Windham Regional Plan
Energy Chapter Appendix B
Methodology: Regional Energy Use and Targets

Please refer to the Department of Public Service's Act 174 landing page, which has guidance for regions and municipalities and a host of tools used in the analyses that support this plan. This supplement provides additional, not comprehensive, methodological information so as not to duplicate that which is already laid out by the State.

As of September 2024, WRC is working on breaking out the regional energy consumption estimates into municipal energy use estimates and targets. Once completed, the municipal data will appear as Appendix C to the 2022 Windham Regional Plan. Unless explicitly stated otherwise, municipal energy data methodologies follow the steps, calculations, and assumptions detailed in the following paragraphs.

Vermont's regional planning commissions (RPCs) have been tasked with developing reasonable estimates for energy consumption across the transportation, heating, and electric energy sectors. While these estimates use the best available data, they should not be considered a unit-by-unit audit of energy use. Rather, they serve as a starting point for better understanding regional energy use patterns, cost drivers, and what we need to do to achieve long-range energy goals. Note that estimates and targets are frequently given in kilowatt-hours (kWh), megawatt-hours (MWh), British thermal units (Btu), and millions of British thermal units (MMBtu) to allow for comparison between different energy types.

Residential, commercial, and industrial electricity usage data was provided by Efficiency Vermont, while transportation and thermal sector data was estimated via the Municipal Consumption Tool, which pulls from a variety of sources, including the Vermont Public Service Department (PSD), American Community Survey (ACS), Vermont Department of Labor (DOL), the Vermont Department of Motor Vehicles (DMV), and DriveElectric (VEIC) (see below for specifics).

Estimating Use

The following explains the series of steps that WRC has taken to calculate estimates of energy use for the Region across all three energy sectors.

Residential Heating Energy Use

Residential thermal energy use was estimated using several generic assumptions and region-specific considerations. ACS data was the primary information source for this sector's analysis–several caveats are worth mentioning:

- ACS data is based on random sampling over a multi-year period with large margins of error, especially for rural communities like the ones in the Windham Region. As the writing of this plan, it remains the most consistent and comprehensive data source on residential heating.
- ACS data identifies only one primary source of heating. In reality, many residents use two or more sources.

According to the PSD, residences in New England use approximately 45,000 to 80,000 BTU of heat energy per square foot annually, averaging statewide at about 110 MMBtu per residence per year for space and

water heating. Space heating is by far the biggest use, and older building stock can require significantly more energy to heat.

Windham Regional Commission (WRC) used the statewide average of 110 MMBtu to establish a baseline estimate for thermal energy use in primary residences. Then, ACS data was used to determine the number of households that use electricity as a primary heating source in the Region. Efficiency Vermont's residential electricity data (see above) accounts for the electricity used to heat homes. So, to avoid double counting this category of consumption, the number of electrically heated homes was subtracted from the total number of occupied housing units:

Total year-round residential thermal energy use = 110 MMBtu * (# of occupied housing units - # of electrically-heated units).

Seasonal homes account for a significant percentage of the Region's housing stock. The Vermont Pathways model estimates that seasonal homes use 15% of the energy of year-round homes. This assumption does not quite fit the Windham Region, where seasonal properties are occupied for long periods and during winter months. As a result, seasonal homes on the Western half of the Region (with closer proximity to the Region's winter recreation areas) were estimated to use 25% of the heating energy of year-round homes; seasonal homes on the Eastern half of the Region were assumed to use 15%. Here is the formula for calculating MMBtu for seasonal units:

Total seasonal residential thermal energy use = 110 MMBtu * ((# of Western seasonal units * 0.25) + (# of Eastern seasonal units * 0.15)).

Commercial Heating Energy Use

Commercial heating consumption was calculated using the Municipal Consumption Tool. Information on commercial establishment counts was sourced from the VT DOL's Economic and Labor Information (ELMI) website. ELMI data was inputted into the Municipal Consumption Tool, which calculated the Region's share of commercial floorspace by industry and outputted total commercial thermal energy use.

Transportation Energy Use

Transportation energy use was also estimated using the Public Service Department's Municipal Consumption Tool. WRC used a calculation identical to the one outlined in the tool, but an adjustment was made to regional accuracy. The State of Vermont estimates that the average annual number of vehicle miles traveled (VMTs) for passenger vehicles is 12,500 VMTs. According to VTrans, drivers in the Windham Region contribute to a large share of total statewide VMTs due to the Region's rural nature. WRC adjusted for this by using a higher value for the regional average number of VMTs (13,250 VMTs rather than 12,500 VMTs). This change resulted in a larger estimate for the number of gallons of gasoline consumed and a higher amount of transportation-related energy use. Similar to the heating sector, the amount of electricity used to power vehicles needed to be discounted from the above calculation because it was already represented in Efficiency Vermont's electrical consumption data (the Municipal consumption Tool does this automatically).

Establishing Targets

WRC derived regional targets for each of the three energy sectors. These targets represent various goals for energy efficiency, conservation, fuel-switching, and renewable generation, and quantify progress for the years 2025, 2035, and 2050. These milestones are intended to help the Region measure progress towards Vermont's overall goals, and are not requirements.

Thermal and Transportation Targets: Energy Efficiency & Conservation and Fuel-Switching Progress

Regional energy targets for the thermal and transportation sectors were derived from the Vermont Pathways model developed in the Low Emissions Analysis Platform (LEAP). The Public Service Department provided RPCs with regionalized Vermont Pathways outputs that became the basis for these targets (see Appendix A for further information). The Vermont Pathways model includes both a Baseline (business as usual) and CAP (Climate Action Plan) Mitigation scenario, representing two different pathways for Vermont's energy transition (one under "normal" policy and programmatic conditions, the other matching the rate of change necessary to meet the 90x50 requirements). WRC opted to use the more ambitious CAP Mitigation scenario in the target-setting exercise for the Region.

WRC borrowed additional information from the Public Service Department's Analysis and Targets Tool to supplement insights gathered from the Vermont Pathways model. Some of the information includes the following:

- The number of residential households, commercial establishments, and passenger vehicles was assumed to increase by 6% over each target year period.
- Average annual residential and commercial heating load was assumed to decrease gradually due to improved thermal efficiency of Vermont's building stock
- Residential structures were assumed to need an average of 1.3 heat pumps/household.

A full walkthrough of the methods, data sources, interim steps, accompanying tools, and supporting resources are hosted by the Department of Public Service. Furthermore, full details of the Vermont Pathways model methods, data sources, and assumptions can be found in Appendix D to Vermont's 2022 Comprehensive Energy Plan.

Electric Sector Targets: Efficiency and Renewable Generation

The Vermont Pathways model does not provide targets for electrical efficiency and conservation. WRC used a separate tool to derive these targets, the 2022 Energy Efficiency Utility (EEU) Market Potential Study. The EEU Market Potential Study does not present two pathways like the Vermont Pathways model does. Rather, it takes the demand information embedded in the Vermont Pathways model, and applies it to electric sector resources to produce targets for electric efficiency in the Region.

Renewable generation targets were determined using PSD's Generation Scenarios Tool. WRC opted to establish baseline renewable generation targets for the years 2025, 2035, and 2050. Targets for renewable generation can be adjusted based on the percentage of future electrical demand regions choose to meet through localized generation. WRC opted to meet 25% of demand with in-region resources. It should be noted that estimates for existing in-region renewable generation (as of 2024) exceed the baseline generation targets that result from the Generation Scenarios Tool.

Generation Potential

Generation potential is the estimate of the maximum build out of renewables under existing conditions and constraints in the Region. These figures were calculated using land availability data as an initial input. WRC conducted a spatial analysis of the Region to determine areas with known or possible constraints restricting the development of renewable resources. These areas included FEMA special flood hazards areas, river corridors, and highest priority forest blocks, among other natural resources areas. For a full list of the factors considered in this spatial analysis, refer to the Energy Chapter of the 2022 Windham Regional Plan.

After determining the number of acres with no known or possible constraints, a minimum number of acres for each type of renewable resource needed to be determined. Following guidance from PSD, WRC assumed that 8 acres would be required for each MW of solar for areas with no known constraints, and 60 acres would be required for each MW of solar in areas with possible constraints (to account for potential siting limitations that "possible constraint areas" might have). A similar method was used for wind, where 4 acres/MW was assumed in areas with no known constraints, and 60 MW/acre was used for areas with possible constraints. Acreage values were multiplied by the number of hours in a year (8,760) and a capacity factor (0.15 for solar, 0.35 for wind), then divided by the number of acres required for each megawatt. This resulted in a value for MWh indicating the Region's generation capacity. Here is the formula:

Generation potential for solar (MWh) = ((acres with no know constraints * 8,760 hours * 0.15)/ 8 MW/acre) + ((acres with possible constraints * 8,760 hours * 0.15)/ 60 MW/acre).

Generation potential for wind (MWh) = ((acres with no know constraints * 8,760 hours * 0.35)/ 4 MW/acre) + ((acres with possible constraints * 8,760 hours * 0.35)/ 60 MW/acre).