most fuel efficient, clean, and renewable. The challenge to this mode of transportation is safety concerns. The road systems have traditionally been designed for automobiles rather than alternative transportation modes. By designing complete streets [43] in congested areas and creating bike path and sidewalk connectivity [44], the safety of these modes of transportation are substantially increased.

> From the website:
>
> "Go Vermont is a resource for Vermonters who want to reduce the cost and environmental impact of driving. We offer free carpool matching and vanpool services, and statewide bus routes, as well as free Go! Vermont resources to help you promote more efficient travel."

Along with increasing the safety of active transportation in planning and design, increasing access to these modes of transportation is critical. Programs like bike shares, rebates for electric assist bikes, and tax deductibles for using electric bikes all encourage usership of this mode of transportation.

Seasonality is often viewed as a prohibitive factor to successful alternative transportation. With thriving biking and walking cultures in other areas of the world, however, it proves that the true prohibitive factors are the access people have to the equipment and the safety and security they feel in using it. By bolstering the strategies already available to our region, alternative transportation is more of a possibility than commonly viewed. Places of work can encourage their employees to partake in alternative transportation by having showers available, bargain rates with public transit for employees, bike racks or storage space, flexible hours, among others.

43 Complete streets: Complete Streets are streets for everyone. They are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists, and public transportation users of all ages and abilities are able to safely move along and across a complete street. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from train stations. – National Complete Streets Coalition.

44 Bike path and sidewalk connectivity refers to the continuity of bike paths and sidewalks in a transportation corridor. As bike paths and sidewalks generally have been added to the road system as an addition, often the lanes are not continuous due to the original design of the road.

Another challenge that the transportation sector faces is tourism. The Vermont economy and the economy of the Windham Region depend heavily upon dollars that come in from out of state due to tourists. Although their vehicle miles traveled are not accounted for in the fuel consumption which the current use and projected use data were calculated from, it is important to recognize the large contribution the consumption has. The Region has the opportunity to incorporation alternative transportation into part of Vermont's draw, while also considering that many tourism-related businesses are dependent upon the tourism via car model. The evolution of transportation and mobility with energy in mind will require adaptations. With artisanal beer and cheese tours and Vermont's beautiful scenery already drawing flocks of tourists, combining them with bike tours and the Region's flourishing alternative transportation systems offers great potential.

CONSERVATION AND EFFICIENCY

Conservation and efficiency are broad topics touching most subject areas. Conservation and efficiency can be applied to both the land use and transportation sectors and where these topics intersect they are discussed in greater detail above. Energy conservation and energy efficiency remain prime areas for investment to realize significant savings in energy use. The region should lead by example to increase energy efficiency and to reduce overall energy consumption. Energy efficiency and conservation should be a primary consideration in all development projects, especially with regards to:

- designing and building housing and commercial structures to capture passive heat and light and to use energy more efficiently and conserve it more effectively;
- fostering the development of local and renewable energy sources;
- encouraging federal and state polices that support more local and distributed electricity generation; and
- accepting local and state regulations that would encourage more energy-efficient land use patterns, or that would require more aggressive and longer-range energy planning.

One on the sectors the Regional Energy Plan focuses on is thermal, or heat. Building and zoning codes are tools which can encourage and enforce conservation in buildings. There many technologies currently circulating which can be applied to new and old buildings to boost their performance.

Heating and cooling systems demand approximately one third of the region's energy consumption. Much of this climate control is fueled by fossil fuels however, there are reliable alternatives. Heat pumps which exchange both hot and cold air are powered by electricity. Because the Region is rich with lumber resources, advanced wood heating systems offer both the ability to efficiently heat buildings renewably but also strengthen the local wood industry while bolstering the economy. With clustered development, district heating is an efficient and effective way to heat multiple buildings. For passive cooling, trees can be strategically planted to block direct sun.

To encourage efficiency in buildings methods like zoning and fee alleviation are powerful tools. Zoning, in this case, would require design for passive solar heating, low flow toilets, LED lighting fixtures, among other technologies. As an incentive tool, fees which otherwise would be applied to new structures could be omitted if those structures are net zero[45].

Though not yet developed to its full capacity, storage has the potential to dramatically aid the Region

45 Net zero buildings generate enough renewable energy annually to meet the consumption needs of the building.

in reaching the 90% renewable by 2050 state goal. Storage for renewable energy generation could boost capacity substantially while also feeding into micro-grids. With increased distributive generation, storage and micro-grids bring resilience to communities across the Region and state.

POLICIES AND IMPLEMENTATION STEPS

Conservation and efficiency are the drivers to achieving the 90x50 goal. In land use, transportation, and heating, action steps and implementable policies will bring about the conservation needed to reach the 90x50 goal. Below are listed implementation steps gleaned from the stakeholder discussions in Windham Region. Attachment A (Appendix 2, page 66) contains sample policy statements generated by the Department of Public Service which can be deemed applicable to the Windham Region.

6. Promote recognition of and activity with NeighborWorks and Heat Squad activity for Eastern Vermont as technical support for weatherization.
7. Promote programs which support a regional push to perform energy audits for all public buildings.
8. Wave building permit fees for new homes designed for net-zero buildings.
9. Increase education on conservation and efficiency by incorporating the topics into school curricula including tours of efficient buildings, hands-on conservation projects, and involvement in school building energy conservation measures.
10. Organize regular region-wide knowledge sharing forums where organizations, towns, and individuals can bring strategies, innovations, and information about conservation and efficiency.
11. Prioritize both new construction and buildings as well as old boilers in need of upgrade to convert to renewable heating.
12. Incorporate complete street design into transportation plans.
13. Increase park and rides/satellite parking lots with access to car shares, bike shares, and public transportation.
14. Decrease downtown parking.
15. Encourage development by smart growth principal guidelines.
16. Promote the Go!Vermont app as centralized online space for organizing carpooling.
17. Wave registration fee for electric vehicles.
18. Free parking for EV's at charging stations.
19. Support a carbon tax.
20. Revitalize village downtowns to reduce the need for longer commutes for amenities and work.
21. Incorporate the cost of greenhouse gas emission into product pricing.
22. Cover cropping as required agricultural practice.
23. Conduct regional study (followed by implementation) of where best to add satellite parking lots to bring accessibility of public transportation and shared transportation to majority of towns.
24. Encourage low grade lumber industry by increasing local market in modern wood heat.

PART V

Appendix

CONTENTS

APPENDIX 1: WINDHAM REGION LEAP SYSTEM MODELING

Summary Results and Methodology

Introduction

This document supplements the regional energy plans created by each Regional Planning Commission (RPC). It was developed by Vermont Energy Investment Corporation (VEIC) as documentation to modeling work performed for the RPCs. An award from the Department of Energy's SunShot Solar Market Pathways program funded the creation of a detailed statewide total energy supply and demand model. The VEIC team used the statewide energy model as a foundation for the region-specific modeling efforts. More detailed methodology is included at the end of this report.

Statewide Approach

Historic information was primarily drawn from the Public Service Department's Utility Facts 2013[1] and EIA data. Projections came from the Total Energy Study (TES)[2], the utilities' Committed Supply[3], and stakeholder input.

Demand Drivers

Each sector has a unit that is used to measure activity in the sector. That unit is the "demand driver" because in the model it is multiplied by the energy intensity of the activity to calculate energy demand.

The population change for each region is calculated from town data in Vermont Population Projections 2010-2030[4]. Growth rates are assumed constant through 2050.

RPC	Annual Growth
Addison	0.00%
Bennington	0.02%
Central VT	0.12%
Chittenden	0.48%
Lamoille	1.46%
Northwest	0.87%
NVDA	0.21%
Rutland	-0.27%
Southern Windsor	0.24%
Two Rivers	0.29%
Windham	0.34%

[1] Vermont Public Service Department, Utility Facts 2013. http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Utility_Facts/Utility%20Facts%202013.pdf

[2] Vermont Public Service Department, Total Energy Study: Final Report on a Total Energy Approach to Meeting the State's Greenhouse Gas and Renewable Energy Goals. December 8, 2014. http://publicservice.vermont.gov/sites/psd/files/Pubs_Plans_Reports/TES/TES%20FINAL%20Report%2020141208.pdf.

[3] Vermont Public Service Department provided the data behind the graph on the bottom half of page E.7 in Utility Facts 2013. It is compiled from utility Integrated Resource Plans.

[4] Jones, Ken, and Lilly Schwarz, Vermont Population Projections-2010-2030, August, 2013. http://dail.vermont.gov/dail-publications/publications-general-reports/vt-population-projections-2010-2030.

People per house are assumed to decrease from 2.4 in 2010 to 2.17 in 2050. This gives the number of households, the basic unit and demand driver in the model for residential energy consumption.

Projected change in the energy demand from the commercial sector was based on commercial sector data in the TES. The demand driver for the commercial sector is commercial building square feet which grow almost 17% from 2010 to 2050.

The team entered total industrial consumption by fuel from the TES directly into the model. It grows from 1.1 TBtu in 2010 to 1.4 TBtu in 2050.

Transportation energy use is based on projections of vehicle miles traveled (VMT). VMT peaked in 2006 and has since declined slightly.[5] Given this, and Vermont's efforts to concentrate development and to support alternatives to single occupant vehicles, VMT per capita is assumed to remain flat at 12,000.

The regional models use two scenarios. The **reference scenario** assumes a continuation of today's energy use patterns, but does not reflect the Vermont's renewable portfolio standard or renewable energy or greenhouse gas emissions goals. The main changes over time in the reference scenario are more fuel efficient cars because of CAFE standards and the expansion of natural gas infrastructure. The **90% x 2050 $_{\text{VEIC}}$ scenario** is designed to achieve the goal of meeting 90% of Vermont's total energy demand with renewable sources. It is adapted from the TES TREES Local scenarios. It is a hybrid of the high and low biofuel cost scenarios, with biodiesel or renewable diesel replacing petroleum diesel in heavy duty vehicles and electricity replacing gasoline in light duty vehicles. Despite a growing population and economy, energy use declines because of efficiency and electrification. Electrification of heating and transportation has a large effect on the total demand because the electric end uses are three to four times more efficient than the combustion versions they replace.

Regionalization Approach

The demand in the statewide model was broken into the state's planning regions. Residential demand was distributed according to housing units using data from the American Community Survey. Commercial and industrial demand was allocated to the regions by service-providing and goods-producing NAICS codes respectively. Fuel use in these sectors was allocated based on existing natural gas infrastructure. In the commercial sector, it was assumed that commercial fuel use per employee has the same average energy intensity across the state. All commercial natural gas use was allocated to the regions currently served by natural gas infrastructure, and the rest of the fuel was allocated to create equal consumption by employee.

[5] Jonathan Dowds et al., "Vermont Transportation Energy Profile," October 2015. http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/Vermont%20Transportation%20Energy%20Profile%202015.pdf.

The industrial sector was assumed to be more diverse in its energy consumption. In the industrial sector, natural gas was allocated among the regions currently served by natural gas based on the number of industrial employees in each region. Other non-electric fuels were distributed among regions without access to natural gas, as it was assumed that other non-electric fuels were primarily used for combustion purposes, and that purpose could likely be served more cheaply with gas. Transportation demand was primarily regionalized through population. The passenger rail sector of transportation demand was regionalized using Amtrak boarding and alighting data to create percentages of rail miles activity by region.[6] The freight rail sector of transportation was regionalized using the following approach: in regions with freight rail infrastructure, activity level was regionalized by share of employees in goods-producing NAICS code sectors. Regions without freight rail infrastructure were determined using a Vermont Rail System map and then assigned an activity level of zero.[7] A weighting factor was applied to regions with freight rail infrastructure to bring the total activity level back up to the calculated statewide total of freight rail short-ton miles in Vermont. Each region's share of state activity and energy use is held constant throughout the analysis period as a simplifying assumption.

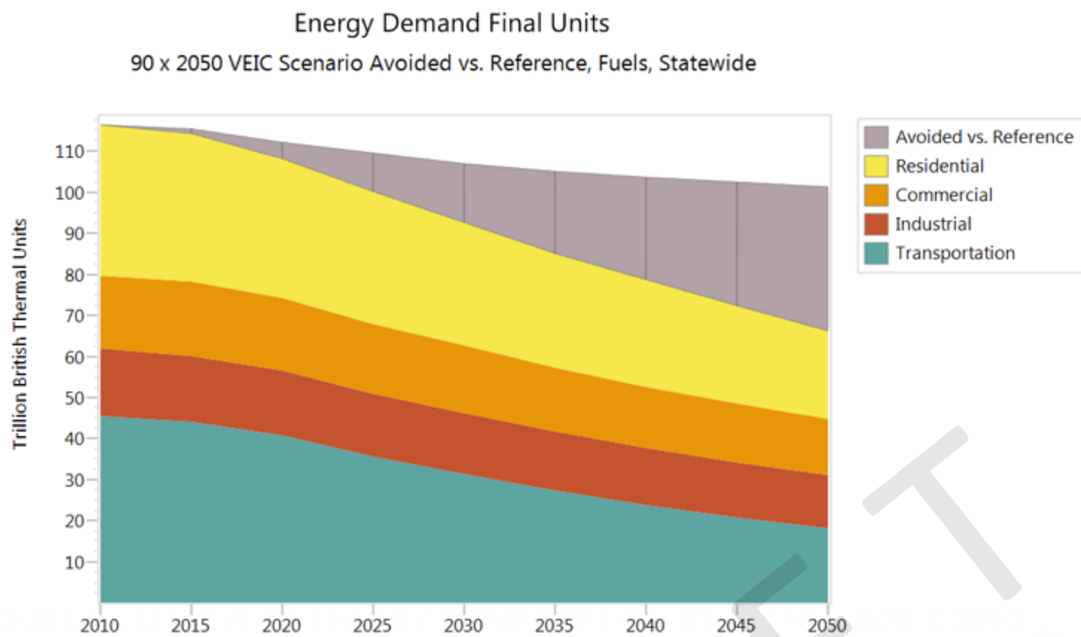
Results

The numbers below show the results of the scenarios in "final units," sometimes referred to as "site" energy. This is the energy households and businesses see on their bills and pay for. Energy analysis is sometimes done at the "source" level, which accounts for inefficiency in power plants and losses from transmission and distribution power lines. The model accounts for those losses when calculating supply, but all results provided here are on the demand side, so do not show them.

The graphs below show the more efficient 90% x 2050 $_{\text{VEIC}}$ scenario, which is one path to reduce demand enough to make 90% renewable supply possible. This scenario makes use of wood energy, but there is more growth in electric heating and transportation to lower total energy demand. Where the graphs show "Avoided vs. Reference," that is the portion of energy that we do not need to provide because of the efficiency in this scenario compared to the less efficient Reference scenario.

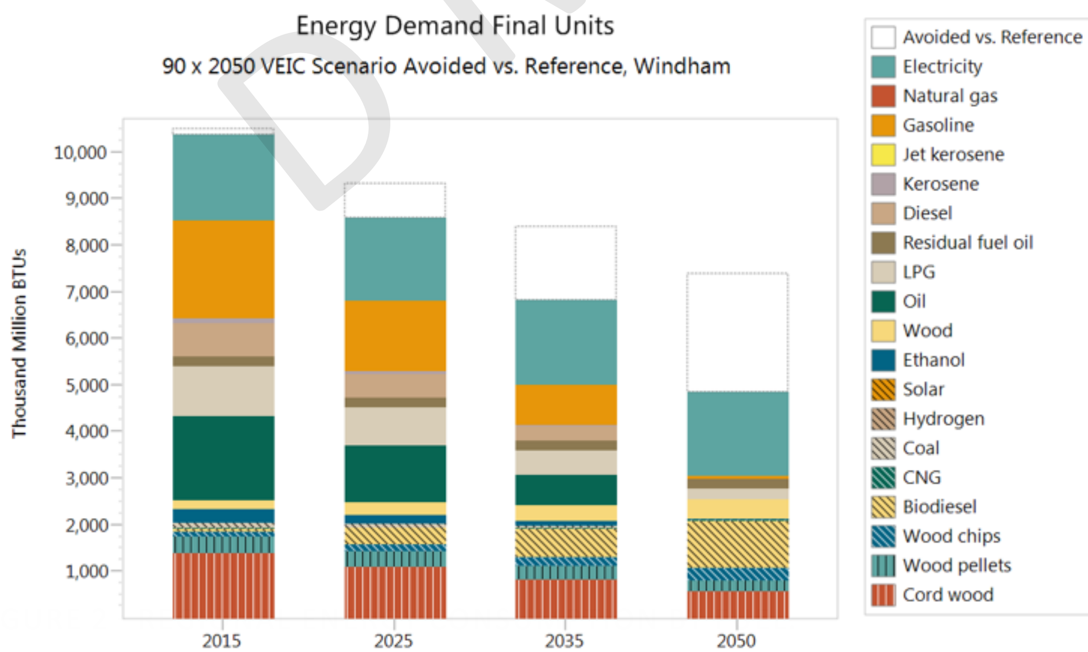
[6] National Association of Railroad Passengers, "*Fact Sheet: Amtrak in Vermont,*" 2016. https://www.narprail.org/site/assets/files/1038/states_2015.pdf.
[7] Streamlined Design, "*Green Mountain Railroad Map*" (Vermont Rail System, 2014). http://www.vermontrailway.com/maps/regional_map.html.

STATEWIDE TOTAL ENERGY CONSUMPTION

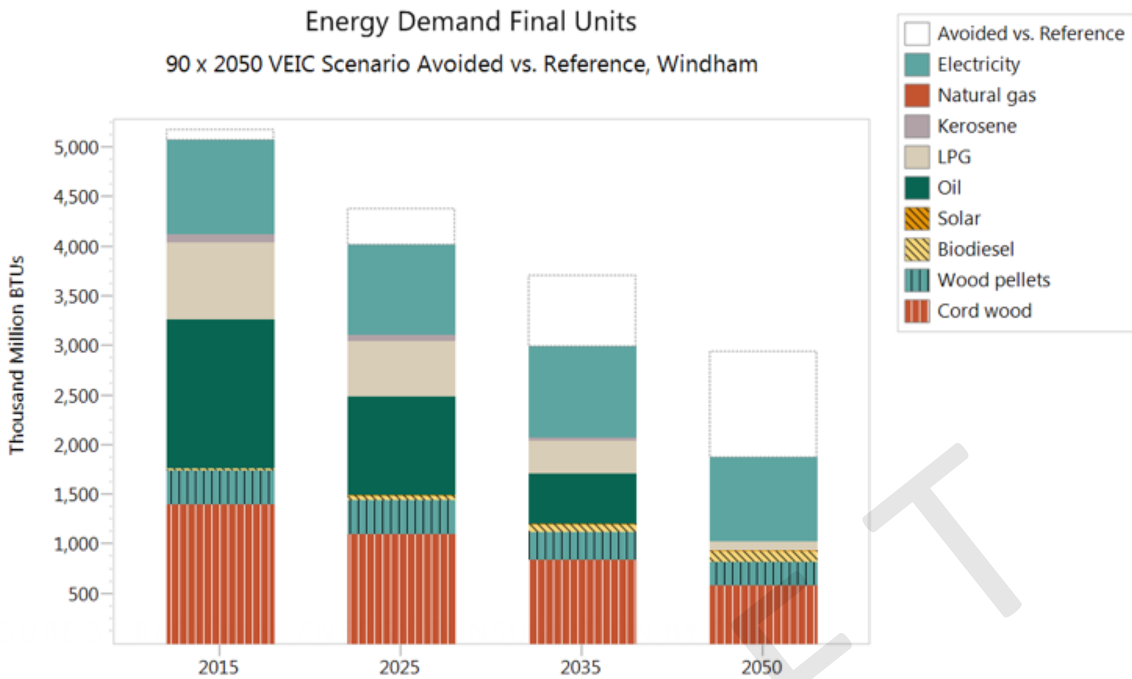


NARIO

REGIONAL TOTAL ENERGY CONSUMPTION



REGIONAL ENERGY CONSUMPTION BY SECTOR



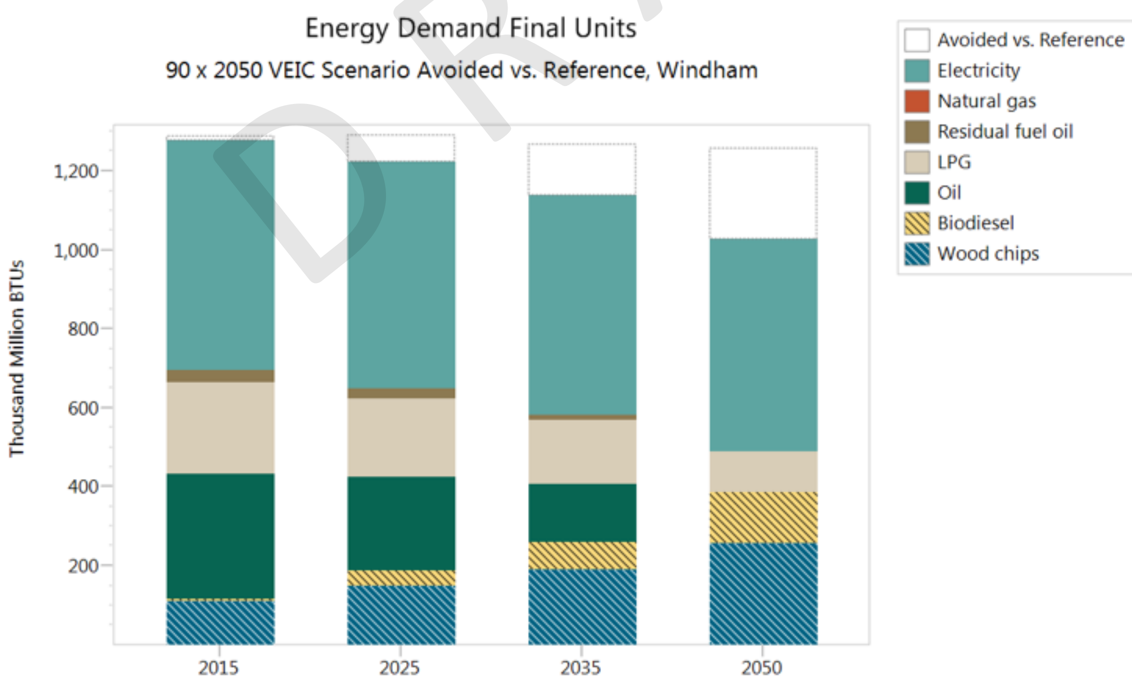


FIGURE 4 - REGIONAL COMMERCIAL ENERGY CONSUMPTION BY FUEL.

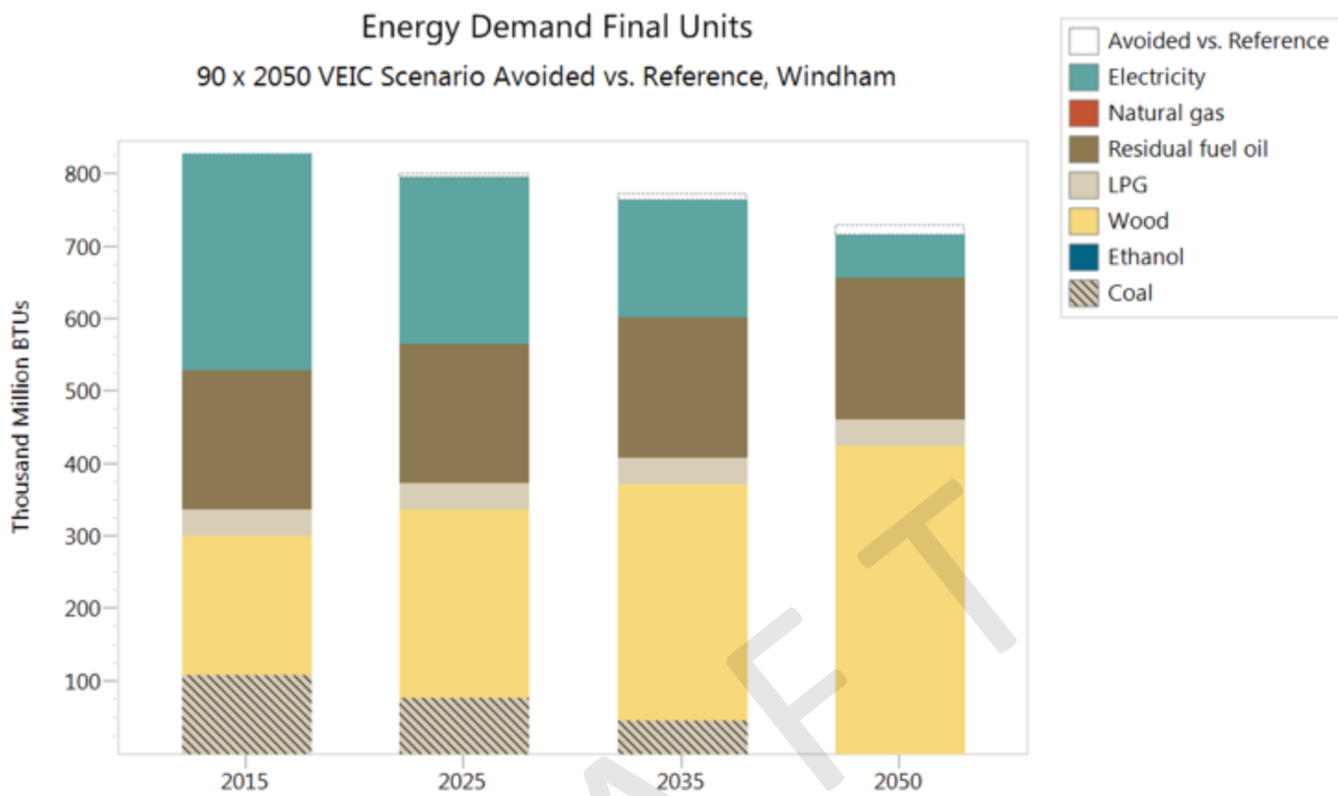


FIGURE 5 - REGIONAL INDUSTRIAL ENERGY CONSUMPTION BY FUEL.

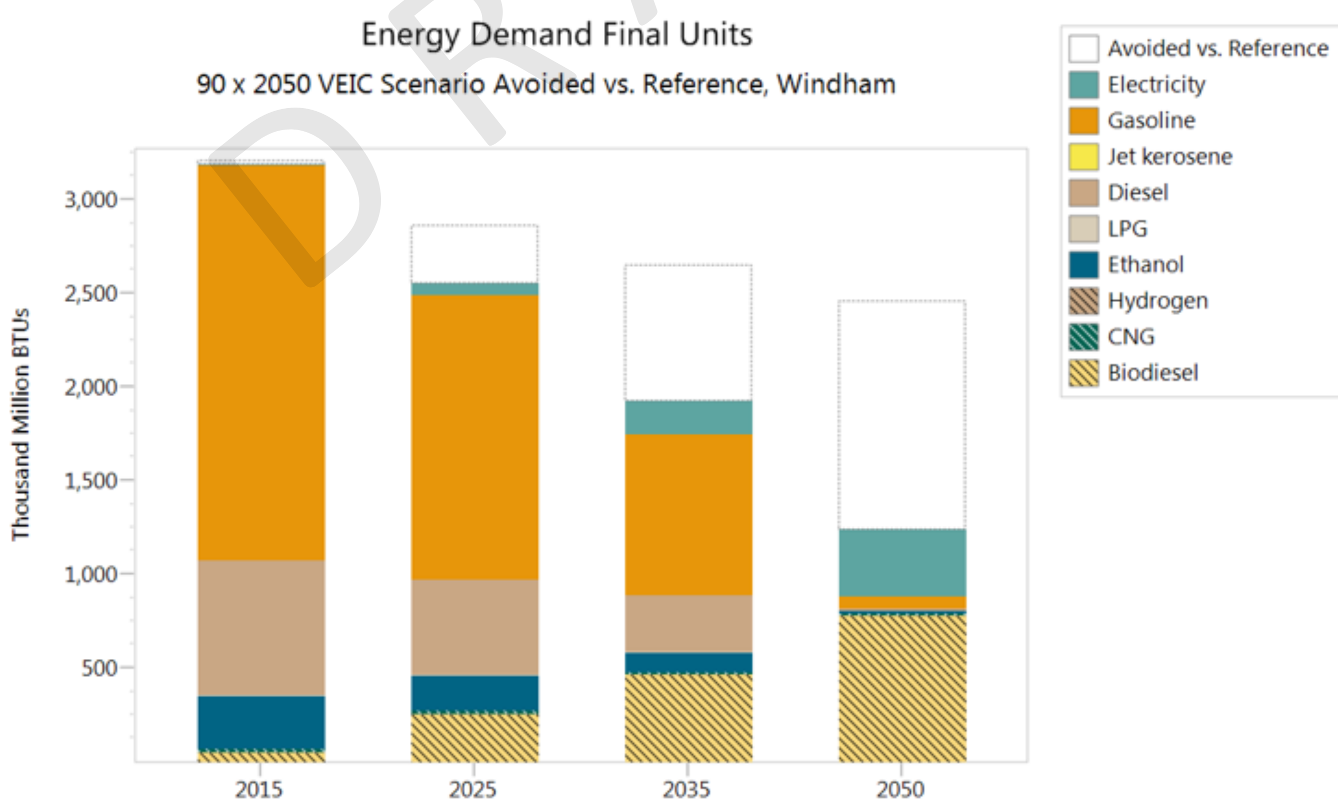


FIGURE 6 - REGIONAL TRANSPORTATION ENERGY CONSUMPTION BY FUEL.

Detailed Sources and Assumptions

Residential

The TES provides total fuels used by sector. We used a combination of industry data and professional judgement to determine demand inputs at a sufficiently fine level of detail to allow for analysis at many levels, including end use (heating, water heating, appliances, etc.), device (boiler, furnace, heat pump) or home-type (single family, multi-family, seasonal, mobile). Assumptions for each are detailed below. All assumptions for residential demand are at a per-home level.

Space Heating

The team determined per home consumption by fuel type and home type. EIA data on Vermont home heating provides the percent share of homes using each type of fuel. 2009 Residential energy consumption survey (RECS) data provided information on heating fuels used by mobile homes. Current heat pumps consumption estimates were found in a 2013 report prepared for Green Mountain Power by Steve LeTendre entitled Hyper Efficient Devices: Assessing the Fuel Displacement Potential in Vermont of Plug-In Vehicles and Heat Pump Technology. Future projections of heat pump efficiency were provided by Efficiency Vermont Efficient Products and Heat Pump program experts.

Additional information came from the following data sources:

- 2010 Housing Needs Assessment [8]
- EIA Vermont State Energy Profile[9]
- 2007-2008 VT Residential Fuel Assessment[10]
- EIA Adjusted Distillate Fuel Oil and Kerosene Sales by End Use[11]

The analyst team made the following assumptions for each home type:

- Multi-family units use 60% of the heating fuel used by single family homes, on average, due to assumed reduced size of multi-family units compared to single-family units. Additionally, where natural gas is available, the team assumed a slightly higher percentage of multi-family homes use natural gas as compared to single family homes, given the high number of multi-family units located in the Burlington area, which is served by the natural gas pipeline. The team also assumed that few multi-family homes rely on cordwood as a primary heating source.

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[8] Vermont Housing and Finance Agency, "2010 Vermont Housing Needs Assessment," December 2009. http://www.vtaffordablehousing.org/documents/resources/623_1.8_Appendix_6_2010_Vermont_Housing_Needs_Assessment.pdf.

[9] U.S. Energy Information Administration, "Vermont Energy Consumption Estimates", 2004. https://www.eia.gov/state/print.cfm?sid=VT

[10] Frederick P. Vermont Residential Fuel Assessment: for the 2007-2008 heating season. Vermont Department of Forest, Parks and Recreation. 2011.

[11] U.S. Energy Information Administration, "Adjusted Distillate Fuel Oil and Kerosene Sales by End Use," December 2015. https://www.eia.gov/dnav/pet/pet_cons_821usea_dcu_nus_a.htm.

• Unoccupied/Seasonal Units: On average, seasonal or unoccupied homes were expected to use 10% of the heating fuel used by single family homes. For cord wood, we expected unoccupied or seasonal homes to use 5% of heating fuel, assuming any seasonal or unoccupied home dependent on cord wood are small in number and may typically be homes unoccupied for most of the winter months (deer camps, summer camps, etc.)

• Mobile homes—we had great mobile home data from 2009 RECS. As heat pumps were not widely deployed in mobile homes in 2009 and did not appear in the RECs data, we applied the ratio of oil consumed between single family homes and mobile homes to estimated single family heat pump use to estimate mobile home heat pump use.

• The reference scenario heating demand projections were developed in line with the TES reference scenario. This included the following: assumed an increase in the number of homes using natural gas, increase in the number of homes using heat pumps as a primary heating source (up to 37% in some home types), an increase in home heated with wood pellets, and drastic decline in homes heating with heating oil. Heating system efficiency and shell efficiency were modeled together and, together, were estimated to increase 5-10% depending on the fuel type. However, heat pumps are expected to continue to rapidly increase in efficiency (becoming 45% more efficient, when combined with shell upgrades, by 2050). We also reflect some trends increasing home sizes.

• In the 90% x 2050 $_{\text{VEIC}}$ scenario, scenario heating demand projections were developed in line with the TES TREES Local scenarios, a hybrid of the high and low biofuel cost scenarios. This included the following: assumed increase in the number of homes using heat pumps as a primary heating source (up to 70% in some home types), an increase in home heated with wood pellets, a drastic decline in homes heating with heating oil and propane, and moderate decline in home heating with natural gas. Heating system efficiency and shell efficiency were modeled together and were estimated to increase 10%-20% depending on the fuel type. However, heat pumps are expected to continue to rapidly increase in efficiency (becoming 50% more efficient, when combined with shell upgrades by 2050). We also reflect some trends increasing home sizes.

Lighting
Lighting efficiency predictions were estimated by Efficiency Vermont products experts.

Water Heating
Water heating estimates were derived from the Efficiency Vermont Technical Reference Manual. [12]

Appliances and Other Household Energy Use:
EnergyStar appliance estimates and the Efficiency Vermont Electric Usage Chart[13] provided estimates for appliance and other extraneous household energy uses.

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[12] Efficiency Vermont, "*Technical Reference User Manual (TRM): Measure Savings Algorithms and Cost Assumptions*, No. 2014-87," March 2015. http://psb.vermont.gov/sites/psb/files/docketsandprojects/electric/majorpendingproceedings/TRM%20User%20Manual%20No.%202015-87C.pdf.

[13] Efficiency Vermont, "*Electric Usage Chart Tool,*" https://www.efficiencyvermont.com/tips-tools/tools/electric-usage-chart-tool.

Using the sources and assumptions listed above, the team created a model that aligned with the residential fuel consumption values in the TES.

Commercial

Commercial energy use estimates are entered in to the model as energy consumed per square foot of commercial space, on average. This was calculated using data from the TES.

Industrial

Industrial use was entered directly from the results of the TES data.

Transportation

The transportation branch focused on aligning with values from the Total Energy Study (TES) Framework for Analysis of Climate-Energy-Technology Systems (FACETS) data in the transportation sector in the Business as Usual (BAU) scenario. The VEIC 90% x 2050 scenario was predominantly aligned with a blend of the Total Renewable Energy and Efficiency Standard (TREES) Local High and Low Bio scenarios in the transportation sector of FACETS data. There were slight deviations from the FACETS data, which are discussed in further detail below.

Light Duty Vehicles

Light Duty Vehicle (LDV) efficiency is based on a number of assumptions: gasoline and ethanol efficiency were derived from the Vermont Transportation Energy Profile.[14] Diesel LDV efficiency was obtained from underlying transportation data used in the Business as Usual scenario for the Total Energy Study, which is referred to as TES Transportation Data below. Biodiesel LDV efficiency was assumed to be 10% less efficient than LDV diesel efficiency.[15] Electric vehicle (EV) efficiency was derived from an Excel worksheet from Drive Electric Vermont. The worksheet calculated EV efficiency using the number of registered EVs in Vermont, EV efficiency associated with each model type, percentage driven in electric mode by model type (if a plugin hybrid vehicle), and the Vermont average annual vehicle miles traveled. LDV electric vehicle efficiency was assumed to increase at a rate of .6%. This was a calculated weighted average of 100-mile electric vehicles, 200-mile electric vehicles, plug-in 10 gasoline hybrid and plug-in 40 gasoline hybrid vehicles from the Energy Information Administration Annual Energy Outlook.[16]

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[14] Jonathan Dowds et al., "*Vermont Transportation Energy Profile*," October 2015. http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/Vermont%20Transportation%20Energy%20Profile%202015.pdf.

[15] U.S. Environmental Protection Agency: Office of Transportation & Air Quality, "*Biodiesel*," Www.fueleconomy.gov, accessed August 19, 2016. https://www.fueleconomy.gov/feg/biodiesel.shtml.

[16] U.S. Energy Information Administration, "*Light-Duty Vehicle Miles per Gallon by Technology Type,*" Annual Energy Outlook 2015. 2015, https://www.eia.gov/forecasts/aeo/data/browser/#/?id=50-AEO2016&cases=ref2016~ref_no_cpp&sourcekey=0.

Miles per LDV was calculated using the following assumptions: data from the Vermont Agency of Transportation provided values for statewide vehicles per capita and annual miles traveled.[17] The total number of LDVs in Vermont was sourced TES Transportation Data. The calculated LDV miles per capita was multiplied by the population of Vermont and divided by the number of LDVs to calculate miles per LDV.

The number of EVs were sourced directly from Drive Electric Vermont, which provided a worksheet of actual EV registrations by make and model. This worksheet was used to calculate an estimate of the number of electric vehicles using the percentage driven in electric mode by vehicle type to devalue the count of plug-in hybrid vehicles. Drive Electric Vermont also provided the number of EVs in the 90% x 2050 $_{\text{VEIC}}$ scenario.

Heavy Duty Vehicles

Similar to the LDV vehicle efficiency methods above, HDV efficiency values contained a variety of assumptions from different sources. A weighted average of HDV diesel efficiency was calculated using registration and fuel economy values from the Transportation Energy Data Book.[18] The vehicle efficiency values for diesel and compressed natural gas (CNG) were all assumed to be equal.[19] Diesel efficiency was reduced by 10% to represent biodiesel efficiency.[20] Propane efficiency was calculated using a weighted average from the Energy Information Administration Annual Energy Outlook table for Freight Transportation Energy Use.[21]

In the 90% x 2050 $_{\text{VEIC}}$ scenario, it was assumed HDVs will switch entirely from diesel to biodiesel or renewable diesel by 2050. This assumption is backed by recent advances with biofuel. Cities such as Oakland and San Francisco are integrating a relatively new product called renewable diesel into their municipal fleets that does not gel in colder temperatures and has a much lower overall emissions factor.[22] Historically, gelling in cold temperatures has prevented higher percentages of plant-based diesel replacement products.

Although there has been some progress toward electrifying HDVs, the VEIC 90% x 2050 scenario does not include electric HDVs. An electric transit bus toured the area and gave employees of BED, GMTA, and VEIC a nearly silent ride around Burlington. The bus is able to fast charge using an immense amount of power that few places on the grid can currently support. The California Air Resources Board indicated

[17] Jonathan Dowds et al., "Vermont Transportation Energy Profile."
[18] Ibid.
[19] "Natural Gas Fuel Basics," Alternative Fuels Data Center, accessed August 19, 2016. http://www.afdc.energy.gov/fuels/natural_gas_basics.html.
[20] U.S. Environmental Protection Agency: Office of Transportation & Air Quality, "Biodiesel."
[21] U.S. Energy Information Administration (EIA), "Freight Transportation Energy Use, Reference Case," Annual Energy Outlook 2015, 2015. http://www.eia.gov/forecasts/aeo/data/browser/#/?id=58-AEO2015&region=0-0&cases=ref2015&start=2012&end=2040&f=A&linechart=ref2015-d021915a.6-58-AEO2015&sourcekey=0.
[22] Oregon Department of Transportation and U.S. Department of Transportation Federal Highway Administration, "Primer on Renewable Diesel," accessed August 29, 2016. http://altfueltoolkit.org/wp-content/uploads/2004/05/Renewable-Diesel-Fact-Sheet.pdf.

a very limited number of electric HDVs are in use within the state.[23] Anecdotally, Tesla communicated it is working on developing an electric semi-tractor that will reduce the costs of freight transport.[24]

The total number of HDVs was calculated using the difference between the total number of HDVs and LDVs in 2010 in the Vermont Transportation Energy Profile and the total number of LDVs from TES Transportation Data.[25] HDV miles per capita was calculated using the ratio of total HDV miles traveled from the 2012 Transportation Energy Data Book and the 2012 American Community Survey U.S. population estimate.[26,27] The total number of HDVs and HDV miles per capita were combined with the population assumptions outlined above to calculate miles per HDV.

Rail

The rail sector of the transportation branch consists of two types: freight and passenger. Currently in Vermont, freight and passenger rail use diesel fuel.[28,29] The energy intensity (Btu/short ton-mile) of freight rail was obtained from the U.S Department of Transportation Bureau of Transportation Statistics.[30] A 10-year average energy intensity of passenger rail (Btu/passenger mile) was also obtained from the U.S Department of Transportation Bureau of Transportation Statistics.[31] Passenger miles were calculated using two sets of information. First, distance between Vermont Amtrak stations and the appropriate Vermont border location were estimated using Google Maps data. Second, 2013 passenger data was obtained from the National Association of Railroad Passengers.[32] Combined, these two components created total Vermont passenger miles. We used a compound growth rate of 3% for forecast future passenger rail demand in the 90% x 2050 $_{\text{VEIC}}$ scenario, consistent with the historical growth rates of rail

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[23] California Environmental Protection Agency Air Resources Board, "Draft Technology Assessment: Medium- and Heavy-Duty Battery Electric Trucks and Buses," October 2015. https://www.arb.ca.gov/msprog/tech/techreport/bev_tech_report.pdf.
[24] Elon Musk, "Master Plan, Part Deux," Tesla, July 20, 2016. https://www.tesla.com/blog/master-plan-part-deux.
25 Jonathan Dowds et al., "*Vermont Transportation Energy Profile.*"
[26] "Transportation Energy Data Book: Edition 33" (Oak Ridge National Laboratory, n.d.), accessed August 18, 2016.
[27] U. S. Census Bureau, "Total Population, Universe: Total Population, 2012 American Community Survey 1-Year Estimates," American Fact Finder, 2012. http://factfinder.census.gov/bkmk/table/1.0/en/ACS/12_1YR/B01003/0100000US.
[28] US Energy Information Administration (EIA), "*Freight Transportation Energy Use, Reference Case.*"
[29] Vermont Agency of Transportation Operations Division - Rail Section, "Passenger Rail Equipment Options for the Amtrak Vermonter and Ethan Allen Express: A Report to the Vermont Legislature," January 2010. http://www.leg.state.vt.us/reports/2010ExternalReports/253921.pdf.
[30] U.S. Department of Transportation: Office of the Assistant Secretary for Research and Technology Bureau of Transportation Statistics, "Table 4-25: Energy Intensity of Class I Railroad Freight Service," accessed August 26, 2016. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_25.html.
[31] U.S. Department of Transportation: Office of the Assistant Secretary for Research and Technology Bureau of Transportation Statistics, "Table 4-26: Energy Intensity of Amtrak Services," accessed August 26, 2016. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_26.html.
[32] National Association of Railroad Passengers, "*Fact Sheet: Amtrak in Vermont,*" 2016. https://www.narprail.org/site/assets/files/1038/states_2015.pdf.

passenger miles in Vermont.[33] Passenger rail is assumed to completely transform to electric locomotion. Freight rail is assumed to transform to biodiesel or renewable diesel.

Air

The total energy of air sector used appropriate FACETS data values directly. The air sector is expected to continue using Jet Fuel in both scenarios.

[33] Joseph Barr, AICP et al., "*Vermont State Rail Plan: Regional Passenger Rail Forecasts.*"

APPENDIX 2:

Attachment A
Policies from Department of Public Service

Below are listed example policies generated by the Department of Public Service. They may or may not prove to fit well with the Windham Region context. Refer to the Regional Energy Plan Guidance Document.

Coordinate with and promote Energy Efficiency Utility (EEU) programs and the state Weatherization Assistance Program for low-income households and encourage residents to participate.

Co-sponsor and organize weatherization workshops for homes and businesses with EEUs.

Identify available electric, natural gas, and deliverable fuel (oil, propane) Energy Efficiency Utility program resources and make web links available on municipal/regional websites.

o Electric EEU – Efficiency Vermont (statewide) and City of Burlington Electric Department (funded through the electric energy efficiency charge)

o Natural Gas EEU – Vermont Gas Systems (funded through the natural gas energy efficiency charge)

o Unregulated Fuels – Thermal Energy and Process Fuel programs

Work with partner organizations and EEUs to offer workshops and educational opportunities to businesses on efficiency in new construction, retrofits, and conservation practices.

Identify large energy usage customers (including large businesses, manufacturing facilities, and schools) as a target audience and encourage participation in commercial and industrial EEU programs.

Facilitate a workshop and/or conduct building walk-throughs for owners of rental housing (including farm labor housing) to encourage implementation of energy efficiency.

Encourage residents to hire Efficiency Excellence Network (EEN) contractors when completing energy efficiency projects by including links to the EEN on municipal/regional websites4.

Facilitate strategic tree planting to maximize energy benefits.

Promoting Energy Efficient Buildings

Promote the use of Vermont's residential building energy label/score.

Promote the use of the residential and commercial building energy standards by distributing code information to permit applicants and ensuring code compliance6.

Promote benchmarking (using the free EPA Portfolio Manager tool and/or with assistance from the EEU's) for commercial buildings.

Include policies that promote or require residential projects to follow the residential stretch energy code.

Include policies that require commercial Act 250 projects to follow commercial stretch energy guidelines.

Promote the construction of net-zero ready buildings by including a discussion of such buildings in the plan and identifying educational opportunities as an implementation action.

Promote the use of landscaping for energy efficiency.

Promote the use of cold climate heat pumps with education/presentations in coordination with the EEUs/electric utilities.

Support the use of ground-source heat pump heating and cooling systems for new construction.

Identify potential locations for wood-fired district heating. For example, locations with a high concentration of buildings (two or more buildings) with space for a central heat plant and/or where there is a large building that could be an anchor for an district heating system that also supplies heat to neighboring buildings.

Provide examples of model ordinances related to district heating projects that require access to town and/or state rights-of-way.

Provide examples of municipal-owned district heating systems including sample documents needed for setting up a district heating service.

Identify managed forest lands closest to the identified potential district heat locations that could supply wood chips to the project

Identify regional/town businesses that make, sell, and/or transport wood chips and/or wood pellets that could be used in a district heat system.

Encourage, promote, and incentivize advanced wood heating by: supporting the conversion of existing fossil fuel heating systems to wood; encouraging local manufacturing of advanced wood heat technology; supporting development of wood fuel delivery infrastructure; supporting development of sustainable forestry and procurement services; expanding wood fuel processing facilities, encouraging bulk wood pellet delivery systems; and providing training and education on the benefits of heating with efficient, clean wood energy systems.

Promote wood stove change-out programs that take older non-EPA certified stoves out of service and replace them with more efficient and lower emitting cord and pellet stoves.

Encourage new construction to install advanced wood heating equipment.

Participate in education campaigns to provide best practices on cordwood and wood pellet selection, storage, and combustion to promote the most efficient, clean, and cost-effective use of wood heating technology while protecting human and environmental health.

Identify any businesses that have a need year-round need for process heat. Encourage these businesses to look into wood fired-fired combined heat and power

Regions should encourage the development of the biomethane sector by supporting proposals for appropriately sited, cost-effective biomethane production facilities and related infrastructure.

Identify potential producers of food and farm waste (farms, food processors, restaurants/schools/institutions with food waste) that could potentially host a farm or food waste digester.

Promoting Consumer Awareness of the Benefits of and Access to EVs and Alternative-Fuel Vehicles

Work with local employers and nonprofit partners such as the Vermont Energy and Climate Action Network and Vermont League of Cities and Towns to encourage broader implementation of EV incentives, such as free or reduced parking costs for EV and fuel-efficient vehicle owners and preferential access to parking spaces limited in supply.

Promote the Drive Electric Vermont webpage, which connects users to financial incentives, dealers, and recharging stations for EVs.

Contact local vehicle dealers to encourage them to offer EV and fuel-efficient vehicles by both sale and lease. Encourage local media and chambers of commerce to provide positive visibility for supplying EVs.

Partner with Drive Electric Vermont, nonprofit organizations, vehicle dealers, and/or state agencies to organize high-visibility events where people can see and test drive EVs, such as county fairs, energy fairs, and summer festivals. Events should also leverage local newspaper and public access coverage to showcase local residents and organizations that are helping to propel the transition to EVs.

Encourage major employers in the community that operate private fleets (for example garbage collection, public transit, colleges and universities, or milk transportation) to switch some of their vehicles to electric or biodiesel-fueled vehicles. Help build awareness of related grant opportunities.

Host a "show and tell" day featuring different kinds of EVs and giving people interested in purchasing them an opportunity to talk with fellow community members who own them.

Deploying EV Infrastructure at Workplaces and Key Public Locations

Assess current access to public and workplace charging (to the extent known) in the community or region and identify strategic locations in busy areas (large employers or areas of high visitation in downtowns) where charging stations should be added or expanded.

Regions should partner with Drive Electric Vermont, the Vermont Clean Cities Coalition, and other organizations to promote the expansion of workplace charging, in particular by continuing funding for incentives that help employers cover the costs of installing charging stations.

Regions should encourage the electric utility operating in their service area to invest in charging infrastructure and to build awareness of charging opportunities as part of their strategy for complying with the state's Renewable Energy Portfolio Standard

Regions should promote and seek grants to fund the installation of DC fast-charging infrastructure at strategic locations along major travel corridors and in transit hubs such as park-and-ride locations.

Plan, advocate for, and consider requiring the installation of Electric Vehicle charging infrastructure as part of new or redevelopment, especially for developments subject to Act 250.

Support the development of additional refueling stations for alternative fuels for both private and public transportation fleets by sharing station development costs between public and private interests.

Work with the Clean Cities Coalition to encourage large fleets to switch to natural gas use where biodiesel is impractical, in areas of the state where natural gas is available. Encourage the use of renewable natural gas through Vermont Gas's forthcoming renewable natural gas green pricing program.

Public and private stakeholders should continue to develop a sustainable biofuels industry in Vermont to enable the production and use of biofuels for transportation, agricultural, and thermal applications.

APPENDIX 3:

Attachment B
Adopted Windham Regional Goals and Policies

Below are the adopted policies from the Windham Regional Plan and the Windham Regional Transportation plan. The full Windham Regional Plan can be accessed here and the Transportation Plan accessed here.

TRANSPORTATION

Land Use Policies

25. Weigh the secondary growth effects that often result from transportation infrastructure improvements and determine if the benefits of the improvements outweigh the costs to existing historical, cultural, and environmental assets.
1. Minimize functional conflicts and require that developers be responsible for relieving new traffic impacts generated by their developments.
2. Avoid strip development and minimize the negative effects of existing strip development.
3. Preserve village character through appropriate design and scale of commercial, industrial, residential, transportation infrastructure and community structures and uses.
4. Preserve and create Right-of-Ways for future transportation linkages between communities, neighborhood services, and other destinations.
5. Avoid extension of roads into and through Resource Lands.

Energy Policies

6. Support emissions standards that reduce regionally generated air pollutants from transportation related activities.
7. Promote the reduction of vehicle miles traveled in Vermont through public education, expanded public transit infrastructure, rideshare programs and, park and ride facilities.
8. Promote alternative fuel vehicles and the infrastructure necessary to fuel those vehicles.
9. Require all development projects to incorporate elements that reduce reliance on single occupancy vehicles, such as providing access to public transit, installing pedestrian and bicycle network links, or providing access to ride-sharing programs.
10. Support efforts to minimize energy consumption, especially non-renewable energy resources, and explore expanded use of alternative fuels.
11. Integrate traffic designs in designated downtowns and village centers that limit idling and calm traffic.

Freight Policies

12. Maintain, improve, and expand passenger and freight rail services.
13. Encourage businesses and industries with high freight demands to locate within the rail corridor, improving mobility of goods by rail.

Public Transportation

14. Implement an integrated, multi-modal transportation system in the urban centers; providing

connections between rail, air, bus, car, bike, and pedestrian.

15. Integrate the use of energy efficient and alternative modes of transportation into community plans and development.
16. Establish effective and efficient public transit services to meet the needs of transit dependent populations and to better serve the general public.
17. Establish a safe and convenient regional system of park & ride lots to encourage ride-sharing.
18. Include transit orientated development in any proposed project.
19. Incorporate public transportation into planned transportation improvements for resort centers.
20. Create new and expand existing public transit services to fulfill intercity and intra-regional demand.

Active Transportation

21. Incorporate ADA regulations and guidelines into all pedestrian projects.
22. Require provision of appropriate pedestrian and bicycle facilities in new development projects.
23. Review and accommodate for non-motorized transportation, such as bicycle lanes, wider shoulders and sidewalks in roadway and bridge projects.
24. Preserve and encourage creation of Rights of Way for future linkages between communities, neighborhoods services and other destinations.

Land Use

1. Direct new growth, such as jobs, housing, commerce, public infrastructure, industry, community facilities, into appropriate development types (regional centers, commercial/industrial areas, rural commercial, resort centers, and villages). New growth should give attention to the type and scale of the existing form, in order to keep these centers culturally, socially, and economically viable. In-fill development and "brownfield" redevelopment are encouraged in these areas.
2. Utilize strategies that increase the energy efficiency of new and existing development. All Major projects reviewed under Act 250 shall provide evidence demonstrating how the development is energy efficient from a regional land use perspective, including projected transportation, heating, and electricity needs.
3. Preserve the historic and architectural character of the region. Support the reuse and repurposing of viable existing structures to retain historic development patterns, densities, and character in the region, especially within regional centers, villages, and hamlets.
4. Consider current and future housing requirements when evaluating business development and expansion projects. Encourage measures that will establish and maintain an adequate housing stock for area workers that satisfy a diversity of needs and income levels.
5. Develop master plans for the transformation of existing rural commercial areas, as identified on the Proposed Land Use Map, into areas serving a mix of uses, offering diversified transportation options and planned infill locations, while also conforming to traditional historic development patterns.
6. Where strip development has already occurred beyond villages and growth centers, promote redevelopment that reflects the historic development patterns of existing hamlets and villages. Strip development in known floodplains and fluvial erosion hazard areas that has experienced past damage should be considered for floodplain restoration and hazard mitigation opportunities.
7. Concentrate ski resort expansion and secondary growth to minimize the trend toward dispersed/sprawl development. All ski resort development shall be reviewed and approved as part of a development master plan before any individual development projects are approved in order to assess cumulative impacts of the potential growth of the development.
8. Plan for and develop public infrastructure, including water and sewer systems, that promotes and enables greater densities in development centers, including regional centers, villages, resort centers,

commercial/industrial sites, and growth areas as identified by town plans.

9. Develop and expand hamlets in a form that maintains traditional density and residential settlement pattern within the Windham Region. Encourage towns to enable this pattern of development in town land use regulations.

10. Provide guidance and training on regulatory and non-regulatory tools for open space and resource protection available to towns for use in town plans and regulations. Encourage implementation of tools such as conservation subdivision, clustered development, and variable lot size in all subdivision development, and especially within rural residential and productive rural lands.

11. Use open space plans and resource protection techniques to protect agriculture, forest, mineral, and Resource Lands from development and fragmentation. Encourage town open space planning and help coordinate those planning efforts through the development of a regional Open Space Plan.

12. Require all major projects reviewed under Act 250 to mitigate any loss of prime agricultural and/or forest land as a result of the development.

13. Promote critical resource areas by educating towns and the public on the importance of preserving exceptional natural resources. Preserve critical resource areas by identifying key sites and by assisting towns in incorporating provisions in their town plans and land use regulations to protect them (and, as appropriate, restore them).

14. Strongly discourage all development in Resource Lands for purposes other than forestry and agriculture. Any development proposed within critical resource areas shall provide evidence as to why the development cannot be avoided, and shall provide mitigation for natural resources impacted by the development.

15. Require that the benefits of any mitigation occurring as a result of a proposed development within the Windham Region be directed to the Windham Region.

Energy

1. Ensure that all energy generation, transmission, and distribution projects further the regional goals for providing a reliable, sufficient, and economical energy supply to the region, promoting energy conservation and efficiency, and furthering the development of energy sources that have zero or low GHG emissions.

2. Work with the State, utility companies, and other energy suppliers to create a regional energy profile as a foundation for planning to meet future regional energy needs and to provide guidance on energy development in our member towns.

3. Support the State in achieving its Total Renewable Energy and Comprehensive Energy Plan goals through avenues that maintain an adequate, reliable, and economical energy supply without causing undue adverse impacts to humans and the environment.

4. Support cost-effective energy efficiency and energy conservation measures, and programs such as Efficiency Vermont to help reduce energy costs in the region.

5. Support incorporation of high-efficiency energy systems, sized appropriately to the energy need, and located in close proximity to the user base.

6. Support the advancement of Smart Grid technology to allow businesses and residents to make informed choices about their energy usage and expenditures by monitoring when they are using energy, how much they are using, and how much it costs.

7. Require that new development and renovations, at minimum, meet State commercial and residential energy building codes. Encourage development to utilize strategies to increase the energy efficiency, including consideration of transportation energy use, on-site generation and heating systems, and reuse/repurposing of existing structures.

8. Provide and distribute educational information on:
   a. Energy conservation techniques;

b. Energy-efficient products and weatherization programs;
c. Available energy options and their respective impacts and costs; and
d. Opportunities for energy diversification and locally based energy sources.

9. Encourage an economically competitive energy supply through increased operation efficiencies, technology upgrades, and availability of low-cost fuels, including natural gas.
10. Balance improved efficiency and conservation measures with the need for new generation and transmission infrastructure to ensure adequate future energy supplies. Support requirements that utilities improve the efficiency of procedures and infrastructure and assist customers to conserve energy and reduce costs.
11. Support the continued availability and use of net metering electrical systems, including both individual and group net metering installations.
12. Encourage a shift toward zero and low-GHG emission energy sources, including the capture of methane gas and its conversion to useful energy.
13. Require sustainable sources and practices for all biomass and bio-fuel projects to ensure that projects create a net reduction in GHG emissions, protect the working landscape, capture and reuse waste heat, and follow verifiable stewardship practices.
14. Support sound energy facility siting practices by ensuring that new developments give adequate attention to facility siting requirements, development constraints, natural resource protection, and land use compatibility.
15. With regard to all energy generation, transmission, and distribution projects:

a. Adhere to a high environmental standard that includes avoiding negative environmental impacts to the extent possible and adequately minimizing and mitigating those that cannot be avoided;
b. Conduct thorough and proper studies and analyses of all anticipated socioeconomic and environmental impacts, both positive and negative;
c. Adequately address all areas of concern regarding proposed developments; and
d. Effectively and adequately address all issues related to facility operation and reliability.

16. Facilitate public participation as an integral part of the decision-making process for siting, evaluating, and relicensing energy generation, transmission, and distribution facilities and for electric utility deregulation.
17. Facilitate inter-town conversations about appropriately scaled and sited generation sources, which include consideration of the wishes of residents regarding the meaning of "appropriate" as expressed in their town plans. The WRC recognizes that host towns and abutting towns may have different goals in this area, and will use its best efforts to gain consensus and/or cooperation among them.

Regional Economy

1. Work with BDCC and other organizations to attract and retain youth in the region by identifying and addressing barriers to their settling here, by providing targeted educational and skill training opportunities, and by creating meaningful career options with livable wages.
2. Promote activities and development that contribute to a strong and diverse economy, providing satisfying and rewarding job opportunities for citizens in all parts of the region and supporting a strong municipal tax base, while maintaining environmental standards and promoting environmental justice.
3. Generate a variety of stable, year–round jobs with wages and other compensation that provide a livable income, and that include skills training programs and other benefits that contribute to the personal development and quality of life for all workers, particularly in areas with high unemployment or high numbers of workers earning less than a livable wage.
4. Utilize existing financial, physical, and technical resources to facilitate economic development, including the creative use and revitalization of suitable existing space for manufacturing and industrial activities, commerce, housing, and the arts.

5. Develop and assist the growth of small businesses including home businesses and entrepreneurial ventures that help preserve and revitalize communities.
6. Support educational programs in technical and trade skills, as well as basic skills such as math and communications, in order to improve the value of opportunities for the region's workforce, both entry–level and advanced.
7. Support the transition of Vermont Yankee employees into new jobs and industries through the development of specific job re-training programs, and entrepreneurial support strategies.
8. Encourage development of land-based industries, focusing on the production, distribution, and marketing of agricultural and forestry products and programs from within the region in a manner that maximizes the sustainable use of these resources, minimizes and repurposes waste, and promotes the economic, physical, and environmental well-being of our communities and their residents.
9. Promote the economy through tourism activities that emphasize the character of the region itself: its beauty, culture, history, wildlife, and outdoor recreation.
10. Support the arts and culture industry by encouraging increased use of community resources, improved cultural opportunities for all residents, and enhanced year-round tourism.

NATURAL RESOURCES

Forest Resources

1. Maintain a high-value, forested landscape in the region composed of large, contiguous parcels by supporting programs such as Use Value Appraisal and encouraging the use of conservation subdivision models, conservation easements, and purchase and ownership of lands for conservation purposes by land trusts, state and local government, or other similar organizations.
2. Support the harvest and use of lower grade timber to ensure full use of the forest resource and help protect the region from the threat of wildfire destruction.
3. Encourage public, industrial, and private landowners to maintain and enhance forest resources on their lands, and to follow sustainable forest management practices that provide habitat for diverse natural species, avoid high grading of timberlands, and follow Acceptable Management Practices.
4. Support the management and eventual eradication of invasive species in the region through activities such as provision of education materials, sponsorship of workshops on best management practices, encouraging the involvement of community organizations, and requiring the eradication or mitigation of invasive species as a condition on permits for development where the introduction or spread of invasive species is likely.
5. Maintain the Vermont tradition of public access to forested lands by encouraging preservation of historic access points and promoting public access connections in development proposals.
6. Continue to support the Vermont Use Value Appraisal (Current Use) Program—a program critical to the forest resource in the region—on a fully funded basis.
7. Support organizations and educational programs that teach or demonstrate sustainable forestry and Acceptable Management Practices, to facilitate understanding and appreciation of the environmental, economic, and recreational benefits offered by the region's forest resource.

Surface Waters

8. Maintain and restore the chemical, biological, and physical quality of the region's surface water per the objective in State water regulations.
9. Maintain undisturbed buffers of vegetation along watercourses, lakes, ponds, wetlands, and vernal pools consistent with State regulations and the highest precedent established by the District Environmental Commission and State Environmental Court in order to protect shorelines, provide shading to prevent

undue increase in stream temperatures, to minimize effects of erosion, sedimentation and other sources of pollution, and to maintain scenic, recreational, and habitat values.

10. Evaluate the licensing or re licensing of hydroelectric power generating facilities on a case by case basis in a manner that supports other provisions of this plan.

11. Maintain any designated Class I wetlands in their natural condition. Ensure that any permitted alterations to Class II and Class III wetlands do not significantly diminish their functional, ecological, or aesthetic values. All projects of regional importance shall provide evidence that onsite wetlands have been field checked and verified by an environmental official or State agency representative.

12. Evaluate inter basin transfers of water on a case by case basis and require project proposals to demonstrate that the water quality in both the sending and receiving basins will not be significantly lowered, that the water table and stream flow in the sending basin will not be detrimentally lowered, and that peak flows in the receiving basin will not be detrimentally increased. For purposes of this policy, a basin is the drainage area of a watercourse that is at least 1,000 acres in area.

13. Encourage towns and community organizations to identify critical resource areas in the region and support efforts to protect these exceptional natural resources.

14. Support surface water classification and management strategies which are consistent with the municipal and regional land use planning objectives for the affected watershed, and which will effectively maintain or improve existing water quality.

15. Maintain water flows in streams at levels that support a full range of in stream uses and values.

16. Require flood hazard and/or fluvial erosion hazard mitigation for development proposals in the floodway, floodplain or fluvial erosion hazard zone.

17. Support State regulations and programs to protect surface waters from run-off and sedimentation caused by agriculture, forestry, recreation, and development activities through the use of tools such as: Acceptable Agricultural Practices (AAP's), Acceptable Management Practices (AMP's) for forestry, and Best Management Practices (BMP's) for erosion control.

Groundwater

18. Avoid contamination of groundwater from the drilling of wells through the use of proper drilling technology and appropriate well placement.

19. Require small-quantity generators of hazardous waste to have storage and disposal plans demonstrating that water contamination risks have been minimized. Support efforts to make appropriate disposal of small-quantities of hazardous waste convenient and effective in the region.

20. Support the Department of Environmental Conservation Water Supply Division in regulating and monitoring water withdrawal from underground sources to ensure that aquifers and surface waters are not significantly depleted, and that water is properly allocated. Promulgation of specific laws and regulations to control water withdrawal and to ensure minimum flows is encouraged.

Soils and Topography

21. Require developers to take special precautions on slopes to avoid environmental damage, including negative consequences associated with erosion and landslides.

a. Minimize areas of earth disturbance, grading, and vegetation clearing on slopes over 15 percent;

b. Design development on slopes over 15 percent such that it minimizes the potential impacts of slides and earthquakes; and

c. Avoid development (other than appropriately designed recreational trails and ski lifts) in areas with slopes exceeding 25 percent or above 2,500 feet in elevation.

22. Require detailed site studies to determine suitability for development where steep slopes occur with

shallow soils. Ensure that all development proposals on such soils provide and conform to a site drainage plan and an erosion control plan for construction phases of the development.

23. Avoid development on wet soils, mucks, clays, silts, and other unstable soils that offer poor support for foundations or footings or that are subject to slippage.

24. Ensure that gravel extraction does not have negative impact on groundwater, surface waters, recreation sites, scenic areas, and special community resources. Future access to gravel resources should be considered in development proposals. Best practices are to be used to minimize dust, noise, and other degradation of air quality.

25. Ensure that effective site rehabilitation plans are provided and implemented for new development projects.

Natural Areas, Fragile Areas and Wildlife Resources

26. Protect Natural Areas, Fragile Areas, wildlife corridors, and important plant and animal habitats.

27. Protect Natural and Fragile Areas from development. When development is proposed near a natural or fragile area a buffer strip, designed in consultation with the appropriate state agency, must be designated and maintained between the development and any natural or fragile area.

28. Support state, federal, and private acquisition of land and/or conservation easements to protect and connect important wildlife habitats and to encourage designation of State Natural and Fragile Areas.

29. Support local, regional, state and federal programs and incentives that encourage private and public landowners to recognize the economic importance of protecting, maintaining and enhancing fish and wildlife habitats and ecosystems.

Air Quality

30. Require that development activities meet state and federal standards for air quality and noise.

Scenic Resources

31. Encourage towns to identify their scenic resources and support efforts for their enhancement and maintenance.

32. Encourage donation of scenic easements to public agencies or to private conservation organizations.

33. Require that the scale, siting, design, and management of new development maintains or enhances the landscape and protects high quality scenic landscapes and scenic corridors as identified by town plans.

34. Minimize visual impacts of high-elevation or ridgeline structures through co-location, design, siting, and color choice. Design and site high-elevation tower structures so that they do not require nighttime illumination.

35. Require illumination of structures and exterior areas only at levels necessary to ensure safety and security of persons and property. Require arrangement of all exterior lighting so that the light source (lamp) is not directly visible from public roads, adjacent residences or distant vantage points. Require shielding of exterior lighting so that the light does not project above the lamp. Discourage exterior area illumination of regionally prominent physical features and landscapes.

36. Plan new or improve existing roads so that they maintain or enhance scenic resources.

37. Screen new development from I-91 and other scenic roads and rivers, as identified by town plans, to the greatest extent practicable using vernacular perimeter plantings of hedges, hedgerows, and street trees.

Housing

1. Promote a diversity of housing stock within the region offering safe, adequate, accessible, and affordable housing to meet the needs of all residents across the entire income spectrum and increase opportunities for owner-occupied housing.

2. Develop housing in a manner that maintains the historic settlement pattern of compact village and

urban centers separated by rural countryside, and that has minimal impact on natural resources, open space, floodplains, fluvial erosion hazard zones, and important agricultural and forest lands.

3. Implement innovative planning, design, and construction techniques that minimize the long term cost and energy consumption of housing, including locating housing convenient to community centers, in proximity to transportation centers, in a compact development arrangement, and employing energy efficient construction techniques.
4. Promote and facilitate the design and retrofit of life safety and accessibility improvements in housing units.
5. Assist the coordination between public and private agencies involved in planning and financing of affordable housing, including alternative mechanisms such as land trusts, cooperative housing, limited equity cooperatives, and others.
6. Ensure that publicly funded projects do not revert to market-driven housing through support of Vermont Housing and Conservation Board (VHCB) covenants that restrict resale to eligible households, VHCB Mortgage Deeds, and Windham and Windsor Housing Trust (WWHT) agreements that restrict resale prices.
7. Support rehabilitation and maintenance of existing affordable housing stock.
8. Support affordable housing projects and encourage waiving of fees, tax credits and property tax abatement, and assistance with public grants and other sources of funding.
9. Facilitate opportunities for housing that is affordable to the region's workforce. All Major Act 250 applications for development that will create fifty new full time equivalent positions shall provide evidence that there is existing available and affordable housing stock for the new employees within a thirty mile commuter shed. If housing that meets this requirement is not available, the development shall include affordable housing within the project or a mitigation payment to be used for affordable housing in the Windham Region.

EDUCATIONAL, CULTURAL, & RECREATIONAL RESOURCES

Educational System

1. Increase the availability, affordability, and accessibility of childcare.
2. Encourage school construction and renovation projects in existing developed areas such as downtowns and village centers in order to take advantage of existing infrastructure, encourage walking and bicycling to school where appropriate, and to enhance revitalization of communities.
3. Encourage and contribute to the ongoing debate about sources and efficiencies of educational funding.
4. Support efforts of libraries to provide materials, technology and facilities for independent learning and development of life long education.
5. Increase offerings for workforce training and adult education programs in the region, and help coordinate partnerships to ensure these programs are well-suited to both the self-employed and employer needs of the region.
6. Facilitate increased opportunities for public and private cooperation in offering vocational and basic competency training to employees and future employees of area businesses and industry.

Media Resources

7. Support greater penetration of public access, educational and government programming (PEG) through new PEG group formation and regional agreements. Encourage cable companies and other video programming service providers to support PEG operating and capital budgets. Encourage cable television companies to provide coverage of regular town meetings and other important local events as part of their cable franchise agreements.
8. Support increased access to information about local events in user-friendly electronic formats.

9. Encourage increased access for residents to state and local public meetings and hearings through Vermont Interactive Television, PEG channels, and other electronic means.

Cultural and Historic Resources

10. Foster and encourage a vibrant local arts/cultural community through assistance and support for local arts friendly facilities, organizations, education, art marketing, and distribution efforts.
11. Support organizational and communication networks serving the region to promote the enhancement of cultural opportunities.
12. Protect places of outstanding educational, aesthetic, archeological, or historical value by discouraging development that would adversely affect these cultural resources, including their destruction or alteration, alteration of surroundings, or the introduction of non-harmonious visual or audible elements. Require mitigation of negative impacts in projects that create unavoidable conflicts.
13. Encourage preservation of significant historic sites or structures through support of ownership, protective easements, and/or other regulatory options.
14. Support rehabilitation and adaptive reuse of significant historic sites and structures.
15. Support local, regional, and State non profit historic preservation trusts.

Recreation

16. Provide varied and accessible opportunities for outdoor recreation.
17. Facilitate the orderly development of needed public and private recreational facilities.
18. Recognize the recreational potential of watercourses and shorelines and encourage provision of facilities for sustainable water-oriented day use that does not impair the resource or related habitat.
19. Protect existing trail corridors and encourage use of abandoned railroad beds, Class 4 roads and other public rights-of-way for future trail development and public access.
20. Encourage federal, state, and local acquisition of land and facilities well-suited for outdoor recreation, provided that adequate financial and management arrangements are made with the involved local governments.
21. Support United States Forest Service acquisition, other than by eminent domain, of private in-holdings within and selected lands adjacent to the Green Mountain National Forest, and adjacent to the Conti Natural Wildlife Area, provided that adequate payments in lieu of taxes are made to the affected local governments by the U.S. Forest Service.
22. Increase public opportunities for multiple-use recreation and for public access to recreation lands. Ensure provision of separate areas or facilities for conflicting uses of recreational resources when such conflicts create safety hazards or significantly impair the use or enjoyment of the resource.

Utilities, Facilities, & Technology

1. Maximize water conservation when planning for development through mechanisms such as low-flow fixtures, water-efficient technologies, and, where appropriate, computerized control systems in order to limit demands on public water supplies.
2. Assist towns and the Agency of Natural Resources (ANR) to develop and disseminate educational material explaining how to reduce hazardous elements and compounds that pose a risk of release to water and soil resources.
3. Support the acquisition of future public and quasi-public utility sites, properties, or interests, and assist towns with identifying these sites for future development

Public and Private water supplies

4. Develop or extend municipal water mains to only those areas where future development is appropriate, including regional centers, villages, resort centers, commercial/industrial locations as identified by town plans, or in areas where extension is required for public health purposes.

5. Review land development within existing or planned wellhead protection areas to ensure that it will not pose a threat of contamination to public water supplies.
6. Minimize erosion and runoff to protect public and private water supplies by maintaining town roads consistent with Best Management Practices for erosion control.
7. Encourage testing of private water supplies for total coliform bacteria annually, and inorganic compounds and alpha radiation at five year intervals to protect public health.

Wastewater Treatment

8. Support environmentally sound and affordable wastewater treatment, including research regarding the viability of alternative on site management systems such as composting toilets and gray water recycling.
9. Educate town representative and the public about the importance of adequately investing in the maintenance of existing public wastewater infrastructure and, where appropriate, the construction of new systems to protect public health.
10. Plan development so as to manage wastewater effectively and to maintain surface and groundwater quality.
11. Support development of new wastewater treatment facilities in areas where future growth is appropriate, including regional centers, villages, resort centers, commercial/industrial locations, and growth centers as identified by town plans, and in areas where extension is required for public health purposes.
12. Encourage installation of community wastewater treatment systems in villages, hamlets, and in clustered housing developments, and ensure that agreements for those facilities adequately provide for ongoing maintenance and oversight.
13. Work with municipalities to improve outreach to on-site sewage disposal system owners through provision of guidance material explaining how to properly maintain their systems. Support development of model pumping ordinance language.
14. Support programs to assist with the replacement of failed on-site sewage disposal systems.

Solid Waste Management

15. Support regulations that govern the safe disposal of all wastes, including hazardous wastes. Encourage all towns to support and participate in regional or state sponsored household hazardous waste collection programs.
16. Support federal, state, and local actions that reduce the volume and toxicity of solid waste in the Windham Region, including implementation of Act 148.
17. Work with solid waste entities and towns to plan for waste disposal needs, including regulations under Act 148, through the establishment of recycling, composting, waste reduction and reuse, and general waste management programs, while addressing public health, environmental quality, and impacts on adjacent and nearby land uses.
18. Support the assessment of waste disposal fees that accurately and fairly charge disposal costs to the waste generators.
19. Work with the District Environmental Commission to satisfy waste management requirements in Act 250 land use permit applications, as appropriate.

Radioactive Waste

20. Ensure the safe and effective storage, transportation, and disposal of low level radioactive waste (LLRW).
21. Work to assure that standards proposed for a LLRW storage site in Vermont are at least as stringent as those applied to any alternative site.
22. Minimize the generation of LLRW and high level radioactive waste (HLRW).
23. Support increased local and regional public involvement regarding all spent nuclear fuel permitting and licensing decisions.

Emergency Planning

24. Build disaster resistant and resilient communities by promoting sound land use planning that accounts for known hazards.

25. Encourage towns and the State of Vermont to continue to improve and adopt road, bridge and culvert codes and standards.
26. Encourage towns to require that all new public and private roads and driveways are properly constructed so that they do not contribute to the damage of town roads from stormwater.
27. Support a regional effort to develop a hazard plan for each town according to FEMA guidelines that stresses disaster mitigation and post-disaster resiliency through coordinated efforts.
28. Encourage towns to adopt and implement flood and fluvial erosion hazard area regulations.
29. Encourage the development and improvement of emergency evacuation plans and local emergency operations plans.
30. Encourage the inclusion of provisions for pets and livestock in town disaster plans.
31. Explore efforts to develop a regional emergency response plan that includes surrounding areas in Vermont, New Hampshire, and Massachusetts.

Emergency Response

32. Provide timely and effective emergency services to all persons regardless of their ability to pay.
33. Provide fire hydrants or other water sources in proposed developments so that fire fighting personnel can adequately serve all structures.
34. Design and build new roads so that emergency vehicles can readily maneuver and access all proposed structures.
35. Ensure that the additional emergency service personnel, facilities, and equipment needed to effectively service new development are available to avoid placing undue demands on existing resources.
36. Support the development and installation of an additional or improved emergency communications infrastructure, systems, and procedures.

Communications infrastructure

37. Promote universal access to broadband telecommunications and information services that are competitive in availability and cost.
38. Encourage reduced rates on advanced telecommunications services, equipment, and user training for libraries, educational, and health care facilities. Support local access to diverse life-long distance learning opportunities and to low-cost public-use computers for internet access.
39. Encourage modernization and expansion of transmission and receiving equipment at existing transmission and receiving stations, including co-location of radio communications.
40. Encourage siting, design, and access to communications towers and structures to provide quality transmission and to minimize negative impacts on natural and scenic resources.
41. Require that communications towers and structures be set back from property lines and public rights of way, such that the tower or structure will not cross the aforementioned lines or rights of way in the event of a collapse.

Human Services

42. Support the development of appropriate facilities to provide for child care, eldercare, and care for persons with disabilities in the region.
43. Assist the coordination of community service organizations to avoid duplication of effort, as is feasible and appropriate.

APPENDIX 4: WINDHAM REGIONAL ENERGY MAPS

Maps for Energy Planning
Windham Regional Commission

WRC has used GIS data layers supplied by the State of Vermont (specifically, the Vermont Center for Geographic Information) to create regional maps for our energy planning efforts, and the efforts of others, including towns. These data layers—both existing layers and those newly-created through a GIS analysis—are specified by the Vermont Department of Public Service (DPS) in the Act 174 Mapping Standards.

Why were these maps created?

DPS provides the following guidance in their standards.
"The Mapping standards lay out a sequence of steps for planners to examine existing renewable resources and to identify potential (and preferred) areas for renewable energy development, and to identify likely unsuitable areas for development, by layering constraint map layers on to raw energy resource potential map layers. The maps should help regions visualize and calculate the potential generation from potential areas, and compare it with the 2025, 2035, and 2050 targets from the Analysis and Targets standards to get a sense of the scale and scope of generation that could be produced within the region to meet the region's needs. DPS will provide additional guidance to accompany the standards that fleshes out the steps, layers, and standards more fully."

What these maps are:

These maps can help Regional Planning Commissions and towns "examine existing renewable resources," and are one tool to be used to "identify potential (and preferred) areas for renewable energy development, and to identify likely unsuitable areas for development."
You can think of these maps as similar to ones used in creating a land use plan. We might do a suitability analysis to find potential locations for residential development using state-level data sets. The resulting development potential map would be similar to these energy maps—it informs us about the land and its resources and its limitations, but would not be the final land use or zoning map; these are created by using the development potential map in conjunction with other information to decide which areas of town are actually preferred for development.

What these maps are not:

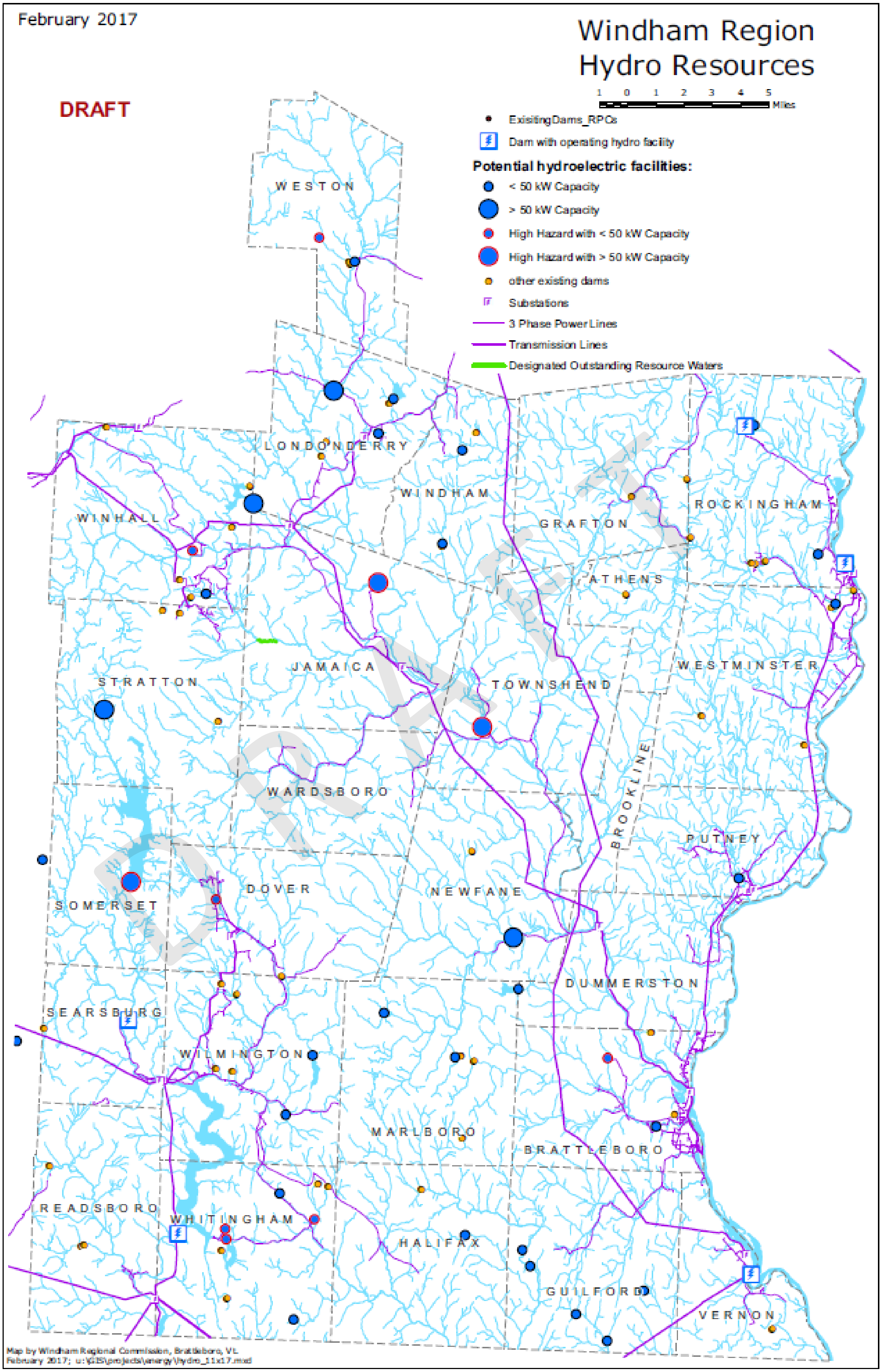
These maps are not a statement of where renewable energy development should occur and should not (or could not) occur. They are not siting maps. While they may identify potential areas for renewable energy development, they do not identify preferred areas for developed (but again, they are a tool to help towns, RPCs, and others identify preferred areas).

How should these maps be used?

These maps, and additional maps that will be created as part of this process, should be used by towns, RPCS, and others as one tool to gain an understanding of the raw resources (wind speeds and solar radiation) necessary for renewable energy development, and those natural and regulatory limitations (the "known" and "possible" constraints specified in the Act 174 standards), that may impact development. Other tools would be verifying this information through direct knowledge or site review. Certainly there are limitations to development in addition to those specified in the standard; the Act 174 energy planning process allows for towns and RPCs to identify their own constraints. These local and regional constraints can be incorporated into subsequent mapping just as towns and regions do at present when developing their proposed land use maps as components of their respective plans

Want further information?

The Energy Atlas on the Vermont Energy Dashboard, http://www.vtenergydashboard.org/, has many of the data layers used in these maps available in an interactive mapping environment. This means you can view the data at various scales, and discover details on where specific constraints lie. For towns that are embarking in their energy planning process, WRC can also produce custom maps showing more detail and added information. WRC can also answer questions about where specific constraints lie.


February 2017
Windham Region
Hydro Resources
DRAFT
1 0 1 2 3 4 5 Miles
ExisitingDams_RPCs
Dam with operating hydro facility
Potential hydroelectric facilities:
< 50 kW Capacity
> 50 kW Capacity
High Hazard with < 50 kW Capacity
High Hazard with > 50 kW Capacity
other existing dams
Substations
3 Phase Power Lines
Transmission Lines
Designated Outstanding Resource Waters
WESTON
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WINDHAM
GRAFTON
ROCKINGHAM
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JAMAICA
WESTMINSTER
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PUTNEY
SOMERSET
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NEWFANE
DUMMERSTON
SEARSBURG
WILMINGTON
MARLBORO
BRATTLEBORO
READSBORO
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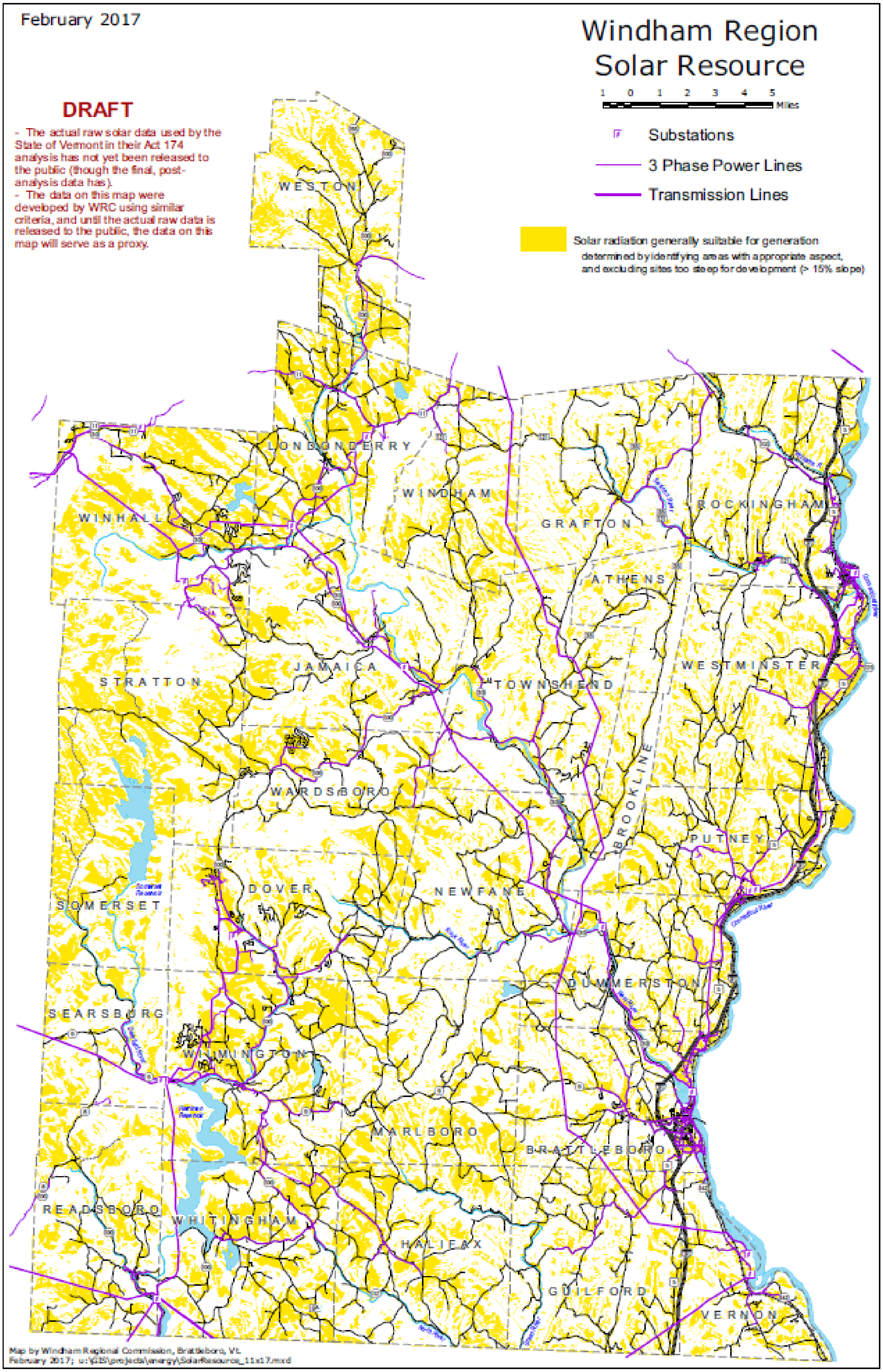
Map by Windham Regional Commission, Brattleboro, VT.
February 2017; u:\GIS\projects\energy\hydro_11x17.mxd


February 2017
Windham Region
Solar Resource
1 0 1 2 3 4 5
Miles
Substations
3 Phase Power Lines
Transmission Lines
Solar radiation generally suitable for generation determined by identifying areas with appropriate aspect, and excluding sites too steep for development (> 15% slope)
DRAFT
- The actual raw solar data used by the State of Vermont in their Act 174 analysis has not yet been released to the public (though the final, post-analysis data has).
- The data on this map were developed by WRC using similar criteria, and until the actual raw data is released to the public, the data on this map will serve as a proxy.
WESTON
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WINDHAM
GRAFTON
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Map by Windham Regional Commission, Brattleboro, VT.
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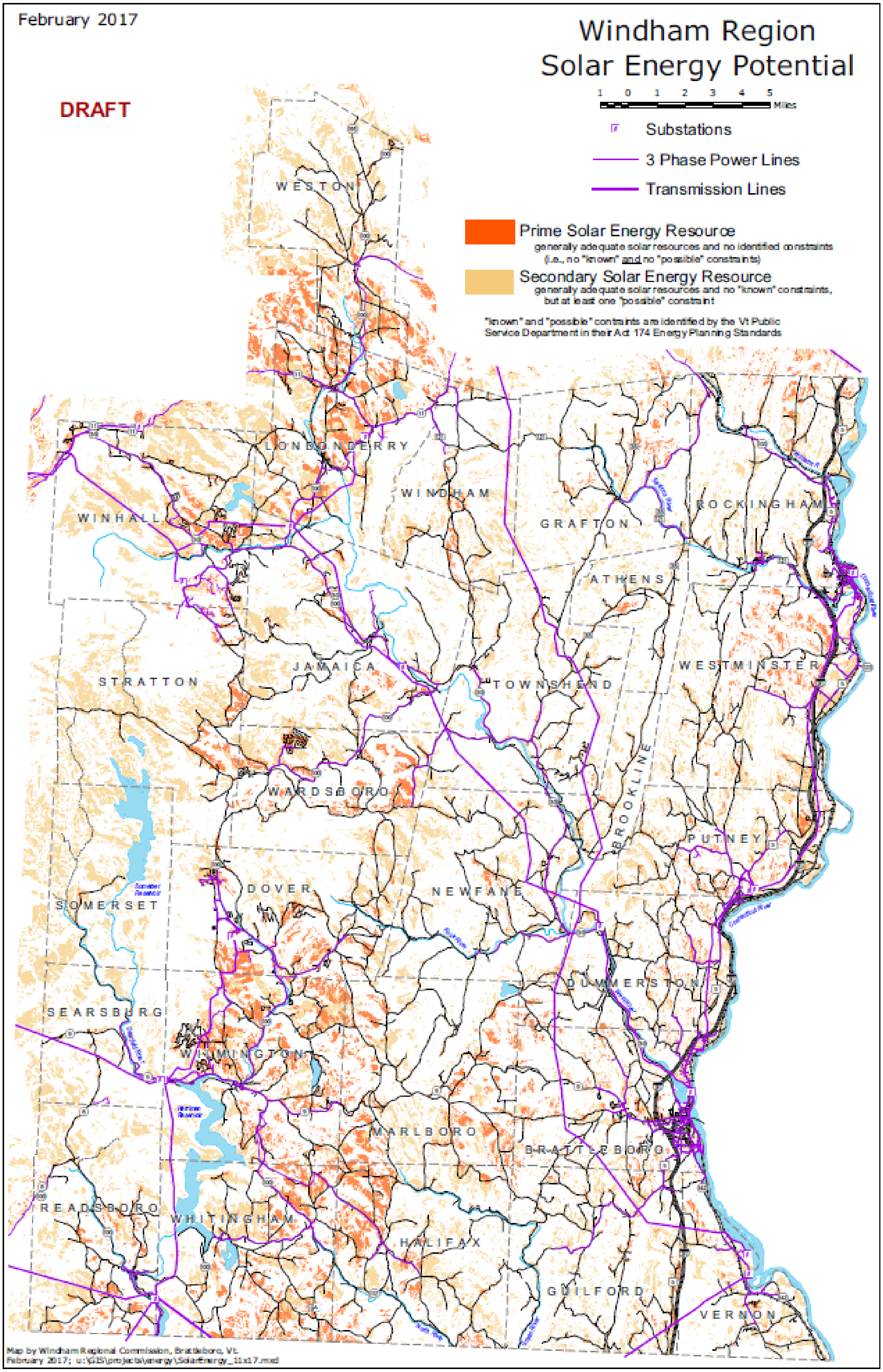
February 2017
Windham Region
Solar Energy Potential
DRAFT
Miles
Substations
3 Phase Power Lines
Transmission Lines
Prime Solar Energy Resource
generally adequate solar resources and no identified constraints
(i.e., no "known" and no "possible" constraints)
Secondary Solar Energy Resource
generally adequate solar resources and no "known" constraints,
but at least one "possible" constraint
"known" and "possible" constraints are identified by the Vt Public
Service Department in their Act 174 Energy Planning Standards
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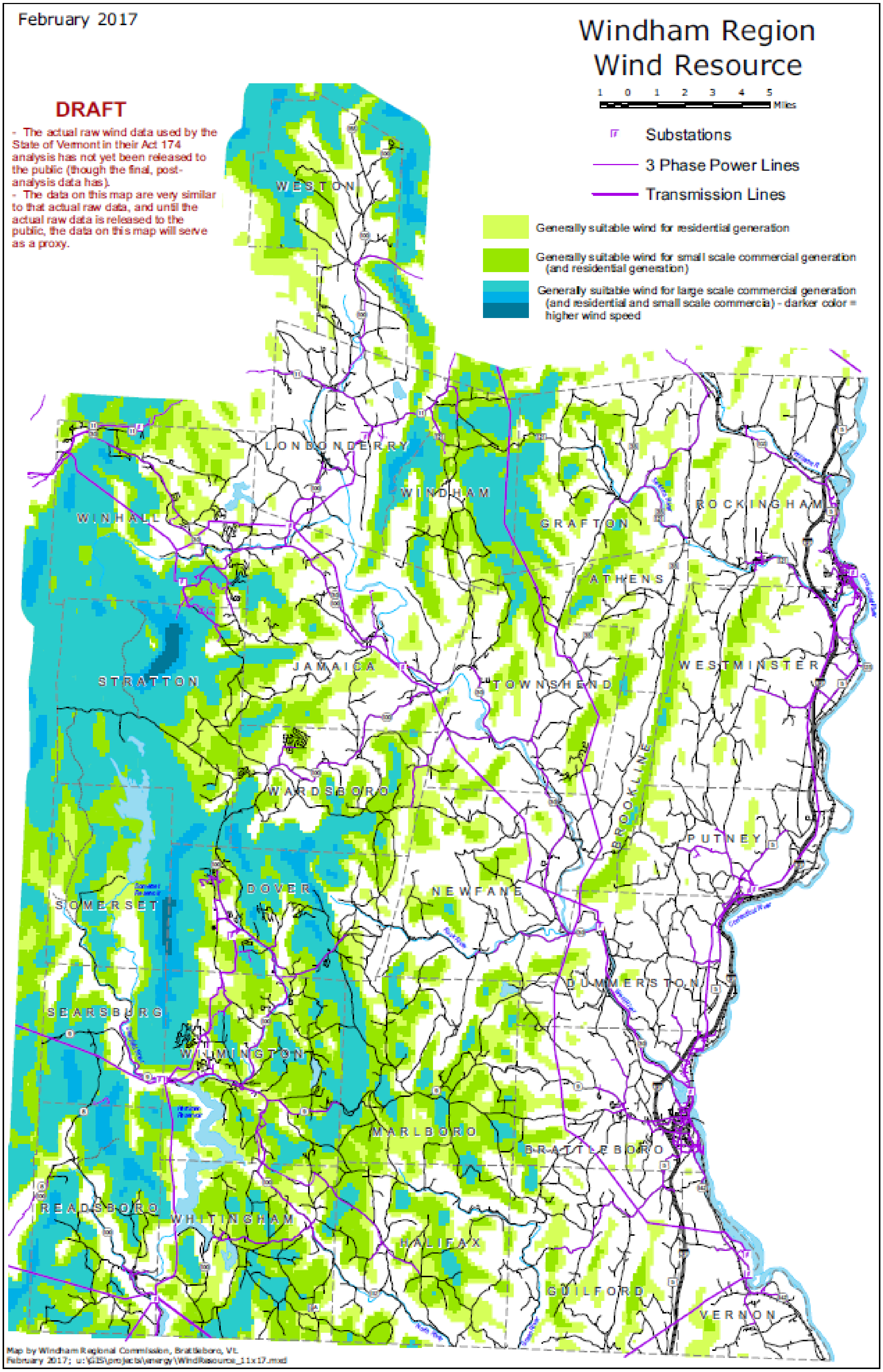
Map by Windham Regional Commission, Brattleboro, Vt.
February 2017; u:\GIS\projects\energy\SolarEnergy_11x17.mxd


February 2017
Windham Region
Wind Resource
1 0 1 2 3 4 5
Miles
Substations
3 Phase Power Lines
Transmission Lines
Generally suitable wind for residential generation
Generally suitable wind for small scale commercial generation (and residential generation)
Generally suitable wind for large scale commercial generation (and residential and small scale commercia) - darker color = higher wind speed
DRAFT
- The actual raw wind data used by the State of Vermont in their Act 174 analysis has not yet been released to the public (though the final, post-analysis data has).
- The data on this map are very similar to that actual raw data, and until the actual raw data is released to the public, the data on this map will serve as a proxy.
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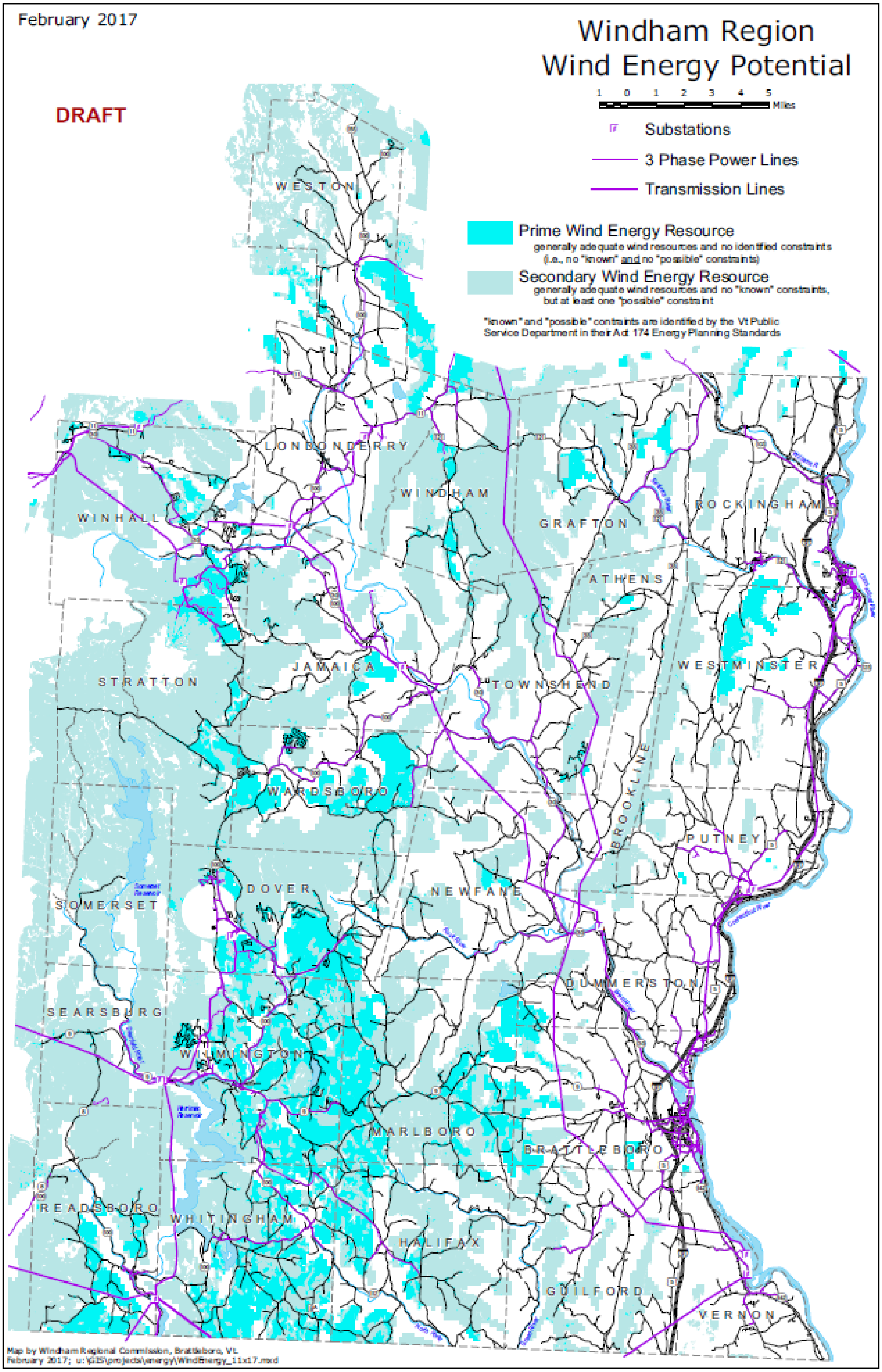
Map by Windham Regional Commission, Brattleboro, VT.
February 2017; u:\GIS\projects\energy\WindResource_11x17.mxd


February 2017
Windham Region
Wind Energy Potential
DRAFT
1 0 1 2 3 4 5
Miles
Substations
3 Phase Power Lines
Transmission Lines
Prime Wind Energy Resource
generally adequate wind resources and no identified constraints
(i.e., no "known" and no "possible" constraints)
Secondary Wind Energy Resource
generally adequate wind resources and no "known" constraints,
but at least one "possible" constraint
"known" and "possible" contraints are identified by the Vt Public
Service Department in their Act 174 Energy Planning Standards
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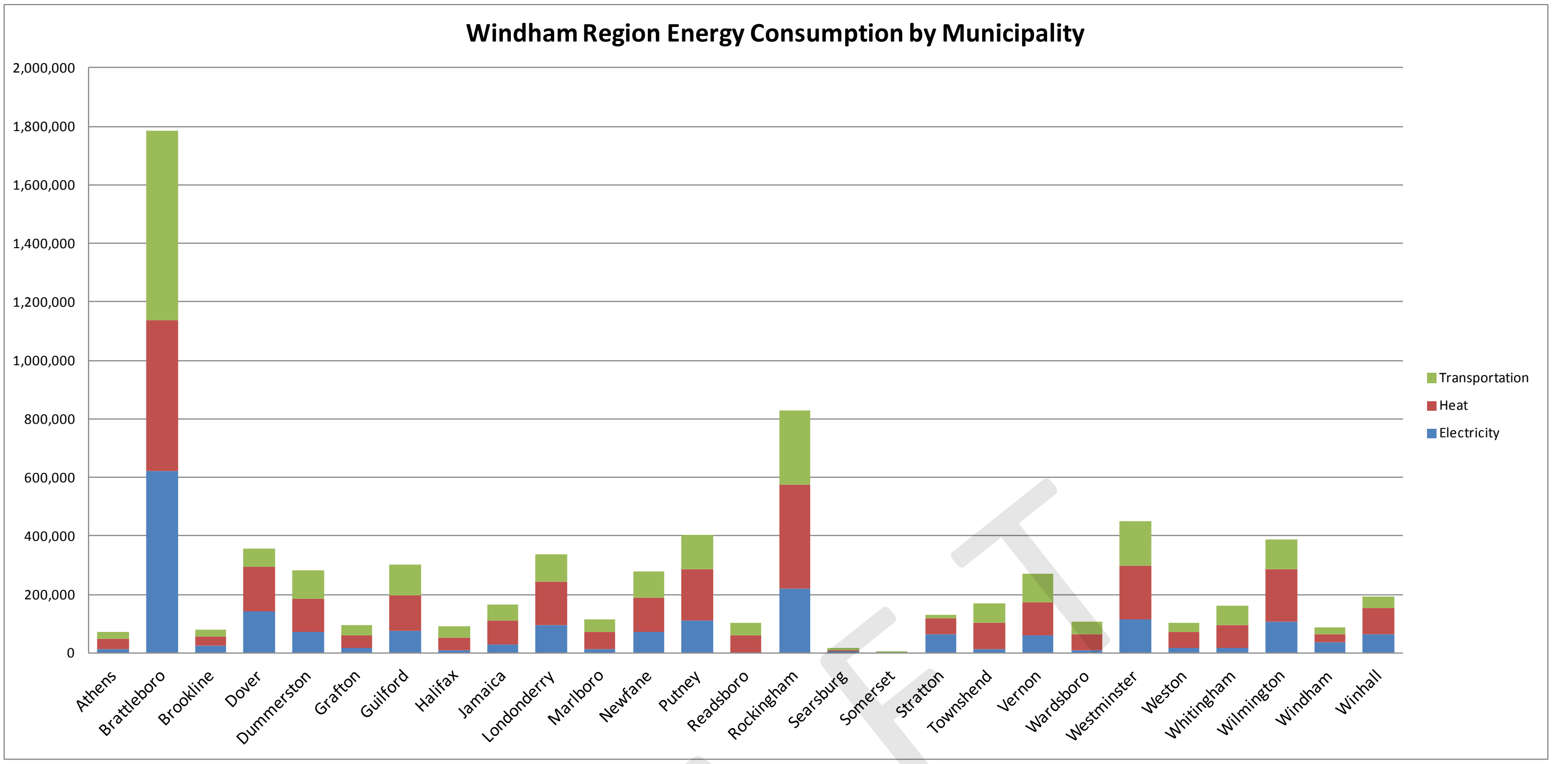
GUILFORD
VERNON
Map by Windham Regional Commission, Brattleboro, Vt.
February 2017; u:\GIS\projects\energy\WindEnergy_11x17.mxd

APPENDIX 5: ESTIMATED ENERGY USE FOR WINDHAM REGION MUNICIPALITIES



Sources for data:

Electricity-
From Efficiency Vermont, measured metered consumption data delivered to all RPC's for these planning purposes, per municipality.

Heat-
Based on
a) number of housing units per municipality, (found at US Census Bureau American FactFinder: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_DP04&src=pt), and
b) number of commercial business per municipality (found at: http://www.vtlmi.info/indareanaics.cfm?areatype=01&src=cew&base=ind2015&from=ind2015&chgtype=numeric&area=000&tw=Y)

Average heating load per residential and commercial building is based on VT state averages (110 MMBtu per household, 725 MMbtu per commercial business, as per DPS guidance and estimates, given to each RPC).

Transportation-
Number of light-duty vehucles based on number of
a) housing units per municipality and
b) VT state averages for counts of vehicles associated with are housing units, found with US Census Bureau American FactFinder (https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_DP04&src=pt)

Fuel consumption based on average annual miles driven per light-duty vehicle in Vermont (12,500), as per DPS guidance. Average fuel economy of light-duty vehicles in Vermont is 22 miles/gallon, also DPS guiadance.
Sources: http://vtrans.vermont.gov/sites/aot/files/MI_VMT_2015.pdf
http://vtrans.vermont.gov/sites/aot/files/2015_Extent_and_Travel_Report.pdf