Central Vermont Regional Planning Commission

MEMO

Date: April 10, 2024

To: Department of Housing and Community Development,
Agency of Natural Resources
Agency of Agriculture, Food and Markets
Chairs of the Legislative Bodies of the Central Vermont Planning Area
Executive Director of Northeastern Vermont Development Association
Executive Director of Lamoille County Regional Planning Commission
Executive Director of Chittenden County Regional Planning Commission
Executive Director of Addison County Regional Planning Commission
Executive Director of Two Rivers-Ottauquechee Regional Commission

From: Christian Meyer, Executive Director

Re: Readoption of the Central Vermont Regional Plan

The Central Vermont Regional Planning Commission (CVRPC) intends to readopt its regional plan to allow staff an additional 12-18 months to work with our Board of Directors and member communities to development a new plan. By readopting the current plan, CVRPC ensures continuity in regional planning efforts while providing staff with the necessary flexibility to craft a comprehensive and well-informed new plan.

Per 24 V.S.A. § 4348b, as part of the readoption process, CVRPC has developed a plan assessment report, attached herein. The CVRPC Regional Plan Assessment Report will address the following five criteria:

1. The extent to which the plan has been implemented since adoption or readoption;
2. An evaluation of the goals and policies and any amendments necessary due to changing conditions of the region;
3. An evaluation of the land use element and any amendments necessary to reflect changes in land use within the region or changes to regional goals and policies;
4. Priorities for implementation in the next five years; and
5. Updates to information and data necessary to support goals and policies.

The current CVRPC Regional Plan is set to expire August 17, 2024. Two public hearings will be held in support of this process, scheduled for May 14, 2024 and July 9, 2024. Comments should be sent to cvrpc@cvregion.com by June 3, 2024. Please contact executive director, Christian Meyer with any questions at meyer@cvregion.com or at (802) 229-0389.

DRAFT

CVRPC Regional Plan Readoption Assessment Report

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Purpose

Per Title 24, Chapter 117 of the Vermont State Statutes, regional planning commissions shall prepare a regional plan that is consistent with the state planning goals (24 V.S.A. § 4302) and municipal and adjacent regional plans. Unless readopted, all regional plans shall expire every eight years. The current Central Vermont Regional Plan became effective August 16, 2016 and, barring readoption, will expire August 17, 2024.

Recognizing that there is need to holistically reexamine the goals and policies of the regional plan, CVRPC began working with its committees to draft a new plan to replace the current plan in late 2022. However, due to high staff turnover and the demands of providing member municipalities technical assistance following the July, 2023 flooding, staff have fallen behind on the prescribed schedule. Readopting the current plan with the expressed intention of completing and adopting a new regional within 12-18 months allows for a seamless transition between the old and new plans, while solicitating broader and more careful public input.

Finally, recent changes to legislation and significant proposed changes to how RPCs develop regional plans is under consideration in the Vermont State Legislature. Giving staff time to integrate these planning requirements as part of the new plan update will lead to a more robust plan that better addresses the current and future state of planning in Vermont.

Per 24 V.S.A. § 4348b, as part of the readoption process, the Central Vermont Regional Plan Assessment Report, may address the following five criteria:

1. The extent to which the plan has been implemented since adoption or readoption;
2. An evaluation of the goals and policies and any amendments necessary due to changing conditions of the region;
3. An evaluation of the land use element and any amendments necessary to reflect changes in land use within the region or changes to regional goals and policies;
4. Priorities for implementation in the next five years; and
5. Updates to information and data necessary to support goals and policies.

Each of these criteria is addressed in the following sections.

The extent to which the plan has been implemented since adoption.

CVRPC has worked closely with its member municipalities to implement the 2016 Central Vermont Regional Plan. This work can be broadly broken into two categories regulatory implementation and non-regulatory implementation.

Regulatory Implementation:

CVRPC has established planning goals and policies and has consistently represented this planning work in state regulatory processes, including the Act 250 permit process, Public Utility Commission (PUC) Section 248 proceedings, review of preferred siting requests, and Section 1111 permit reviews.

To guide CVRPC's regulatory implementation of the regional plan, the Board of Commissioners established the Project Review Committee as an advisory committee. Staff provide the Committee with monthly updates on all current and future applications that are active within the region. When projects are viewed to have a wider regional impact, the committee meets to determine if the project has 'Significant Regional Impact' (as defined in the regional plan) and develop formal RPC comments.

- CVRPC exercises its status as a statutory party in Act 250 whenever new development has the potential to have a 'Significant Regional Impact' or is designated as a 'Major' project by the NRB.
- Through work with the Central Vermont municipalities, CVRPC coordinates where utility siting is preferred and where it should be avoided. CVRPC applies these findings through participation in the Section 248 process.
- The Project Review Committee reviews sites for preferred site status. This process is done in consultation with regional land use maps and municipal planning goals.
- Section 1111 (19 V.S.A. § 1111) permits are for use of the state right of way. CVRPC monitors Section 1111 permit applications for projects of regional significance.

Non-Regulatory Implementation

Non-regulatory implementation refers to the use of strategies, programs, and actions that do not involve the enforcement of laws or regulations to achieve a particular goal or objective. For CVRPC non-regulatory implementation often involves voluntary measures, assistance, education, outreach, partnerships, and other collaborative approaches to encourage desired behaviors or outcomes. For regional planning commissions, this is the largest portion of its implementation work.

Broadly the CVRPC engages in the following areas of planning implementation:

- Community Development
    - Brownfields
    - Housing
    - Economic Development
    - Health Equity
- Emergency Planning
- Emergency response and recovery
- Town Planning
- Natural Resources
- Transportation
- GIS
- Energy

CVRPC has created or participates in a variety of standing committees that support the implementation of the goals related to these areas of planning. The committees are tasked with providing the wider Board of Commissioners with the findings from more detailed analyses. These committees included:

The Regional Plan Committee supports the Board by making recommendations to the Board regarding CVRPC's duties as specified within 24 V.S.A. Section 4345a(5), preparation of a regional plan and amendments, and implementation of the regional plan.

The Project Review Committee supports the Board by fulfilling CVRPC's statutory role as specified within 24 V.S.A. Section 26 4345a(13) and (14) and to aid other parties to make conformance determinations when directed by the Board. These items are commonly referred to Act 250 (10 V.S.A. Chapter 151) and Section 248 (30 V.S.A. Chapter 29 5).

The Municipal Plan Review Committee supports the Board by making recommendations regarding the Commission's duties as specified within 24 V.S.A. Sections 4350, Review and consultation regarding municipal planning effort, subsections (a) and (b), and Section 4352, Optional determination of energy compliance; enhanced energy planning, subsection (b), Municipal plan.

In addition to these standing committees, the Board has created the following special committees:

The Brownfields Advisory Committee oversees the Commission's brownfields program and provides local and regional input regarding brownfield issues important to the region.

The Clean Water Advisory Committee oversees the Commission's water quality planning program in accordance with CVRPC plans, policies, and procedures, acts as a liaison between local communities and the Vermont Agency of Natural Resources (ANR), and provides local and regional input regarding water quality issues important to the region.

The Transportation Advisory Committee oversees the Commission's transportation planning program in accordance with CVRPC plans, policies, and procedures, acts as a liaison between local communities and the Vermont Agency of Transportation (AOT), and provides local and regional input regarding transportation issues important to the region.

CVRPC, its committees, and its staff have worked to implement the goals in the above fields through ongoing collaboration with municipal partners and stakeholders. CVRPC has worked hand in hand with our municipalities to draft plans, provided training on planning needs, built relationships with under-represented community members, represented regional planning goals on state advisory committees, provided ad hoc technical assistance to meet town needs, drafted grant applications, and administered construction projects to help advance the regional plan. The following is an incomplete summary of some of the notable work CVRPC has completed across its active areas of planning.

Community Development

- Wrote or assisted partners in drafting grant applications
- Fostered regional activities, such as identifying collaborate overlap for childcare advancement with Let's Grow Kids and the Mayor of Montpelier.

Brownfields

- Provided technical assistance or funding support for Phase I analyses, Phase II analyses and Corrective Action Plans. Worked directly with: Northfield, Barre City, Woodbury, Cabot, Montpelier, and Calais

Housing

- Tailored an accessory dwelling unit guide for the CVRPC region.
- Provided project review for Act 250 support
- Affordability study on costs of housing and transportation in Central Vermont

Economic development

- Provided technical assistance for the Vermont Economic Resiliency Initiative.
- Administered Community development Block Grants, USDA Rural Development Grant, and other federal funds for member municipalities to implement municipal and regional planning goals
- Joined four county consortium to apply for EDA funding to develop a Comprehensive Economic Development Strategy (CEDS). Participated in planning work and adopted CEDS.

Health Equity

- Participated in THRIVE, Central Vermont's accountable care organization, which is working to align resources at more than 15 agencies and organizations to improve social outcomes in Washington County. Social determinates of health include economic stability, physical environment, education, food, social context, and the health care system.

Emergency Planning

- Drafted Local Hazard Mitigation Plans for nearly all member municipalities.
- Supported planning in Plainfield to identify hazards associated with bridges and worked with the community all the way through securing construction funding for bridge reconstruction.
- Studied targeted tributaries of the Winooski for flood hazards
- Provided technical assistance to Central Vermont municipalities to regularly update their Local Emergency Management Plans.

Emergency Response and Recovery

- Provided support to the State Emergency Operations Center during and following high hazard event.
- Provided Local Liaison support to the SEOC when activated.

Town Planning

- Directly worked with municipalities to complete town plan updates
- Provided technical assistance to municipalities in their work to update zoning bylaws
- Provided village master planning services and support for member municipalities
- Provided trainings for town representatives and partners
- Held regular consultations with planning commission to help municipalities advance local planning goals and work toward meeting state planning goals.
- Developed or provided assistance to municipalities in drafting capital improvement plans
- Supported municipal applications for the state designation programs and designation updates
- Developed regional trail connections map

Natural Resources

- Applied for and was assigned to be the Winooski Basin Clean Water Service Provider.

- Completed stormwater implementation projects in Northfield, Barre City, Calais, Woodbury, Moretown, Plainfield
- Provided regional municipalities and partners stormwater runoff trainings
- Provided grant application assistance for stormwater mitigation programs
- Provided stormwater master planning administrative services as well as technical assistance

Transportation

- Provided data reporting for AOT as needed
- Completed multiple feasibility studies for member municipalities.
- Conducted road weather vulnerability analyses
- Completed bridge and culvert inventories for CVRPC municipalities on a revolving schedule.
- Collected data park and rides, traffic volumes and bike and ped activity as needed.
- Conducted Road Erosion Inventories
- Supported transit through participation on the GMT Board of Commissioners and facilitated conversations with rural municipalities to ensure their transit needs are represented in planning work.
- Supported COVID-19 safety for individuals experiencing homelessness by identifying transportation resources that could be used to transition homeless shelter residents to hotel facilities and transportation resources the shelter could use during the pandemic.

GIS

- Regularly provided mapping services and assistance to each CVRPC community. Objectives varied from supporting emergency services, State designation programs, zoning map updates, mapping historical Districts and Wayfinding
- Created web maps for municipalities

Energy

- Developed an enhanced energy plan. Reviewed and provided conformance letters to Municipalities completing enhanced energy plans. Five municipalities have completed enhanced municipal energy plans
- Promoted and provided technical assistance to CVRPC communities to take advantage of the Municipal Energy Resilience Program.
- Hosted regional energy round table
- Participated in State Renewable Energy Standards update committee

Each year, alongside the work programs linked to the ACCD Regional Planning Grant and AOT Transportation Planning Initiative funding, CVRPC develops and approves a specific task-oriented work program. These tasks are designed to assist the region's 23 municipalities advance toward meeting the state planning goals and requirements.

In service of its role as liaison between its member municipalities and broader, interregional or statewide initiatives, CVRPC staff participate as members on other boards and steering committees. Additionally, and where germane, CVRPC provides feedback on statewide planning documents. In this capacity CVRPC advocates for the policies that align with the goals of the regional plan. CVRPC serves on the following boards:

- Green Mountain Transit Board of Commissioners
- Central Vermont Economic Development Corporation's Board of Directors (ex officio)
- Mad River Valley Planning District Steering Committee (ex officio)

Staff also participate in the in the following committees:

- Regional Emergency Management Committee
- THRIVE (the Central Vermont Accountable Communities for Health)

Finally, the Vermont Department of Environmental Conservation (DEC) selected CVRPC to serve as the Clean Water Service Provider (CWSP) for the Winooski basin. As a CWSP, CVRPC plays a pivotal role in the implementation of Vermont's Clean Water Service Delivery Act (also known as Act 76). Serving in this role is in line with the Region's natural resource goals and is helping to advance projects that will reduce phosphorus in the Champlain Basin while simultaneously mitigating flood risk or implementing best management practices.

An evaluation of the goals and policies and any amendments necessary due to changing conditions of the region;

The goals or policies of the Readopted Regional Plan will go largely unchanged from the 2016 Central Vermont Regional Plan. The exceptions to this are the adoption of an updated energy element and corresponding pathways to meet the new data requirements for an Enhanced Energy Plan, and the prescription of regional housing targets per Act 47 of 2023. Despite these modest changes, CVRPC recognizes that, while our current goals have allowed CVRPC to effectively plan for the region, much has changed over the last eight years. CVRPC recognizes that issues like housing, equity, flooding, climate adaptation, the clean energy transition, health equity, and substance misuse among other planning topics have risen in importance, however without having the proper time to engage with each of our committees, all of our Commissioners, and our member municipalities, CVRPC is not positioned to fully evaluate how our goals need to be revised. Therefore, the Commission and staff intend to undertake the hard work of updating these goals and policies carefully and deliberately.

To these ends, the current plan, with the above noted updates, meets the requirements of 24 V.S.A. 4348a and in 2018 was amended to receive substantial deference in Section 248.

An evaluation of the land use element and any amendments necessary to reflect changes in land use within the region or changes to regional goals and policies

Current CVRPC land use policies promote the protection of natural resources and fragile environments, planning for compact village centers with surrounding rural countryside, and the protection of key flood plains to reduce inundation risk. Broadly, these goals remain unchanged. However, how they will be applied is evolving. Central Vermont experienced the devastating impacts of flooding in the July 2023. These events have given new urgency to protecting and reconnecting flood plains across the Winooski Basin to help protect our more densely settled areas. The shortage and cost of housing is now a crisis. The region aims to provide technical assistance on how and where new housing can be added and where the services exist to support it.

Further these forces are driving legislative changes and define how the region plans for housing and develops its future land use map. CVRPC is already drafting new elements of the regional plan that

incorporate recommendations for the 2023 VAPDA led Regional Planning Study. CVRPC was an active participant in this study and plans on integrating the proposed land uses into its future land use map once legislation is finalized. CVRPC is also considering how to adopt new legislative changes and mandates that may fall to the RPC related to the State designation program and Act 250 if they arise as part of the 2023-2024 legislative session.

Priorities for implementation in the next five years

CVRPC's priorities continue to lie at the nexus between land use, transportation, hazard mitigation, conservation, and energy planning. CVRPC recognizes that some of the most important work we can do to positively impact the region is through providing technical assistance to our member municipalities.
Municipal assistance will include:

- Provide technical assistance for municipal plan development
- Provide technical assistance for municipal bylaw modernization and adoption of updated flood hazard maps.
- Provide municipal trainings for practitioners and the general public on the planning
- Provide facilitation for municipalities to develop discrete flood prevention and mitigation projects with the goal of short immediate implementation.
- Help municipalities pursue grant funding to implement planning and project construction.

Regionally, CVRPC will:

- Update the Central Vermont Regional Plan
- Develop a Safety Action Plan with a goal of zero traffic fatalities – *Vision Zero* – for Central Vermont
- Continue to review projects for significant regional impact for Act 250 permits and Section 248
- Engage with the state on planning initiative and studies
- Continue to develop clean water projects as the CWSP

Updates to information and data necessary to support goals and policies.

Generally, the Central Vermont planning area has not undergone any significant or unanticipated changes since the 2016 plan was drafted. Population growth has largely remained flat with only a slight uptick in the 2020 decennial census. Median age of the region has continued to increase, and while this trend is not new, it will inform many of the goals developed in the new regional plan around housing and the supporting services. Other macro-level changes to the region's demographics include the impacts of migration associated with the COVID-19 Pandemic, a changing climate, and the 2023 flooding. However, the long-term impacts of these events may not be evident in the data for years to come. In conclusion, there is no indication that changes to the information and data used in the 2016 plan have changed in such a way to invalidate the current goals and policies.

However, while the foundational data for the region has been largely unchanged, per state statute, certain updates are required as part of this readoption.

(1.) **Appendix 1 - Energy Element:** An updated draft of the energy element is attached to this report. This lone chapter has been revised to meet the updated standards of Act 174. Updating this chapter is necessary for the CVRPC to maintain an enhanced energy plan, to receive substantial deference in Section 248 proceedings, and to be able to review municipal enhanced energy

plans for conformance. Appendix 1 includes the Enhanced Energy Element, excerpts from the Infrastructure Element that provide supporting information required to meet the Act 174 standards, and an Energy Plan Supplement that includes methodology.

(2.) **Appendix 2 - Housing Targets:** Per 2023 statutory updates to 24 V.S.A. § 4348a, an addendum to the Housing Element has been included in this Report to integrate housing targets for the region and each of its municipalities. These housing targets have been developed by CVRPC and are meant to serve as a placeholder until the completion of the Department of Housing and Community Development's update to the housing assessment.

Appendix 1 – Energy Element

STATUTORY REQUIREMENTS

Regional Enhanced Energy Plans must (in addition to being adopted):

- Include the energy element as described in 24 V.S.A. § 4348a(a)(3)
    - which may include an analysis of resources, needs, scarcities, costs, and problems within the region across all energy sectors, including electric, thermal, and transportation;
    - statement of policy on the conservation and efficient use of energy and the development and siting of renewable energy resources;
    - a statement of policy on patterns and densities of land use likely to result in conservation of energy;
    - identification of potential areas for the development and siting of renewable energy resources and areas that are unsuitable for siting those resources or particular categories or sizes of those resources.
- Be consistent with state energy policy (described below) in the manner described in 24 V.S.A. § 4302(f)(1): ***To make efficient use of energy, provide for the development of renewable energy resources, and reduce emissions of greenhouse gasses***. Including*: increasing the energy efficiency of new and existing buildings; identifying areas suitable for renewable energy generation; encouraging the use and development of renewable or lower emission energy sources for electricity, heat, and transportation; and reducing transportation energy demand and single occupancy vehicle use.*
    - Greenhouse gas reduction requirements under 10 V.S.A. § 578(a) (26% from 2005 levels by 2025; 40% from 1990 levels by 2030; 80% from 1990 levels by 2050)
    - The 25 x 25 goal for renewable energy under 10 V.S.A. § 580 (25% in-state renewables supply for all energy uses by 2025)
    - Building efficiency goals under 10 V.S.A. § 581 (e.g., reduce fossil fuel consumption across all buildings by 10% by 2025)
    - State energy policy under 30 V.S.A. § 202a and the recommendations for regional and municipal planning pertaining to the efficient use of energy and the siting and development of renewable energy resources contained in the State energy plans adopted pursuant to 30 V.S.A. §§ 202a and 202b
    - The distributed renewable generation and energy transformation categories of resources to meet the requirements of the Renewable Energy Standard under 30 V.S.A. §§ 8004 and 8005
- Meet all standards for issuing a determination of energy compliance detailed in the 2022 Comprehensive Energy Plan and detailed here: Final Update Regional Determination Standards_ Form Fillable.docx (live.com)

Infrastructure Chapter Excerpt

Energy Infrastructure: Electricity

This section details existing infrastructure including generation, key trends, and challenges (including outages). Energy analyses and targets for the electricity, thermal, and transportation sectors, renewable energy generation siting, and recommendations can be found in the Energy Chapter.

Energy is a vital component of modern life. When sources of power are lost or interrupted, even temporarily, the rhythms of our lives are profoundly interrupted. Business and industry halt and residents and goods dependent on electricity and other types of power are at great risk. Our electric infrastructure in Vermont is increasingly vulnerable to extreme weather conditions due to climate change. This comes at a time when we anticipate significant increases in demand for reliable and affordable electricity due to overlapping causes including addressing rural infrastructure gaps, regional growth and development, increasing need for heating & cooling, as well as electrification of the thermal and transportation sectors.

While existing and potential sources of electric power in the region are more than adequate (see Enhanced Energy Element), the region's electric infrastructure is aging and reaching performance limits. While the costs of developing new infrastructure are high upfront, potential long-term cost savings are increasing as technology is rapidly advancing and markets are shifting to match need and the urgency of the climate crisis. Integrating renewable energy infrastructure more comprehensively into all scales of our planning across the region is important to not only maximize associated community benefits but also to minimize negative environmental and land use impacts of electric generation, transmission, and distribution (see Enhanced Energy Element). CVRPC's objective is to ensure that energy generation, distribution and transmission facilities are located, designed, and correctly-sized to support the Region's community and economic needs, which increasingly means it must be reliable, resilient, and affordable as well as sustainable to reduce operational costs and Green House Gas emission contributions (further reducing long-term costs).

Electric Distribution Utilities (DUs):

In 2021, Vermont distribution utilities purchased over 5.8 million MWh of electricity to meet the demand of their customers, of this 64% came from renewable resources and 18% came from carbon free resources. Also in 2021, Vermont distribution utilities retired just over 4 million renewable energy certificates[1] (i.e. equivalent to just over 4 million MWh of electricity) to meet their obligations under Vermont's Renewable Energy Standards, of this 72% of the electricity Vermont accounted for was renewable; including nuclear 90% of it was low-carbon[2].

[1] Renewable energy credits (RECs) are the accounting system used to track all renewable electricity generation in or sold into ISO New England's regional electric system (ISO= Independent System Operator). These certificates ensure no two entities claim credit for that electricity, and provides a mechanism to buy and retire (aka take credit) for renewable energy generation regardless of their own production and use (or rather to compensate for it).

[2] See 3 one-page resources for more info: *Where does Vermont's electricity come from*, *Current policies & programs*, *and Tradeoffs between different sources of electricity*- these were made as part of the Say WATT? Regional Event Series in the fall of 2023 during which the Department of Public Service partnered with the RPCs to offer a series of engagement opportunities for Vermonters to weigh in on renewable electricity policies and programs: https://publicservice.vermont.gov/renewables

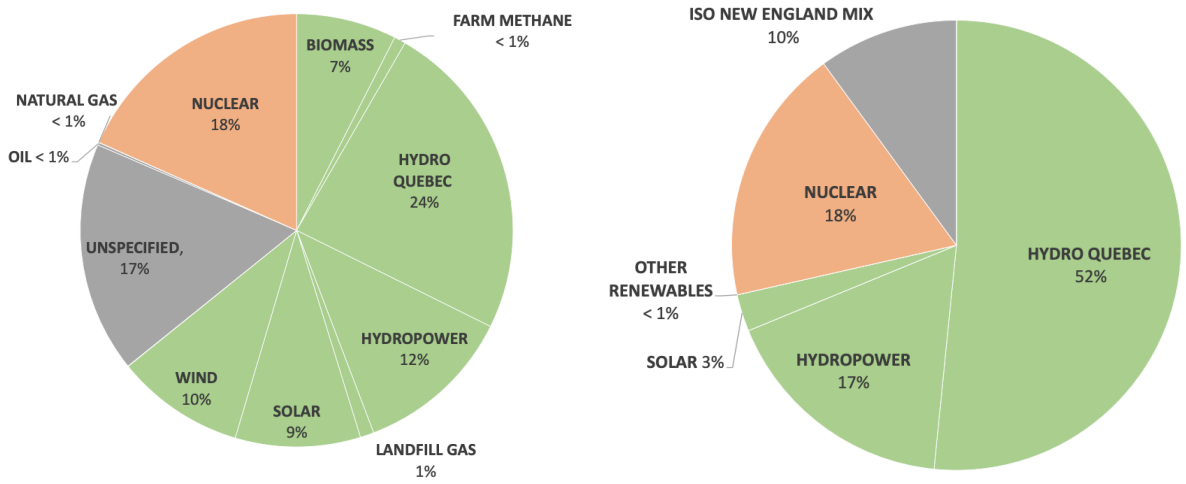

Figure 1: 2021 Vermont Electricity Characteristics: the left shows the electricity Vermont utilities generated and bought to meet demand, the right shows how renewable Vermont's electricity is considered based on renewable energy certificates (*Department of Public Service Webinar: Where Does VT Electricity Come From?* *https://publicservice.vermont.gov/sites/dps/files/documents/Webinar%201%20-%20Where%20does%20VT%20electricity%20come%20from.pdf*)

Central Vermont is served by four different distribution utility companies including Green Mountain Power, Washington Electric Cooperative, the Northfield Electric Department, and the Hardwick Electric Department (see Table 1, below, for customer counts and types by town; and Figure 2 for DU territory). Green Mountain Power (GMP) and Washington Electric Cooperative Inc. (WEC) are the region's primary distribution utilities, geographically covering most of the region. Central Vermont is unique in that most municipalities are served by at least two distribution utilities (exceptions are Warren, Waterbury, and Barre City served only by GMP; Northfield, Moretown, Berlin, and Calais are each served by 3 DUs). GMP territory is located primarily in the more populous valley areas such as Barre City, Montpelier, and many of the villages along the major transportation routes (Figure 2 above); WEC territory fills in the more rural, and primarily residential, areas. The Northfield Electric serves part of Northfield, as well as small parts of Moretown and Berlin; The Hardwick Electric Department serves much of Woodbury and a small sliver of Calais. Three phase power is limited in the region to where GMP provides it (see Figure 2 above), this is important for siting distributed generation projects but not absolutely required for most residential and even some smaller municipal/commercial plants.

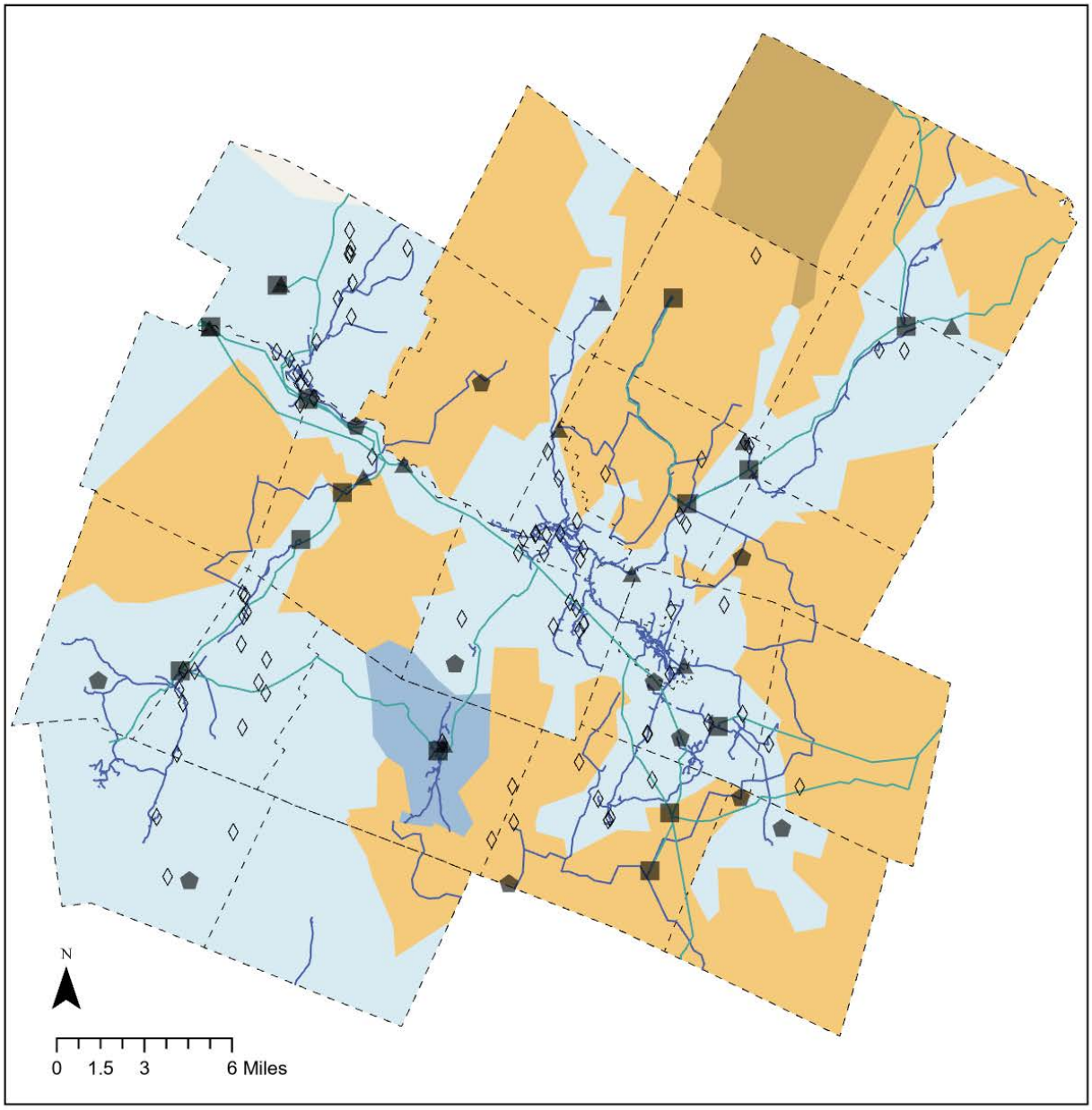

Figure 2: CVRPC Distribution Utility Territory and Infrastructure (substations, transmission lines, 3 phase power lines)
Place Holders: Distribution Utility Territory Map (only shows substations and transmission lines; distribution circuits GMP only available here)

Table 1: Customer/Member by Town and Distribution Utility (DU)

	GMP	WEC	Northfield	Hardwick
Regional Total	**27,246**	**7,167**	**2,200**	**738**[3]
Barre City	4,525			
Barre Town	3,745	412		
Berlin	1,398	83	*	
Cabot	297	508		
Calais	121	733		*
Duxbury	208	471		
East Montpelier	599	753		
Fayston	710	346		
Marshfield	547	202		
Middlesex	306	578		
Montpelier	4,794	18		
Moretown	585	325	*	
Northfield	271	289	2124[4]	
Orange	55	494		
Plainfield	406	355		
Roxbury	269	111		
Waitsfield	1,376	50		
Warren	2,494			
Washington	334	223		
Waterbury	3,072			
Williamstown	901	892		
Woodbury		78		
Worcester	233	246		

Table 2: Customer/Member by Type and Distribution Utility (DU)

DU	Dairy Farm	Residential	Commercial	Large Power	**Total**
GMP		22,337	4,909		**27,246**
WEC	33	6,725	398	11	**7,167**
Northfield					**2,200**
Hardwick					**738**

[3] Northfield Electric and Hardwick Electric did not provide updated customer counts by towns, these numbers come from their Integrated Resource Plans and the number from Hardwick Electric specifically reflects the number of customers on the Woodbury Circuit which may or may not reflect the true total customers in the region (a map of their circuits is not available online). Data requests were sent over the course of Fall 2023 and Winter 2024.

[4] Northfield has not provided specific customer counts by town; 2200 customers are served according to the Integrated Resource Plan; Efficiency VT data reported 2,124 residential premises served in Northfield, subtracting those reported by GMP and WEC gives this number although it should be noted that Efficiency Vermont data is simply given as residential premises not customers.

The Washington Electric Cooperative Inc. (WEC), a member-owner utility run by a 9-person member elected board, provides electricity to the more rural areas throughout Central Vermont. Its service territory covers a larger area geographically in Central Vermont than any other utility, serving approximately 7,167 customers. Due to the rural nature of WEC's service area, residential users account for an unusually high proportion of total demand; furthermore, the rural infrastructure is not co-located as often with roads nor hardened (buried), making it both more susceptible to Vermont's increasingly frequent extreme weather and more difficult to maintain and repair.

Central Vermont has 32 substations in 14 of our towns; most towns are at least partially served by additional substations outside the region. Distribution substation location, condition, and headroom capacity are important to consider when proposing distributed generation (DG) projects (see Enhanced Energy Element for a description of barriers and costs). Ultimately, the different distribution utilities in our region have unique challenges and benefits, most towns can utilize coverage by 2 or more DUs to maximize opportunities and minimize limitations, however at the individual scale this is rarely possible. The municipality can thus play a critical role in supporting residents and businesses to access key energy opportunities including renewable generation and storage, EVSE, energy efficiency measures, and more (see enhanced energy element).

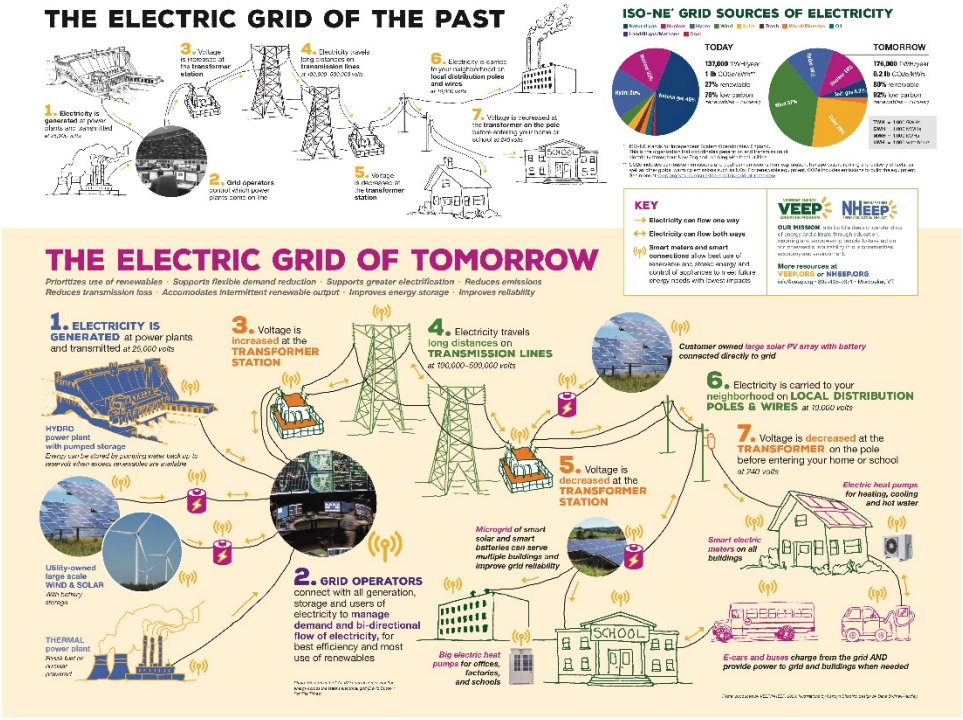

Figure 3: Electrical Grid Systems Primer, Poster from Vermont Energy Education Program[5]

[5] Vermont Energy Education Program provides resources and curricula including additional posters on Energy Audits and Actions, Heating Vermont Homes, Vermont's Climate Action Plan, VT Electricity Use and Sources, the Climate Impact of Getting to School and more (https://veep.org).

Electric Transmission

The Vermont Electric Power Company, Inc. (VELCO) manages the safe, reliable, cost-effective transmission of electric power throughout Vermont and as part of the integrated New England regional network. VELCO updates its Long Range Transmission Plan every 3 years. The 2021 Long Range Transmission Plan[6] highlights that peak demand is forecast to grow due to accelerating electrification of the heating and transportation sectors. While the transmission system has sufficient capacity to serve expected future demand for the first 10-years of the 20-year planning horizon:

- Load management is necessary to serve high electrification loads consistent with Vermont's total energy goals in the 20-year planning horizon,
- Currently, DG projects are reviewed on a project-by -project basis without regard to transmission system impact, to prevent further stressing transmission and distribution systems careful coordinated statewide planning is required to successfully integrate future distributed generation and storage without significant grid reinforcements;
- There are sub-transmission scale reliability issues (categorized as causing high or low voltage, or a thermal overload in which equipment exceeds its rate temperature).

As DUs take on more and more interconnection of distributed energy projects, coordination between VELCO, DUs, the region[7], and municipalities will be increasingly important to ensure not only Vermont and its stakeholders can meet their respective goals, but that we do so in a manner that minimizes negative impacts to our landscapes and natural resources and maximizes benefits to all Vermonters foremost those who have been disproportionately burdened by energy costs and reliability issues to build resilience for all. CVRPC continues to work with DUs to integrate their Integrated Resource Planning into regional and municipal planning and project development and to advocate that regional and municipal energy planning and goals in turn are considered in their Integrated Resource Planning Processes.

Efficiency Utility

Efficiency Vermont is the statewide energy efficiency utility; it provides technical advice and financial incentives to residents, businesses, non-profits, and municipalities alike to reduce their energy use and costs with efficiency buildings, equipment, and lighting. CVRPC works closely with Efficiency Vermont to connect municipalities with opportunities and to provide support to energy committees and coordinators with resources for their communities. CVRPC also works with Efficiency Vermont to provide data on consumption and efficiency measures implemented, as well as to adapt incentives programs and support in recovery situations (e.g. July 2023 floods). More information about energy efficiency and conservation, as well as supporting partners can be found in the Enhanced Energy Element of this plan. Additional key partners include Capstone Community Action who provide income-based fuel support, weatherization, and more to community members with the lowest incomes and highest needs.

Existing Generation & Storage Facilities

For an in-depth discussion of future renewable generation in the context of demand and energy planning see the Enhanced Energy Element, this section summarizes existing energy infrastructure including non-combustion-based renewables (solar, wind, and hydroelectric), combustion-based renewables (biomass specifically for electricity generation- for discussion on biomass and the thermal sector see the Energy chapter), nuclear energy, and fossil fuels (as categorized by the 2022 State Comprehensive Energy Plan).

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[6] https://www.velco.com/assets/documents/2021%20VLRTP%20to%20PUC_FINAL.pdf

[7] noted also by the Department of Public Service in the 2022 Vermont Comprehensive Energy Plan (e.g. pages 68, 87) https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan_0.pdf

There is one remaining fossil fuel peaking power plant in Central Vermont in Berlin run by Green Mountain Power:

Table 3: Regional Fossil Fuel Generation

Resource Type	MW	Town	Name	Details
Fossil Fuels	46.5MW	Berlin	Berlin 1	Gas Turbine, 46yo. Largest peaking plant in VT consisting of a gas turbine generator and 2 engines run on low-sulfur kerosene fuels. Full winter output is 50MW; 40MW in summer. Improvements were made in 2008, 2012, 2013, 2019, and 2020[8].

Existing Renewable Energy Generation has noticeably increased since the last plan:

Table 4: Existing Renewable Electricity Generation

Existing Generation	**2024**		**2016**	
Resource Type	**MW**	**MWh**	**MW**	**MWh**
Solar	41.7	53876.4	24	29,919
Wind	0.24	473.04	0.14	486
Hydroelectric	26	134,861.4*	25	88,467
Biomass (wood, methane, farm biogas)	0	0	3	13,091
Total Existing Regional Renewable Electricity Generation	**68**	**189,211**	52.14	131,963
Total Storage	**7.95MW****			

Sources: Distributed Generation Survey (Distribution Utilities, Public Utilities Commission, Department of Public Service), Distribution Utilities Integrated Resource Plans, Federal Energy Regulatory Commission, Low Impact Hydropower Institute (Hydroelectric), Town Plans, State Comprehensive Energy Plan.
**calculated using constants provided in the supplement (consistent with those used by the Public Service Department and the Generations Scenarios Tool), except for hydroelectric which was taken directly from DUs IRPs, FERC, and LIHI.*

The closure of the Moretown Landfill is a significant change for Central Vermont; while there are thus no longer biomass electricity generation facilities in the region, WEC acquired a significant portion of their power to serve their territories including Central Vermont from the Coventry Landfill facility among others biomass facilities just outside the region. CVRPC does not anticipate biomass becoming an electricity generation source in the region, although it plays a critical role in the thermal sector for both space and water heating and will continue to be a key resource for residential heating in particular (see Enhanced Energy Element).

The region's hydroelectric facilities, though few in number make up over a third of the region's renewable generation, balancing ecological considerations, flood management, and energy generation potential at these and potential future sites is a high priority topic for future planning efforts (see Map of existing and potential hydroelectric sites in the Enhanced Energy Element). These are not new resources, despite the contrast in the table above, they were not reported in the previous plans assessment which likely was sourced specifically

[8] page 192 of Green Mountain Power's 2021 Integrated Resource Plan https://greenmountainpower.com/wp-content/uploads/2021/12/2021-Integrated-Resource-Plan.pdf

from the distributed generation inventory (DG Survey, see below) based off the Public Utilities Commission which focuses, generally, on smaller projects most participating in the State's net-metering program.

By and large the most change has been solar generation; in terms of numbers most are small residential scale plants (many, but certainly not all, are rooftop- we do not have data specifying the type. Below, in the table of renewable distributed generation in our region (<5MW), there is a clear preference, or at least ability to access and implement, smaller scale projects.

Table 5 Distributed Generation Projects <5MW (DG Inventory as of 2/2024)

Total from DG Survey (not regional total)	MW	# Projects	
Generation <15kW Category I	14.69856	2233	Residential scale- most solar.
Generation 15kW to <150kW (Category II)	6.56739	184	Generally includes Municipal/Community Scale (not limited to)
Generation 150kW to <500kW (Category III)	6.18665	23	Currently have to be preferred sites to participate in net metering
Generation 500kW+	22.944	23	
DG Total:	50.3966	2463	

Source: Public Service Department 2/1/24, Current DG Survey (<5MW), see Methodology for aggregation below

This is very much in line with the results of community engagement efforts CVRPC conducted in the fall of 2023 in partnership with the Department of Public Service and the other RPCs. CVRPC found that in addition to consistent support for a diversity of renewable resources, that support was bounded by scale- as in support decreased with the scale of the project increasing (see full report[9]). CVRPC has found both in these engagement opportunities and while working with municipalities more broadly, technology type is not generally the key factor except for strongest opposition. Instead scale, location, and perceived community benefits/burdens are important to the region. An emphasis on local, community-scale, generation and storage is paired with other measures including efficiency/weatherization, waste heat recovery opportunities, dual land use, energy independence, and more representing a more holistic view of energy systems that stemmed from a wider variety of perspectives than are often considered. See the Enhanced Energy Element for considerations and discussion of future renewable energy generation and more.

Inset box on Current State Renewable Electricity Policies/Programs

[9] CVRPC Report on Renewable Energy Standards Update Regional Engagement Events
https://publicservice.vermont.gov/sites/dps/files/documents/CVRPC%20RES%20Event%20Summary.pdf

Table 6 Existing Renewable Energy Generation and Storage by Town

TOTAL EXISTING GENERATION			PROPOSED		EXISTING SOLAR			EXISITNG HYDROELECTRIC			EXISTING WIND		
Town	Total MW	% Regional	Projects	MW	Projects	MW	% Regional	Projects	MW	% Regional	Projects	MW	% Regional
Barre City	1.03	1.50%			138	0.93	2.20%		0	0.00%	1	0.1	42.39%
Barre Town	7.92	11.70%			273	7.79	18.70%	1	0.014	0.10%	3	0.12	51.28%
Berlin	1.32	1.90%	2 solar projects	4.4	79	1.32	3.20%						
Cabot	5.84	8.60%			53	0.84	2.00%	1	5	19.20%			
Calais	0.43	0.60%			54	0.43	1.00%						
Duxbury	9.25	13.60%			51	0.45	1.10%	1	8.8	33.80%			
East Montpelier	3.45	5.10%			148	2.28	5.50%	3	1.16	4.50%			
Fayston	0.48	0.70%			65	0.48	1.20%						
Marshfield	0.61	0.90%			68	0.61	1.50%						
Middlesex	0.75	1.10%			104	0.75	1.80%						
Montpelier	4.71	6.90%			307	3.78	9.10%	2	0.93	3.60%			
Moretown	5.21	7.70%			112	0.81	1.90%	2	4.4	16.90%			
Northfield	0.39	0.60%	16 solar projects, 2 hydroelectric projects	1.26	52	0.39	0.90%				1	0.003	1.04%
Orange	1.19	1.80%			23	1.19	2.90%						
Plainfield	0.53	0.80%			81	0.53	1.30%						
Roxbury	0.26	0.40%			32	0.26	0.60%						
Waitsfield	2.6	3.80%			132	2.6	6.20%						
Warren	1.34	2.00%			140	1.34	3.20%				1	0.003	1.06%
Washington	0.24	0.40%			29	0.23	0.60%				1	0.01	4.24%
Waterbury	9.97	14.70%			338	4.45	10.70%	1	5.53	21.20%			
Williamstown	9.97	14.70%			100	9.97	23.90%						
Woodbury	0.02	0.02%			2	0.02	0.04%						
Worcester	0.42	0.60%			39	0.24	0.60%	1	0.18	0.70%			
TOTAL EXISTING	**67.95**		**5.66**		**2420**	**41.7**		**12**	**26.02**		**7**	**0.24**	

	STORAGE		
Town	Total MW	Number of Projects	% Regional
Barre City	0.1367	17	1.72%
Barre Town	5.209	26	65.52%
Berlin	0.09	10	1.13%
Cabot	0.029	3	0.36%
Calais	0.01	1	0.13%
Duxbury	0.039	5	0.49%
East Montpelier	0.069	7	0.87%
Fayston	0.105	12	1.32%
Marshfield	0.08	9	1.01%
Middlesex	0.079	8	0.99%
Montpelier	0.3595	41	4.52%
Moretown	0.097	11	1.22%
Northfield	0.035	5	0.44%
Orange	0	0	0.00%
Plainfield	0.02	2	0.25%
Roxbury	0.075	9	0.94%
Waitsfield	0.3695	41	4.65%
Warren	0.543	60	6.83%

Washington	0.025	3	0.31%
Waterbury	0.539	62	6.78%
Williamstown	0.01	1	0.13%
Woodbury	0	0	0.00%
Worcester	0.03	3	0.38%
TOTAL EXISTING	**7.9497**	**336**	**100.00%**

Key Challenge

Vermont Distribution Utilities, to varying degrees, are implementing programs to smooth energy demand peaks and valleys through flexible load management, incentives, and battery storage. These initiatives are intended to increase system reliability, help address the climate crisis, and lower customer costs. The 2021 Vermont Long-Range Transmission Plan continues to emphasize the importance of thoughtful siting of generation with respect to interconnection and grid capacity, grid automation, deployment of battery storage and flexible load management programs, grid reinforcements, as well as the communications infrastructure necessary to synchronize energy demands with supply across DUs, to ensure Vermont's transmission grid reliably serves expected load growth. The implications for our regional infrastructure, to the municipal, and household scales, include the importance of the "get ready" approach to retrofitting/switching over individual systems and components to be in line with, and thus benefitting from these broader investments which includes at times, higher up front costs and/or more intentional and longer-term phased planning- the Enhanced Energy Element will touch on many specific measures further. CVRPC thus anticipates, the key challenge facing our region is the capacity and coordination to draw down unprecedented funding and invest in not only transforming the energy sectors to meet legally binding GWSA goals to mitigate future climate change, but to support all our communities down to the local scale so that none are left behind or without options.

The vulnerability of our critical infrastructure including our energy systems to high wind, wet heavy snow, and flooding has become increasingly apparent (see Climate Chapter). In the last 5 years or so, CVRPC has noticed the increased consideration of climate impacts in DU planning, for example GMP has conducted topographical surveys of their substations to assess their location in relation to FEMA-designated floodplains.[10] While the Middlesex transmission station and hydro generation are both located on ground higher than the 100-year and 500-year floodplain, the Waterbury distribution substation was rebuilt outside the 100-year flood plain (moved from 48 Winooski Street, Waterbury to Cloverdale Lane), and the Barre South End distribution substation was raised three feet at its current location (121 South Main Street Barre City) so that it is above the 100-year floodplain (Riverton in Berlin remains in the 500-year floodplain). Again, due to structure, dominant customer type and distribution, not to mention historical development, our region's DUs are not equipped equally to handle large infrastructure projects nor the increasingly demanding recovery efforts in response to extreme weather (see outages table). CVRPC will continue to work with regional and state stakeholders, including the DUs themselves, to identify opportunities for funding and technical assistance, build transparency in planning processes, and promote public data sharing to support municipal and community efforts including Local Hazard Mitigation and Local Emergency Management Planning, as well as the development of projects and programs that promote on-site back-up power and/or the establishment of community micro-grids.

[10] 2021 GMP IRP Appendix I: Substations https://greenmountainpower.com/wp-content/uploads/2022/01/Appendix-I-Substations.pdf;

Enhanced Energy Element

3

Introduction

An introduction to the role of energy in the region with a focus on current electricity infrastructure can be found in the updated Infrastructure Chapter Excerpt of this report. The components of this Enhanced Energy Element will be integrated into existing planning processes. In addition to the Enhanced Energy Element (Chapter 3) and accompanying supplements, relevant sections are intended to ultimately be found in the Infrastructure, Natural and Working Lands, Climate, Housing, and Connected Communities chapters of the next full Regional Plan Update (see the Table 1 below for a brief summary of these intentions). Together, these elements meet the standards outlined in Act 174 (enhanced energy plan) in addition to meeting the statutory requirements for the energy element (Title 24, Chapter 117, section §4348a(a)(3)). They have been pulled together and abbreviated for the purpose of this report. This update is intended as the first phase of a more comprehensive full regional plan update (2025). This allows CVRPC to work with its municipalities in developing and updating their own plans; to further develop and customize targets; expand our mapping products including coordination with distribution utility integrated resource planning; and coordinate pathways. Highlights in progress for the next update include:

- a summary of municipal building & facilities needs and distributed energy projects established via the Municipal Energy Resilience Grant Program assessment reports (and municipal energy use baselines):
- regional GHG (greenhouse gas) emissions inventory:
- expanded mapping products and tools:
- siting guidelines based on project size and type:
- stakeholder and program insets.

Table 1 Future Integration into Full Regional Plan Update (2025)

Chapter	Components
Infrastructure	Introduction to Electric Infrastructure & Stakeholders, Distribution and Transmission constraints and improvements; Regional Trends, Grid Modernization and Resilience; other Energy Infrastructure
Transportation	EV &EVSE (existing), EV-&EVSE-ready regs/policies, transportation sector use, analyses and targets (Enhanced Energy Plan components); implications of electrification; municipal fleet inventories, policy changes, goals re electrification, efficiency, reducing VMT, etc.
Housing/Healthy Communities/Economy	RBES, Net Zero Ready by 2030, EVSE& Solar Ready, Energy Burden, Affordable Heat Act, Thermal Sector; CBES, renewable energy industry hub

After a brief overview of statutory requirements and context of major state policies, this element will introduce some key energy equity and stakeholder considerations in order to frame the more technical discussions that follow. These framing considerations are intended to ensure policies, recommendations, and implementation pathways center an energy transition that is both expedient and accessible to not only all our communities but all our community members. The majority of this element is split into the three energy sectors: Electricity, Thermal, and Transportation each featuring current use estimations, followed by regional targets and analyses, key issues, and implementation pathways. The final section includes a more in-depth discussion of existing and future renewable energy generation (and supporting energy infrastructure) in the Central Vermont Region and includes mapping products and analyses, as well as next steps. These sections are intended to follow, broadly, the structure of the Regional Determination Standards for the determination of energy compliance.

State and Regional Context

During the 2016 legislative session, the State of Vermont passed Act 174, an act related to improving the siting of energy projects. Act 174 outlines a path whereby regions and municipalities could receive "substantial deference"[1] for applications that seek to receive a Certificate of Public Good before the Public Utility Commission (formerly the Public Service Board) if certain considerations were incorporated into a regional or municipal development plan. Act 174 provides an avenue for regions and municipalities to have increased input in PUC determinations for Certificates of Public Good regarding renewable energy generation facilities. Otherwise, a plan will receive "due consideration" in the Section 248 review process. Act 174 is categorized as enhanced energy planning and goes beyond what is outlined in 24 VSA 117 Section §4348a and §4382 respectively (see below for contents; supplement for details). In general, the requirements of Act 174, and updated in 2022 in line with the Climate Action Plan, work in conjunction with the existing statutory information required to be included in a regional plan's energy element (as described in 24 V.S.A. § 4348a(a)(3)). Furthermore, the standards outlined in Act 174 require regional and municipal plans to be consistent with the following State Goals, Policies, and Plans in Table 2.

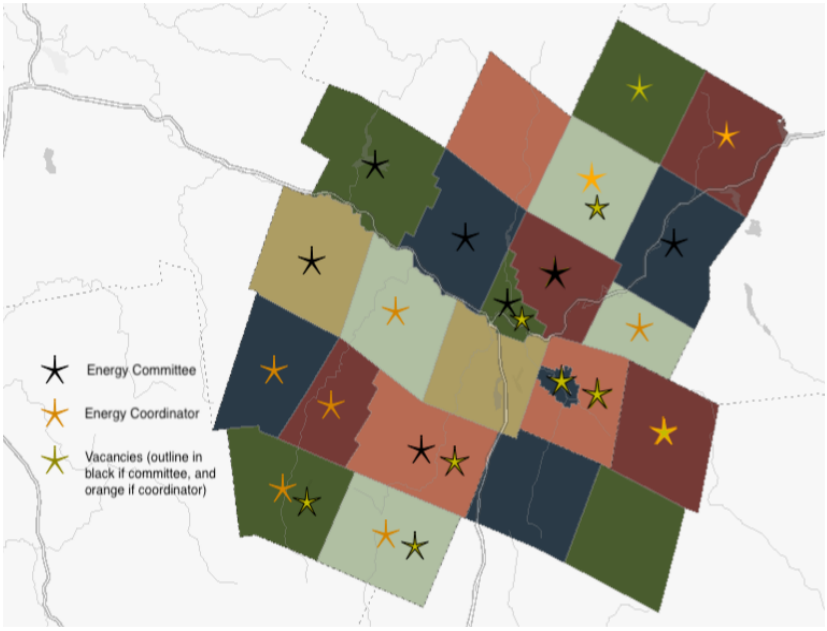
Table 2 Overarching State Goals and Policies

	2025	2030	2035	2040	2050
Comprehensive Energy Plan 30 V.S.A § 202a State Energy Policy	25% of energy needs from renewable sources		45% of energy needs from renewable sources		90% of energy needs from renewable sources
meet % of demand from renewable resources:	10% transportation demand 30% thermal demand	100% electricity demands (2032) carbon-free (≥75% renewable)		45% transportation demand 80% thermal demand (2042)	
Global Warming Solutions Act:	26% reduction GHG from 2005 levels	40% reduction from 1990 levels			80% reduction from 1990 levels

[1] According to Act 174 of 2016, "substantial deference" means that a land conservation measure or specific policy shall be applied in accordance with its terms unless there is a clear and convincing demonstration that other factors affecting the general good of the State outweigh the application of the measure or policy. The term shall not include consideration of whether the determination of energy compliance should or should not have been affirmative under 24 V.S.A. § 4352.

10 V.S.A. § 578(a) GHG Emissions Reduction Requirements;					
25 by 25 State Goal 10 V.S.A. § 580	produce 25% state energy consumption in-state				
Building Efficiency Goals 10 V.S.A. § 581	reduce fossil fuel consumption across all buildings by 10%				
Climate Action Plan 10 V.S.A. § 592		90,000 homes weatherized			
Renewable Energy Standard 30 V.S.A. § 8004 and 8005	Update pending:	100% Renewable for GMP&VEC (Tier I) 20% Instate Renewable by 2032 GMP&VEC (Tier II)	100% renewable all other DUs (Tier I) 20% Instate Renewable all other DUs (Tier II) 20% New Regional Renewable for GMP, 10% all other DUs (excluding large hydro; restrictions on biomass) 100% Load Growth from new renewables for GMP&VPPSA		

The Central Vermont Regional Planning Commission first received a Determination of Energy Compliance (DOEC) through the Vermont Public Utilities Commission (PUC) with the 2018 Regional Energy Plan adopted as an amendment and Appendix A-7 of the 2016 Regional Plan. Since, 7 of municipalities have received determinations of energy compliance via municipal enhanced energy plans including Barre Town, Northfield, Waterbury, Waitsfield, Middlesex, Plainfield, and Woodbury, 1 municipality has a Net Zero Action Plan (Montpelier), 5 are currently in the Enhanced Energy Planning process (including Worcester, East Montpelier, and Marshfield), and at least 5 more municipalities had developed drafts which were interrupted by the pandemic (and while they have not yet submitted their plans for approval, do include targets, maps, and preferred siting language in their existing town plans). Municipal breakouts of the Regional analyses and targets based State forecasting from the Low Emissions Analysis Platform (LEAP), a software tool for energy system modeling and emissions accounting, across residential, commercial, industrial, and transportation energy use, as well as a municipal breakouts of the mapping products to support municipal planning and implementation, will be posted and hosted on the CVRPC website once this plan has been reviewed and approved (drafts will likely be made available earlier over the course of April 2024, to support the 5+ municipalities currently working on their own enhanced energy plans).



PLACEHOLDER FIGURE 1: Town with Enhanced Energy Plans, Energy Committees and Coordinators

As of Winter 2024, Central Vermont has 15 towns with active Energy Committees and/or Coordinators and 5 towns with vacant or inactive Energy Committees or Coordinators (Figure 1). Energy Committees and Coordinators have varying roles:

- Advise town legislative and planning bodies concerning Town energy policy including enhanced energy planning, project development/review, etc.,
- Promote municipal energy efficiency and resilience, and lower energy costs,
- Develop municipal/community projects from renewable energy generation and storage projects to running WindowDressers Community Builds (see insert),
- Develop and implement community outreach, education, & neighbor: neighbor campaigns to provide residents and businesses with resources to reduce energy burdens, improve energy efficiency, and reduce greenhouse gas emissions.

CVRPC has noticed a significant increase in engagement with enhanced energy and other planning processes at the local, regional, and local levels in parallel with town participation in programs like Municipal Energy Resilience Grant Program (Act 172), the new incentives available through the IRA (Inflation Reduction Act), etc. as more towns see a role for themselves in project development while feeling urgency to reduce energy burdens and increase community resilience in the face of global climate change.

Pathways & Implementation Actions

The Pathways & Implementation Actions are described in the goals and policies presented throughout this report; these provide the basis for how the region will meet our target goals, as well as additional regional and state goals in line with the Vermont Climate Action Plan and Comprehensive Energy Plan. CVRPC regional energy planning, in coordination with neighboring regions and the Department of Public Service, strives to integrate overarching goals and principles from the Energy Equity Project (EEP) in an effort to assess the potential impacts of the policies included herein (Enhanced Energy Plan Standard 10).

CVRPC has approached discussions of trends and key issues, and especially implementation pathways in this plan with intention to prioritize access, affordability, and participation considering folks most burdened by the impacts of climate change and the costs of energy in Vermont *first* (including folks with low or fixed incomes,

residents of color, renters, electrically dependent residents, etc.). CVRPC has adapted the guiding principles and assessment rubric[2] from the Just Transitions sub-committee of the Vermont Climate Council to utilize in future planning as well as project development and prioritization processes. Often, short term upfront costs are evoked as an equity issue to programs and policies that in the medium and long term can have profound desired impact while barriers like access, mechanisms of incentives (e.g. reimbursement, loans, tax-incentives), and/or other frequently cited barriers are perpetuated. CVRPC, in partnership with THRIVE Community Health partners and our energy committees and coordinators, have been working with income based and recovery adder programs (e.g. with Efficiency Vermont) and the State in the development of programs like ChargeVT, to move towards upfront cost coverage, community-build, sliding scale match, and other mechanisms in coordination with revolving loan funds and/or community funds to lower barriers. At all scales it is increasingly important to consider the time frame used to determine least cost: longer term cost horizons are critical when considering the benefits and costs of a just transitions. Clean, affordable, resilient, and reliable energy is a critical component of building social as well as physical infrastructure and community resilience. It is an important time to leverage federal and state funding opportunities by building administrative and procurement capacity, establishing community benefit agreement models, and fostering community expertise sharing. Transitioning away from fossil fuels, promoting energy efficiency, weatherization, and renewables, while addressing energy burden will have direct and positive impacts for all Vermonters.

Energy burden is just one metric to consider when assessing potential impacts and needs. In Central Vermont, outages (frequency and duration), income, distribution utility, and fuel assistance uptake, are key recurring considerations throughout this report and the region. A series of new tools and metrics have been and continue to be developed at the State and Federal level with varying applicability to Vermont (inset below). CVRPC is committed to continue to engage with these tools and resources and integrate them into future planning.

Federal Indices/Programs	State Definitions	State Indices/Tools

• Justice40+/-
  • Energy Justice Mapping Tool- Disadvantage Communities Reporter
  • Climate and Economic Justice Screening Tool
  • EPA-EJ screening and mapping tool
■ Economic Innovation Group's Distressed Communities Index (DCI) Interactive Map: relative distress scores and economic distress characteristics
■ DOE's Low-Income Energy Affordability Data (LEAD) Tool
■ Social Vulnerability Index Score (relative health burden; GMP used as part of their scoring)
■ EIG's Opportunity Zone Activity Map, Distressed Energy Community, Disadvantaged Community
	As defined by Act 154, environmental justice populations are "any census block group in which: (A) the annual median household income is not more than 80% of the State median household income; (B) Person of Color and Indigenous Peoples comprise at least 6% or more of the population; or (C) at least 1% or more of households have limited English proficiency."	■ Vermont Environmental Disparity Index and Environmental Risk
		■ Forthcoming Environmental Justice Communities Tool (S.248)
		■ Municipal Vulnerabilities Index (Climate Action Office)
		■ Vermont Community Index/Underserved Communities (AOA)
		■ Vermont Department of Health's vulnerability indicators

[2] Vermont Climate Council's Guiding Principles for a Just Transition

Most of these tools rely on American Community Survey data and the census tract resolution is often too coarse to be very useful. For example, using the Climate & Economic Justice Screening Tool (CJEST) associated with the Justice 40 campaign (which uses data from DOE's LEAD Score, the EPA's EJScreen, and ACS) only 1 Barre City Tract would qualify as disadvantaged in Central Vermont; although the improved energy justice map viewer with the 36 burden indicators could be useful in the context of project prioritization at the state and perhaps at the regional level, they do not provide useful insights for municipal scale planning. They are however, attached to eligibility for funding and technical assistance programs making these useful and important guardrails, albeit coarse ones. Meaningful community level asset inventories, needs assessments, sustained community engagement, and related efforts will be critical going forward to drive frontline community identification for prioritization--any of these could be included as pathway actions for implementation. Furthermore, establishing an iterative process where this is done regularly and to the project scale is a pathway that merits consideration.

The implementation actions identified in this section focus primarily in areas where the Central Vermont Regional Planning Commission is already working to support its member municipalities through energy, local land use, transportation, environmental, and health equity planning activities. To this end, implementation actions are aggregated from across this plan to establish consistency across the different programs and priorities; to ensure all the categories for implementation as noted above were adequately addressed, guidance from the Department of Public Service related to implementation was utilized. Where appropriate, the implementation actions and pathways identify who will be responsible for completing each action, the timeframe for when it should be completed, and an anticipated outcome that will help provide measures for success. These pathways serve as the basis for how energy planning will be incorporated into regional activities, with suggestions for municipalities as well.

While Central Vermont is home to key members of the Clean Energy Industry, not only in Vermont but nationally, a significant challenge in the implementation of the region’s energy goals is lack of workforce. Supporting workforce development at a rapid rate has to become a key priority for all those engaged with climate and energy planning. The Clean Energy Industry Report has tracked Vermont employment in the clean energy sectors since 2014. As of 2020, clean energy jobs made up about 6% of total employment in Vermont. Generally, the median wage for clean energy jobs (approx. $27/hour) is much higher than the statewide median wage (approx. $19/hour). Meeting our climate commitments via investments in energy efficiency and clean energy can be a win for Vermont consumers, the Vermont economy, and Vermont workers.

Town	Median Household Income	Electricity Spending	Thermal Spending	Transportation Spending	Total Spending	Total Energy Burden	Energy Burden Group
Barre City	$35,225	$1,110	$1,965	$2,227	**$5,302**	**15.1%**	Highest
Cabot	$43,864	$1,096	$2,081	$2,725	**$5,902**	**13.5%**	High
Plainfield	$48,529	$987	$2,222	$2,657	**$5,865**	**12.1%**	High
Worcester	$49,167	$1,085	$1,882	$2,757	**$5,724**	**11.6%**	High
Williamstown	$57,792	$1,221	$2,317	$2,584	**$6,122**	**10.6%**	Moderate
Washington	$56,696	$1,213	$2,062	$2,693	**$5,968**	**10.5%**	Moderate
Roxbury	$56,667	$1,059	$1,987	$2,703	**$5,749**	**10.1%**	Moderate
Berlin	$59,792	$1,161	$2,120	$2,585	**$5,866**	**9.8%**	Moderate
Marshfield	$60,833	$1,081	$2,050	$2,680	**$5,812**	**9.6%**	Moderate
Orange	$62,829	$1,094	$2,089	$2,692	**$5,874**	**9.3%**	Moderate
Waterbury	$65,750	$1,131	$2,426	$2,557	**$6,114**	**9.3%**	Moderate
Warren	$66,250	$1,101	$2,343	$2,608	**$6,052**	**9.1%**	Moderate
Barre Town	$70,521	$1,204	$2,396	$2,669	**$6,268**	**8.9%**	Low
East Montpelier	$67,844	$1,209	$2,131	$2,678	**$6,018**	**8.9%**	Low
Calais	$64,766	$964	$1,974	$2,747	**$5,685**	**8.8%**	Low
Moretown	$69,375	$1,135	$2,223	$2,707	**$6,065**	**8.7%**	Low
Woodbury	$63,438	$949	$1,839	$2,755	**$5,543**	**8.7%**	Low
Northfield	$67,750	$1,105	$2,099	$2,585	**$5,789**	**8.5%**	Low
Montpelier	$60,793	$957	$1,804	$2,288	**$5,049**	**8.3%**	Low
Middlesex	$74,188	$1,130	$2,191	$2,749	**$6,071**	**8.2%**	Low
Duxbury	$75,000	$1,074	$2,276	$2,752	**$6,103**	**8.1%**	Low
Fayston	$79,940	$1,080	$2,646	$2,681	**$6,407**	**8%**	Low
Waitsfield	$78,264	$1,189	$2,317	$2,660	**$6,166**	**7%**	Low

Table 3 Energy Burden (2019 Efficiency Vermont Report)

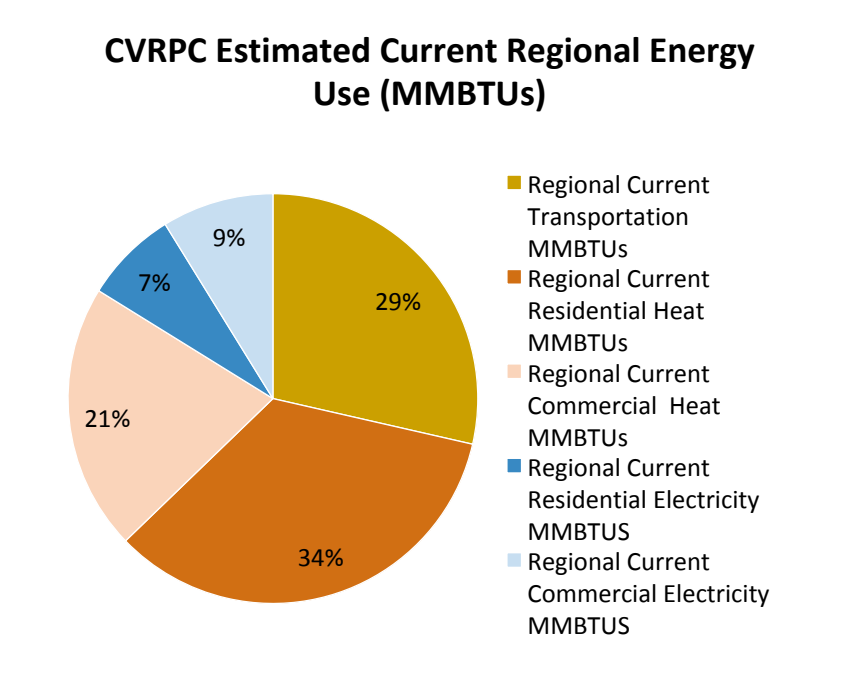
CVRPC Energy Use, Targets, and Pathways (by Sector)

The data in this section is intended to provide an overview of current Central Vermont (CVRPC) energy use and a sense of the trajectories and scale of change needed to meet the region's shares of the State's goals. Current residential and commercial & industrial electricity usage data is provided by Efficiency Vermont (both municipal and regional totals- see supplement), transportation and thermal sector data is estimated via the Municipal Consumption Tool which pulls from a variety of sources including the Vermont Department of Public Service, American Community Survey, Vermont Department of Labor, the Vermont Department of Motor Vehicles, and DriveElectric (VEIC) (see supplement for specifics). Using the regionalized LEAP results provided by the Department of Public Service, targets are established to provide milestones for thermal efficiency; renewable energy use; and conversion of thermal and transportation energy from fossil fuel based to renewable resources. These milestones are intended to help the region measure progress towards the overall goals and are not identified as requirements. **Regional LEAP targets were disaggregated using each municipality's share of current regional energy use, municipal disaggregation factors were calculated for transportation (Light Duty Vehicles), residential thermal, commercial thermal, residential electric, and commercial electric.** Targets are established for the years 2025, 2035, and 2050 which coincide with the State Comprehensive Energy Plan (update 2022). Targets include both a "business as usual" baseline and the CAP (Climate Action Plan) mitigation scenario targets. While a summary of results is included below and referenced throughout this chapter, a walkthrough of the methods, data sources, and interim steps are included in the supplement and accompanying tools and supporting resources hosted by the Department of Public Service. Furthermore, full details of the LEAP Model methods, data sources and assumptions may be found as Appendix D to the 2022 Comprehensive Energy Plan[3]. Municipal analyses and targets will be made available on the CVRPC website and in the supplement.

Regional Energy Use Summary:

Table 4 Estimates Current Regional Energy Use

Source: Municipal Consumption Worksheet Department of Public Service- ACS 5 Year Estimates



Sector	Current Regional Energy Use (MMBTUs)
Transportation (LDV)	**2,829,963**
Residential Thermal	3,386,790
Commercial Thermal	2,083,630
Total Thermal	**5,477,225**
Residential Electric	729,483
Commercial & Industrial Electric	872,505
Total Electric	**1,601,987**

[3] https://publicservice.vermont.gov/content/2022-cep-analysis-greenhouse-gas-emission-reduction-pathways-vermont

Broadly across 2020-2023, the thermal sector is still the largest energy use at 57% including both residential and commercial space and water heating. Transportation is the second largest energy use in the region accounting for 27% of total usage although it is important to note this is limited to light-duty vehicles (commercial and medium- and heavy- duty data not available), followed by the electric sector at 16%.

The sections below focus on the electric, thermal, and transportation sectors one at a time, introducing current use, regional targets, key challenges, and pathways. However, it is important to consider inter-sector impacts and measures. For examples, the electrification of the transportation and thermal sectors is demanding a state wide rethinking of electrical efficiency targets and use trajectories (increasing), while geothermal and waste heat recovery systems can offset increasing electric thermal load; weatherization is a key precursor to fuel switching impacts, while fuel switching and HVAC retrofits should consider future potential project phases including on-site generation and storage, etc.

Thermal Sector- Residential

This section provides a coarse regional overview of current energy use in the thermal sector- space and water heating- in the residential and commercial sectors, followed by sector targets, and pathways to meet them. The residential thermal sector currently makes up the largest share of regional energy use (see table 4 above); the tables below provide a rough summary of fuel types and how homes are heated in the Central Vermont Region. These estimates are based on 2022 ACS 5-year estimates, which have large margins of error especially in rural areas and only identify one primary heating fuel while many residents use two or more (see Methodology Supplement for detailed discussion). Fossil fuels continue to be the predominant source of residential heating in Central Vermont with fuel oil the most widely used reported in 49% of CVRPC households (51% of owner-occupied and 43% of renter-occupied CVRPC households), followed by propane; together reported in 78% of the regions households (82% of renter-occupied homes and 77% of owner-occupied homes). Wood/biomass is used in approximately 14% of the regions homes (18% owner-occupied and only 4% renter-occupied homes). Variation across our region is high; in a quarter of the towns in our region wood is used in 34-43% of homes (see below for further discussion of wood heat). Approximately 6% of homes report electricity as their heat source, this is a slight increase from the previous plan which is interpreted as likely to be heat pumps, although the base % is likely to be residual electric resistance heat- as we track changes in electric heat into the future, it will likely increase with the adoption of air sourced and ground source heat pumps, although this may be obscured if they are used, as they often are, in combination with other heating sources (thus it will depend on if they are reported as primary or secondary sources). Lastly, due to large margins of error, it is difficult to determine if there are indeed less than 1% of households still using coal and without fuel; it is difficult to interpret the categories of solar and other, solar may refer to passive or active solar heating, or given the rise since the last plan it's possible respondents have installed solar panels and have heat pumps and are misidentifying their fuel type. The predominance of fossil fuel in the residential heating sector is a cost burden to our region's residents and contributes a relatively small amount of in state labor to our economy (in comparison to cord wood or even electricity which keep more jobs and dollars local); there is a clear opportunity and responsibility across the region to consider fuel-switching (primary heating source or entirely), weatherization and other efficiency measures which will reduce fuel use and emissions contributions (see below).

Table 5 Current Regional Residential Heating Energy Use by Fuel Source

Residential Fuel Source	2020 ACS 5 Year Estimate				2015 ACS 5 Year Estimate			
	CVRPC Households	CVRPC % Households	CVRPC Square Footage Heated	CVRPC BTU (in Billions)	CVRPC Households	CVRPC % of Households	CVRPC Square Footage Heated	CVRPC BTU (in Billions)
Natural Gas & Propane	7,935	29%	12,927,060	776	5,983	22%	9,632,438	578
Electricity	1,534	6%	1,937,060	116	1,206	5%	1,494,263	90
Fuel Oil	13,376	49%	23,073,188	1,384	14,238	53%	24,431,228	1,466
Coal	15	<1%	29,352	1.8	66	<1%	132,664	8
Wood	3,875	14%	7,342,750	441	5,031	19%	9,493,439	570
Other (Solar +)	656	2%	1,117,591	67	392	2%	696,536	42
No Fuel	34	<1%	44,545	2.7	22	<1%	42,680	3
Total	**27,425**		**46,427,157**	**2788**	**26,938**		**45,923,248**	**2755**

Source: 2016-2020 5 Year American Community Survey; 2011-2015 ACS; DPO4, B25117, B25010

Table 6 Current Regional Residential Heating Cost Estimate

Fuel Type	Standard Unit	BTUs/Unit	Cost/Unit	Total Regional Current Costs	Source (cost/unit)
Fuel Oil, kerosene, etc.	Gallon	140,000	$4.133	40,869,208.29	Vermont Average Residential-EIA (March 2024)
Bottled, tank, or LP gas (propane)	Gallon	91,000	$3.575	30,470,927.14	Vermont Average Residential-EIA (March 2024)
Coal or coke	Ton	19,590,000	$500	44,949.46	VT newspapers and quote VT&NH suppliers
Wood (seasoned)	Cord	20,000,000	$350	7,709,887.50	(275 green-450 kiln dried) VT newspapers and quoted VT suppliers
Wood Pellets	Ton	16,400,000	$405		Vermont wood/pick-up; Energy Co-op of VT
Electricity	Kilowatt hour	3,412	$0.2109	3,939,594.36	**VT State Energy Profile, US Energy Information Administration**
Other Fuel (includes solar)				4,142,353.99	
Regional Total Cost				**$87,176,920.74**	

Tables 5, 6,& 8 are based on total occupied units, as there are many seasonal, recreation, and/or occasional use (2nd) homes across the region, Table 7 supplies an additional adder to take into consideration thermal use in these homes. Data was sourced from the 2022 ACS 5-Year Average B25004 Vacancy Characteristics (see methodology and rationale in the supplement). The Department of Public Service guidelines suggest that on average, seasonal homes account for about 5% of the thermal energy used in a year-round home (for example a seasonal camp may not have a central heating system, but it still may use propane to heat the water, have a woodstove or fireplace for unseasonably cool nights, etc.). This guidance does not quite match the Central Vermont region as several communities with many seasonal residents use their properties throughout the winter specifically and/or for more than occasional use. Thus, for estimation purposes we assigned 10% to seasonal units in the towns on the eastern half of the region featuring many lakes with summer seasonal population influx, and 25% for those on the western half of the region proximate to the region's ski resorts. While thus far fewer low temperature degree days in the winter has yet to result in reduced fuel consumption in the winter (without stable declining temperatures, residents may not adjust as naturally to cold temperatures), more frequent high temperature degree days are associated with increased heat-related health issues (VDH Climate Dashboard) including Central Vermont where few have adopted air conditioning and the threshold for health impacts is lower (86 as compared to 90 in Burlington). The increased use of air conditioning in the region will need to be assessed in future updates, as we continued to experience increasingly extreme storms, loss of stable seasons, and overall warmer, wetter conditions associated with Climate Change.

Table 7 Current Regional Residential Thermal Energy Adder (MMBTU) for Seasonal/Vacation Homes

	Seasonal/Vacation Homes	MMBTUs	% Use
Orange	36	396	0.1
Washington	55	605	0.1
Williamstown	73	803	0.1
Barre City	0	0	0.1
Barre Town	27	297	0.1
Berlin	57	627	0.1
Cabot	116	1276	0.1
Calais	117	1287	0.1
Duxbury	56	1540	0.25
East Montpelier	30	330	0.1
Fayston	565	15537.5	0.25
Marshfield	45	495	0.1
Middlesex	48	1320	0.25
Montpelier	88	968	0.1
Morteown	77	2117.5	0.25
Northfield	58	1595	0.25
Plainfield	19	209	0.1
Roxbury	124	3410	0.25
Waitsfield	233	6407.5	0.25
Warren	1735	47712.5	0.25
Waterbury	171	4702.5	0.25
Woodbury	341	3751	0.1
Worcester	66	1815	0.25
Totals	**4,137**	**97,201.5**	

TABLE 8 Current Regional Residential Fuel Use by Type and Town

% of Fuel Use by Tenure	ORANGE						WASHINGTON					
	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	#	%	#	%	#	%	#	%	#	%	#	%
Utility gas	0	0.0%	0	0.0%	**0**	**0.0%**	16	3.2%	0	0.0%	**16**	**3.1%**
Bottled, tank, or LP gas	75	19.5%	4	10.5%	**79**	**18.7%**	109	22.1%	13	46.4%	**122**	**23.4%**
Electricity	0	0.0%	3	7.9%	**3**	**0.7%**	0	0.0%	0	0.0%	**0**	**0.0%**
Fuel oil, kerosene, etc.	204	53.1%	31	81.6%	**235**	**55.7%**	191	38.7%	3	10.7%	**194**	**37.2%**
Coal or coke	3	0.8%	0	0.0%	**3**	**0.7%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	86	22.4%	0	0.0%	**86**	**20.4%**	169	34.2%	12	42.9%	**181**	**34.7%**
Other Fuel (Includes Solar)	16	4.2%	0	0.0%	**16**	**3.8%**	9	1.8%	0	0.0%	**9**	**1.7%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	384		38		**422**		494		28		**522**	

% of Fuel Use by Tenure	WILLIAMSTOWN						BARRE CITY					
	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	#	%	#	%	#	%	#	%	#	%	#	%
Utility gas	0	0.0%	0	0.0%	**0**	**0.0%**	58	3.3%	144	7.1%	202	5.3%
Bottled, tank, or LP gas	326	26.7%	75	78.9%	**401**	**30.5%**	286	16.3%	562	27.6%	848	22.3%
Electricity	30	2.5%	0	0.0%	**30**	**2.3%**	45	2.6%	287	14.1%	332	8.7%
Fuel oil, kerosene, etc.	679	55.7%	20	21.1%	**699**	**53.2%**	1,187	67.6%	976	47.9%	2163	57.0%
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	0	0.0%
Wood	160	13.1%	0	0.0%	**160**	**12.2%**	98	5.6%	48	2.4%	146	3.8%
Other Fuel (Includes Solar)	25	2.0%	0	0.0%	**25**	**1.9%**	72	4.1%	22	1.1%	94	2.5%
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	10	0.6%	0	0.0%	10	0.3%
Total Occupied Housing Units	1120		95		**1315**		1756		2039		3795	

% of Fuel Use by Tenure	BARRE TOWN						BERLIN					
	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	#	%	#	%	#	%	#	%	#	%	#	%
Utility gas	10	0.3%	0	0.0%	**10**	**0.3%**	10	1.0%	0	0.0%	**10**	**0.9%**
Bottled, tank, or LP gas	389	12.8%	76	14.4%	**465**	**13.0%**	219	22.9%	32	25.8%	**251**	**23.2%**
Electricity	82	2.7%	157	29.7%	**239**	**6.7%**	12	1.3%	4	3.2%	**16**	**1.5%**

Fuel oil, kerosene, etc.	2,146	70.4%	296	56.0%	**2442**	**68.3%**	614	64.1%	75	60.5%	**689**	**63.7%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	393	12.9%	0	0.0%	**393**	**11.0%**	88	9.2%	13	10.5%	**101**	**9.3%**
Other Fuel (Includes Solar)	27	0.9%	0	0.0%	**27**	**0.8%**	15	1.6%	0	0.0%	**15**	**1.4%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	3047		529		3576		958		124		1082	

% of Fuel Use by Tenure	**CABOT**						**CALAIS**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		**Owner Occupied**		**Renter Occupied**		**Total Occupied**	
	♯	**%**	♯	**%**	♯	**%**	♯	**%**	♯	**%**	♯	**%**
Utility gas	0	0.0%	0	0.0%	**0**	**0.0%**	26	4.1%	0	0.0%	**26**	**3.6%**
Bottled, tank, or LP gas	108	21.1%	24	24.7%	**132**	**21.7%**	86	13.6%	52	57.8%	**138**	**19.1%**
Electricity	11	2.2%	10	10.3%	**21**	**3.5%**	0	0.0%	0	0.0%	**0**	**0.0%**
Fuel oil, kerosene, etc.	144	28.2%	35	36.1%	**179**	**29.4%**	193	30.5%	24	26.7%	**217**	**30.0%**
Coal or coke	2	0.4%	0	0.0%	**2**	**0.3%**	8	1.3%	0	0.0%	**8**	**1.1%**
Wood	181	35.4%	28	28.9%	**209**	**34.4%**	295	46.6%	14	15.6%	**309**	**42.7%**
Other Fuel (Includes Solar)	65	12.7%	0	0.0%	**65**	**10.7%**	25	3.9%	0	0.0%	**25**	**3.5%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	511		97		**608**		633		90		**723**	

% of Fuel Use by Tenure	**DUXBURY**						**EAST MONTPELIER**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		**Owner Occupied**		**Renter Occupied**		**Total Occupied**	
	♯	**%**	♯	**%**	♯	**%**	♯	**%**	♯	**%**	♯	**%**
Utility gas	3	0.6%	0	0.0%	**3**	**0.5%**	0	0.0%	0	0.0%	**0**	**0.0%**
Bottled, tank, or LP gas	201	41.5%	42	50.0%	**243**	**42.8%**	319	32.5%	18	12.5%	**337**	**29.9%**
Electricity	0	0.0%	0	0.0%	**0**	**0.0%**	16	1.6%	14	9.7%	**30**	**2.7%**
Fuel oil, kerosene, etc.	150	31.0%	35	41.7%	**185**	**32.6%**	378	38.5%	107	74.3%	**485**	**43.0%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	130	26.9%	3	3.6%	**133**	**23.4%**	239	24.3%	5	3.5%	**244**	**21.7%**
Other Fuel (Includes Solar)	0	0.0%	4	4.8%	**4**	**0.7%**	31	3.2%	0	0.0%	**31**	**2.8%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	484		84		**568**		983		144		**1127**	

% of Fuel Use by Tenure	**FAYSTON**	**MARSHFIELD**

	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	♯	%	♯	%	♯	%	♯	%	♯	%	♯	%
Utility gas	4	1.0%	0	0.0%	**4**	**0.8%**	6	1.1%	0	0.0%	**6**	**1.0%**
Bottled, tank, or LP gas	254	60.5%	54	100.0%	**308**	**65.0%**	89	16.3%	5	7.6%	**94**	**15.4%**
Electricity	0	0.0%	0	0.0%	**0**	**0.0%**	15	2.8%	0	0.0%	**15**	**2.5%**
Fuel oil, kerosene, etc.	81	19.3%	0	0.0%	**81**	**17.1%**	207	38.0%	33	50.0%	**240**	**39.3%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	78	18.6%	0	0.0%	**78**	**16.5%**	198	36.3%	28	42.4%	**226**	**37.0%**
Other Fuel (Includes Solar)	3	0.7%	0	0.0%	**3**	**0.6%**	30	5.5%	0	0.0%	**30**	**4.9%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	420		54		**474**		545		66		**611**	

% of Fuel Use by Tenure	MIDDLESEX						MONTPELIER					
	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	♯	%	♯	%	♯	%	♯	%	♯	%	♯	%
Utility gas	5	0.7%	0	0.0%	**5**	**0.7%**	47	2.2%	85	5.0%	**132**	**3.4%**
Bottled, tank, or LP gas	215	30.4%	8	25.0%	**223**	**30.1%**	363	16.9%	627	36.7%	**990**	**25.6%**
Electricity	5	0.7%	0	0.0%	**5**	**0.7%**	80	3.7%	173	10.1%	**253**	**6.6%**
Fuel oil, kerosene, etc.	291	41.1%	11	34.4%	**302**	**40.8%**	1,369	63.6%	723	42.4%	**2092**	**54.2%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	177	25.0%	13	40.6%	**190**	**25.7%**	251	11.7%	14	0.8%	**265**	**6.9%**
Other Fuel (Includes Solar)	15	2.1%	0	0.0%	**15**	**2.0%**	39	1.8%	66	3.9%	**105**	**2.7%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	5	0.2%	19	1.1%	**24**	**0.6%**
Total Occupied Housing Units	708		32		**740**		2154		1707		**3861**	

% of Fuel Use by Tenure	MORETOWN						NORTHFIELD					
	Owner Occupied		Renter Occupied		Total Occupied		Owner Occupied		Renter Occupied		Total Occupied	
	619	%	102	%	♯	%	1,351	%	455	%	♯	%
Utility gas	3	0.5%	0	0.0%	**3**	**0.4%**	0	0.0%	32	7.0%	**32**	**1.8%**
Bottled, tank, or LP gas	267	43.1%	42	41.2%	**309**	**42.9%**	156	11.5%	45	9.9%	**201**	**11.1%**
Electricity	26	4.2%	38	37.3%	**64**	**8.9%**	28	2.1%	73	16.0%	**101**	**5.6%**
Fuel oil, kerosene, etc.	178	28.8%	16	15.7%	**194**	**26.9%**	910	67.4%	278	61.1%	**1188**	**65.8%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	119	19.2%	3	2.9%	**122**	**16.9%**	257	19.0%	0	0.0%	**257**	**14.2%**

Other Fuel (Includes Solar)	26	4.2%	3	2.9%	**29**	**4.0%**	0	0.0%	27	5.9%	**27**	**1.5%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	619		102		**721**		1351		455		**1806**	

% of Fuel Use by Tenure	**PLAINFIELD**						**ROXBURY**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		**Owner Occupied**		**Renter Occupied**		**Total Occupied**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Utility gas	0	0.0%	0	0.0%	**0**	**0.0%**	3	0.8%	0	0.0%	**3**	**0.7%**
Bottled, tank, or LP gas	85	22.8%	28	16.5%	**113**	**20.8%**	100	27.4%	8	12.5%	**108**	**25.2%**
Electricity	2	0.5%	22	12.9%	**24**	**4.4%**	0	0.0%	1	1.6%	**1**	**0.2%**
Fuel oil, kerosene, etc.	148	39.8%	103	60.6%	**251**	**46.3%**	161	44.1%	35	54.7%	**196**	**45.7%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	2	0.5%	0	0.0%	**2**	**0.5%**
Wood	114	30.6%	17	10.0%	**131**	**24.2%**	94	25.8%	14	21.9%	**108**	**25.2%**
Other Fuel (Includes Solar)	23	6.2%	0	0.0%	**23**	**4.2%**	5	1.4%	6	9.4%	**11**	**2.6%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	372		170		**542**		365		64		**429**	

% of Fuel Use by Tenure	**WAITSFIELD**						**WARREN**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		**Owner Occupied**		**Renter Occupied**		**Total Occupied**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Utility gas	0	0.0%	22	10.5%	**22**	**2.6%**	17	2.7%	37	28.5%	**54**	**7.1%**
Bottled, tank, or LP gas	342	52.7%	90	43.1%	**432**	**50.3%**	366	58.5%	73	56.2%	**439**	**58.1%**
Electricity	76	11.7%	18	8.6%	**94**	**11.0%**	44	7.0%	0	0.0%	**44**	**5.8%**
Fuel oil, kerosene, etc.	167	25.7%	40	19.1%	**207**	**24.1%**	76	12.1%	11	8.5%	**87**	**11.5%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	54	8.3%	11	5.3%	**65**	**7.6%**	116	18.5%	0	0.0%	**116**	**15.3%**
Other Fuel (Includes Solar)	10	1.5%	28	13.4%	**38**	**4.4%**	7	1.1%	9	6.9%	**16**	**2.1%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	649		209		**858**		626		130		**756**	

% of Fuel Use by Tenure	**WATERBURY**						**WOODBURY**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		**Owner Occupied**		**Renter Occupied**		**Total Occupied**	
	#	**%**	**#**	**5**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Utility gas	30	2.0%	17	2.5%	**47**	**2.2%**	0	0.0%	0	0.0%	**0**	**0.0%**

Bottled, tank, or LP gas	620	41.1%	345	51.0%	**965**	**44.2%**	46	17.4%	6	20.7%	**52**	**17.7%**
Electricity	64	4.2%	186	27.5%	**250**	**11.4%**	8	3.0%	0	0.0%	**8**	**2.7%**
Fuel oil, kerosene, etc.	667	44.2%	128	18.9%	**795**	**36.4%**	114	43.2%	6	20.7%	**120**	**41.0%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Wood	96	6.4%	0	0.0%	**96**	**4.4%**	94	35.6%	17	58.6%	**111**	**37.9%**
Other Fuel (Includes Solar)	32	2.1%	0	0.0%	**32**	**1.5%**	2	0.8%	0	0.0%	**2**	**0.7%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	0	0.0%	0	0.0%	**0**	**0.0%**
Total Occupied Housing Units	1509		676		**2185**		264		29		**293**	

% of Fuel Use by Tenure	**Worcester**						**REGION TOTAL**					
	Owner Occupied		**Renter Occupied**		**Total Occupied**		Owner Occupied		Renter Occupied		**Regional Total**	
	♯	**%**	♯	**%**	♯	**%**	Totals	%	Totals	%	**Totals**	**%**
Utility gas	0	0.0%	0	0.0%	**0**	**0.0%**	238	1%	337	5%	**575**	**2%**
Bottled, tank, or LP gas	87	26.3%	23	28.8%	**110**	**26.8%**	5,108	25%	2,252	32%	**7,360**	**27%**
Electricity	4	1.2%	0	0.0%	**4**	**1.0%**	548	3%	986	14%	**1,534**	**6%**
Fuel oil, kerosene, etc.	100	30.2%	35	43.8%	**135**	**32.8%**	10,355	51%	3,021	43%	**13,376**	**49%**
Coal or coke	0	0.0%	0	0.0%	**0**	**0.0%**	15	0%	0	0%	**15**	**0%**
Wood	126	38.1%	22	27.5%	**148**	**36.0%**	3,613	18%	262	4%	**3,875**	**14%**
Other Fuel (Includes Solar)	14	4.2%	0	0.0%	**14**	**3.4%**	491	2%	165	2%	**656**	**2%**
No fuel used	0	0.0%	0	0.0%	**0**	**0.0%**	15	0%	19	0%	**34**	**0%**
Total Occupied Housing Units	331		80		**411**		20,383		7,042		**27,425**	

Wood Heat

The Department of Public Service in the 2022 Comprehensive Energy Plan reports that 21%-22% of the total heating demand in Vermont is currently met by wood heat with cordwood alone supplying almost 18% of all heating (pp 193 VT CEP). While only based on 502 household participants (including approximately 100 in Washington county and a little over 50 in Orange County), the State's 2018-2019 Residential Fuel Assessment provides the most comprehensive, albeit intermittent, report on wood use. Approximately 35% of Vermont households report burning cordwood for primary (22%) or supplemental (13%) space heating during the 2018-2019 season (a steady rate since the 90s for primary heating %). In 2018-2019, Vermonters used over 400,000 cords of wood, averaging 6 cords per household using it as primary heat, and 2 cords per household using it as supplementary heat; those reporting wood pellets approximately half use as their primary heating (4 tons on average compared to 1 ton on average for those using it for supplementary heat). Approximately a third of households and more than 2/3 of those burning wood report using woodstoves, approximately 8% wood pellet stoves, and very few fireplace woodstove inserts, wood furnace or boilers, or combination furnaces.

While previous iterations of the assessment found a correlation between more heating degree days and more wood consumption, this newest assessment found that the less severe winter season than average still resulted in more wood use than average. While the report does not posit an explanation, increasing unpredictable weather conditions and temperatures associated with our changing climate and our aging housing stock are likely key factors.

Central Vermont broadly follows Vermont trends: wood is widely used for residential heating with an estimated 47% of Vermont homes relying on it as their primary or secondary heat source (2018-2019 Heating Season Residential Fuel Assessment Report), increased popularity in schools (replacing fuel oil), and a recent jump in small commercial and residential buildings converting to pellet boilers or pellet stoves as a supplemental heat source (VT CEP pp159). While this section will focus mostly on residential wood heating, wood heating is also a key system in our regions schools, municipal buildings, and as part of some industrial processes. In Central Vermont, approximately 18% of owner-occupied and 4% of renter-occupied housing units use wood for a total of approximately 15% of occupied housing units in the region (Table 9, below). There are clear geographic and demographic trends across the region regarding wood use; wood makes up 34-43% of household heating sources along the north of our region including Calais, Marshfield, Woodbury, Worcester, and Cabot (as well as Washington), while the less densely populated municipalities throughout the rest of the region range from 15-26% (including Middlesex, Roxbury, Plainfield, Duxbury, East Montpelier, Orange, Fayston, Moretown, and Warren), with significantly less use in our density centers ranging from 4-14% in Barre City, Waterbury, Montpelier, Waitsfield, Berlin, Barre Town, Williamstown, and Northfield (see Table below).

Table 9 Current Wood Fuel Use in Occupied Housing Units by Town

	Owner Occupied		Renter Occupied		Total Occupied	
Orange	86	22.4%	0	0.0%	**86**	**20.4%**
Washington	169	34.2%	12	42.9%	**181**	**34.7%**
Williamstown	160	13.1%	0	0.0%	**160**	**12.2%**
Barre City	98	5.6%	48	2.4%	146	3.8%
Barre Town	393	12.9%	0	0.0%	**393**	**11.0%**
Berlin	88	9.2%	13	10.5%	**101**	**9.3%**
Cabot	181	35.4%	28	28.9%	**209**	**34.4%**

Calais	295	46.6%	14	15.6%	**309**	**42.7%**
Duxbury	130	26.9%	3	3.6%	**133**	**23.4%**
East Montpelier	239	24.3%	5	3.5%	**244**	**21.7%**
Fayston	78	18.6%	0	0.0%	**78**	**16.5%**
Marshfield	198	36.3%	28	42.4%	**226**	**37.0%**
Middlesex	177	25.0%	13	40.6%	**190**	**25.7%**
Montpelier	251	11.7%	14	0.8%	**265**	**6.9%**
Moretown	119	19.2%	3	2.9%	**122**	**16.9%**
Northfield	257	19.0%	0	0.0%	**257**	**14.2%**
Plainfield	114	30.6%	17	10.0%	**131**	**24.2%**
Roxbury	94	25.8%	14	21.9%	**108**	**25.2%**
Waitsfield	54	8.3%	11	5.3%	**65**	**7.6%**
Warren	116	18.5%	0	0.0%	**116**	**15.3%**
Waterbury	96	6.4%	0	0.0%	**96**	**4.4%**
Woodbury	94	35.6%	17	58.6%	**111**	**37.9%**
Worcester	126	38.1%	22	27.5%	**148**	**36.0%**

Source: 2022 ACS 5-year average B25117

Efficient wood heat (efficient stoves or automated boilers and furnaces) reduces greenhouse gas emissions and heating costs compared to fossil heat. Unlike heat pumps, for which the potential savings or costs do vary depending on utility territory among other factors, cost savings from the use of efficient wood and pellet stoves are often more straightforward (although automated wood pellet boilers do often depend on equipment purchase incentives to achieve pricey parity). Furthermore, cordwood in particular is readily available (although see challenges below); among households using wood heat (primary and secondary) over 1/3 report they themselves, an immediate family member, or a friend cut the wood personally, while approximately ½ report they purchased log lengths. Together, these characteristics make efficient wood heat a particularly important pathway for fixed and low-income residents in our region to reduce their costs and greenhouse gas emissions however not all forms of advance wood heat are equally in line with the state's goals for air quality, forest ecology, and energy (see Challenges starting page 196 2022 CEP, see the CEP for more on wood supply and current programs as well).

Wood heat has an additional role to play managing and reducing peak winter electrical loads, either stand alone or in combination with heat pumps, wood stoves provide opportunities for homes, schools, and municipal buildings to avoid peak electric costs during cold snaps as well as regular use. In addition to flexibility, advanced wood heat options can provide resilience benefits, again either stand alone or in combination with heat pumps; smaller and more affordable battery systems could also be integrated to provide backup power to advanced wood heat components which require less power than heat pumps to operate (the CEP and CAP note a potential role for advanced wood heat as part of the utility demand response programs to further reduce thermal electric loads especially when wholesale electricity prices and GHG emissions are at peaks).

Common perceived benefits of advanced wood heat are economic, tied to the idea that the use of wood keeps heating dollars in the local economy and supports forest-product jobs and businesses. While this was well-established by the Baseline Assessment of Wood Heating in Vermont (2016) for cordwood (updates can be found in the CEP and CAP), the same assessment found that over ¾ of bulk pellets burned in VT are imported from outside Vermont; at the time of writing there were only 2 pellet producers in the state. While pellets and

chips may still be a viable choice for some, including many of our region's schools, municipal buildings, and some homes, there are added vehicle miles traveled and energy used in processing to account for. These considerations together with the availability and accessibility of cordwood, as well as the existing use, suggest cordwood remains an important option for central Vermonters, especially for residential heating. However, despite its commonness, much is produced by inefficient woodstoves. Thus, CVRPC supports the transition from fossil fuel heating fuels using not only heat pumps (air and ground sourced), but also strongly supports the conversion of inefficient wood stoves to advanced wood heat stoves to reduce air pollution emissions, reduce heating costs, amount of wood fuel used, and provide an accessible option for many Vermonters- our targets for the thermal sector reflect this commitment.

Commercial Thermal

Table 10 Current Regional Commercial Thermal (Heating) Energy Use

Commercial Establishments	Average Thermal Energy Used Per Establishment (MMBTUs)	Regional Commercial Thermal Energy Use (MMBTUs)
2231	934	2,083,630

Source: Municipal Consumption Tool, CVRPC & Department of Public Service using data from the Department of Labor

Most of the region's commercial/industrial energy usage can be attributed to space heating and process heating. There is less distinction between many of our region's businesses' buildings and the residential sector, though in more developed towns we do have more conventional commercial premises. Many of our region's schools are on wood heat, and several of our larger businesses have championed net-zero buildings and practices. Harnessing the expertise and capacity of our region's experts to mentor and support small commercial businesses to do the same may be a key way to implement our targets (see below).

Act 172 Municipal Energy Resilience Grant Program:
Regional Analyses in Progress

- Establish Energy Use Baseline for each town (municipal buildings & facilities)
  - Annual Energy use across sectors
  - Building Audit results
- Town and Regional Goals
  - Cost Savings
  - Resilience
  - Future Demand
  - GHG Emissions
- Resident Uptake Efficiency Measures

Targets & Key Discussions

Table 11 Residential Weatherization Targets

Regional **Residential** New Retrofits

(Number of Housing Units)						
Scenario	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
Baseline Scenario	1,378	2,847	4,205	5,496	6,833	9,658
CAP Mitigation	2,202	7,758	13,314	16,767	20,219	27,125
Target % of Homes Weatherized*						
Baseline Scenario		10%		18%		30%
CAP Mitigation		28%		56%		85%

Table 11 identifies the number of existing residential structures in Central Vermont that would need to be weatherized in each of the target years to meet the State's energy goals (CAP Mitigation, Baseline scenario indicates business as usual). These target percentages are lower than those targets include in the 2018 Enhanced Energy Plan because instead of using the historical 5year housing unit % increase rate, CVRPC used the midpoint between the 2015-2020 rate (+1.8%) and the almost 12% rate associated with our housing needs assessment including in this regional plan update. Thus a 7% increase of housing units was used when converting the LEAP targets into target percentages. Targets are cumulative.

Weatherization

A portion of Central Vermont's housing stock is older and was constructed at a time when no specific codes existed for energy efficiency. Residential Building Energy Standards (RBES) and the Commercial Building Energy Standards (CBES) for new construction set minimum thresholds for energy efficiency. This will encourage new construction to address energy efficiency, however a lack of enforcement may hinder implementation.

Weatherization of our buildings across sectors is one of the most important pathways for our region; it is not only a key conservation of electricity and emissions reduction strategy but also has significant health and financial benefits Energy-burdened Vermonters spend disproportionately more of their income on energy especially heating, heating (and increasing cooling) that escapes through leaky windows, cracks in the doors, and poorly insulated building envelopes. Recent research on energy burden and the need for integrated low-income housing and energy policy shows multiple, interrelated health risks are linked to and intensified by energy burden[4]. For example, high and/or overdue energy bills can contribute to stress and mental health concerns, which can exacerbate adverse decision-making about heating/cooling, which can then further exacerbate health issues such as asthma, heart disease, and malnutrition, as well as physical inactivity.

In Central Vermont, there are 2 main entities involved with weatherization: **Capstone Community Action** provides weatherization for lowest income residents (see table below for number of homes weatherized per year in recent years), while **Efficiency Vermont** provides weatherization services and income-based incentives for other residents and businesses. (see supplements for savings and breakdown). Capstone Community Action administers Vermont's Weatherization Assistance Program in Central VT which aims to help low-income Vermonters save fuel and money by improving the energy efficiency, health and safety of their home while reducing carbon emissions. On average, the program makes about $10,000 worth of improvements per home,

[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4819257/

installs about 1,500 square feet of insulation, and reduces drafts by about 40%[5] (see table below for project counts).

> *"The largest barrier to low-income home weatherization continues to be the presence of vermiculite insulation, a material known for containing asbestos. Unfortunately, there are also many other structural issues present in Vermont's older housing stock which can prohibit Weatherization such as leaky roofs, wet basements, knob and tube wiring, and other structural issues. Historically, these issues would "defer" weatherization of a home indefinitely. Vermont's Weatherization Program has adopted a "zero deferral" policy in recognition that addressing non-energy related issues that otherwise prevent weatherization is a critical equity policy. OEO secured $125,000 of Vermont Low Income Trust for Electricity (VLITE) funds for vermiculite remediation and continues to leverage Zonolite Trust Funds. Additional funding to address deferral issues comes from the Vermont Community Foundation, as well as ARPA State Fiscal Recovery (SFR) funds."* **Performance Indicators for the Weatherization Assistance Program Report to the Vermont Legislature 2022**

Efficiency Vermont only monitors home weatherization programs done through the Home Performance with ENERGY STAR® (HPwES) program. HPwES is a comprehensive whole-house approach to diagnosing and addressing thermal and health/safety issues in the home to ensure a more energy efficient, comfortable, safe, and healthy home. A project is a collection of one or more energy efficient measures that have been implemented at a customer's physical location. A customer can be associated with one or more projects and in some cases, a project may be associated with multiple customers. Efficiency Vermont's data does not capture do-it-yourself projects or projects that do not go through the HPwES program. The data below indicates the number of weatherization and energy efficiency projects completed per year across the Central Vermont, while this is not comprehensive, it provides some indication of progress.

Most weatherization assistance funds in Vermont are available to homeowners, and some to commercial properties as well; renters have been identified as a group underserved by the health, comfort, and financial savings associated with weatherization (see Energy Action Network Working Group on Renter Weatherization led by Rights & Democracy for more[6]). Rental housing represents about 30% of Vermont's housing stock- including 25% of occupied units in Central Vermont- and almost 75% of people who rent their homes have incomes under Vermont's median household income of approximately $63,500. Tenants often cannot weatherize their homes because it is cost-prohibitive, but also because major structural changes to a building must include a willing landlord to participate.

The Energy Action Network (EAN) estimated that Vermont needs to weatherize 13,400 homes each year (or at least 90,000 total) by 2030 to meet its climate goals (Efficiency Vermont); currently, less than 2,000 homes are weatherized a year in Vermont- Table 12 provides a summary of homes weatherized in Central Vermont and the profound savings and impacts these programs make. There are not comprehensive numbers of total

[5] https://legislature.vermont.gov/Documents/2022/WorkGroups/House%20Appropriations/Reports%20and%20Resources/W~Department%20for%20Children%20and%20Families~Performance%20Indicators%20for%20the%20Vermont%20Weatherization%20Assistance%20Program~1-28-2022.pdf

[6] https://eanvt.org/network-action-teams/tenant-wx/; https://eanvt.org/network-action-teams/weatherization-at-scale-action-team/

homes weatherized nor are all projects reported below bring a home up to the same standard of weatherization, however they provide some sense of progress. At the current rate, weatherizing between 300-700 homes a year the region is on pace to meet the baseline scenario provided in Table 11 but falls short of our regional CAP target. There are several likely contributing factors to the nearly doubling of projects this past year including both severe residential damage in the July 2023 flood event and the additional state incentives/rebates expanded for affected properties, and the launch of major federal incentives provided via the Inflation Reduction Act which will expand both existing State programs and additional opportunities through 2031. For example, the **Home Energy Performance-Based Whole-House Rebates (HOMES) Program** will provide eligible households with rebates of $2,000 to $8,000 for whole-home energy-saving retrofits and weatherization such as improving insulation and methodically sealing air leaks. The region has a key opportunity through 2031 to support weatherization and draw down investments which will substantially improve the condition of our housing stock, improve health and wellbeing, and reduce energy burden on top of reducing fossil fuel use and GHG emissions. Additionally, affordable and expanded housing is a key priority for our region and municipalities, building these to energy code (and better yet, to stretch code or higher energy standards) will contribute to the region's weatherization targets.

Table 12 Summary of 2020-2023 Residential Weatherization (Efficiency Vermont projects include Home Performance with Energy Star, other weatherization projects, and residential new construction projects; their total savings include all measures)

	2020		2021		2022		2023	
Total Homes Weatherized (Capstone only)	78		143		112		173	
Performance with ENERGY STAR Projects (Efficiency VT)	136		123		70		329	
Weatherization Projects (Efficiency VT)	40		46		57		143	
Residential New Construction Projects	8		21		25		54	
Total kWh Saved (Capstone)	526.28		49,639.31		38,114.35		106,643.73	
Total MMBTUs Saved (Capstone)	2,680.07		2,843.15		5,220.97		6,915.32	
Total kWh Saved (Efficiency VT))*	3,476,376		471,560					
Thermal MMBTUs Saved (Efficiency VT)*	13,800		32,206		31,520			
Town Totals	**Capstone (Homes)**	**Efficiency Vermont (Projects)**	**Capstone (Homes)**	**Efficiency Vermont (Projects)**	**Capstone (Homes)**	**Efficiency Vermont (Projects)**	**Capstone (Homes)**	**Efficiency Vermont (Projects)**
Barre City	20	31	25	38	19	28	38	
Barre Town	10	7	14	1	11	4	11	

Berlin	3	4	3	2	12	3	8	
Cabot	1	4	2	3	6	2	8	
Calais	2	8	2	7	3	2	9	
Duxbury	0	0	0	4	1	5	1	
East Montpelier	5	6	2	3	3	5	6	
Fayston	1	3	0	3	2	5	0	
Marshfield	1	4	2	3	2	2	2	
Middlesex	2	5	0	5	1	5	5	
Montpelier	10	41	16	46	17	27	28	
Moretown	2	5	2	10	3	3	1	
Northfield	5	10	29	12	14	6	10	
Orange	2	0	3	0	2	0	6	
Plainfield	1	8	3	4	2	1	3	
Roxbury	2	3	0	2	1	1	1	
Waitsfield	1	6	2	2	0	9	0	
Warren	0	9	2	12	1	11	0	
Washington	1	0	3	3	0	4	4	
Waterbury	4	20	1	25	3	21	7	
Williamstown	4	7	28	3	4	2	14	
Woodbury	0	0	1	2	3	2	3	
Worcester	1	3	3	0	2	4	8	
Regional Total	**78**	**184**	**143**	**190**	**112**	**152**	**173**	

Weatherization of commercial and other buildings will also play a role in meeting our energy goals; focusing on municipal buildings and facilities, schools, and other key community buildings will also support community resilience and health. CVRPC is in the process of developing custom targets for the region based on municipal participation in the Municipal Energy Resilience Program and similar programs.

System Conversions (Fuel Switching)

Similar to weatherization and best following it, older existing buildings will commonly have outdated and inefficient mechanical systems that can be replaced and updated. These often include oil-based heating systems, propane, or inefficient wood-fired units. With advances in technology, cold weather heat pumps, high efficiency wood stoves, and other mechanical systems can provide significant efficiency improvements for existing buildings that reduce fuel use and thus cost and significantly improve the health of occupants. System conversion, and the building modifications sometimes required to do so, can however be a challenge for residents with low and fixed incomes.

Vermonters face on average a thermal energy burden of roughly 4%, while some communities face even higher upwards of 6-7%, with individual Vermonters greater still. Research by Efficiency Vermont shows that towns identified as most severely burdened by thermal costs tend to show low overall thermal spending but have household income well below the statewide median. Furthermore, Efficiency Vermont reports that household fuel use is correlated with income and whether a home is owner or renter occupied, with lower-income households disproportionately using fuel oil and inefficient resistance heating systems while owner-occupied homes are much more likely to heat with wood and less likely to heat with inefficient aged electric resistance than rental properties (163 CEP). Spending is relatively inelastic- consumers do not have a lot of control over the amount of energy they use on an ongoing basis.

As discussed above, there are a considerable number of income-based incentives, rebates, and programs for residents and business owners alike (Efficiency Vermont, Capstone Community Action, and now substantial federal programs- see the State Comprehensive Energy Plan or reach out to your local energy committee for a comprehensive overview). Increasingly, distribution utilities offer programs for income-eligible Vermonters to help lower the cost of energy and take part in the energy transition, this includes incentives for heat pumps, efficient wood stoves, and more for homes, businesses, schools, and municipalities. The High-Efficiency Electric Home Rebate Program will be another additional residential energy program run by the Department of Public Service through 2031 (IRA) to support existing incentive and technical assistance. This program will provide point-of-sale rebates to low- and moderate-income households for a variety of electric technologies, including heat pumps for space heating and cooling, heat pump water heaters, electric stoves and ovens, and electric service upgrades. Eligible households will be able to receive up to $14,000 for installing energy efficient electric equipment, including up to $8,000 for heat pumps, $1,750 for heat pump water heaters, and $840 for electric stoves. Complementary programs including Energy Efficiency Contractor Training Grants to support workforce development, and tax credits and direct pay options for homeowners, municipalities, and other eligible participants for energy efficiency home improvements, on-site renewable generation and storage, up to 30% are also available through 2032.

CVRPC continues to provide information and support to municipalities to promote these programs and opportunities, while working with administrating bodies to remove barriers for lowest income Vermonters and renters. As noted previously, new construction will generally include these high efficiency systems which will help address energy conservation. Additional Efficiency Vermont Efficiency Measures include appliances, lighting, motor controls, etc. and future, continuing these measures also importantly contribute to our targets as outlined below and for total residential demand as included in the supplement.

Inset Incentives/Programs/Resources

Table 13 Efficiency Vermont Regional Summary Selected Measures

	2020	2021	2022	Total
Heat Pump Water Heat Installations	260	321	307	**888**
Cold Climate Heat Pump Installations	618	711	817	**2146**
Wood Heating Installations	178	240	82	**500**
Total Regional Quantity Additional Efficiency Measures				
Air Conditioning Efficiency	299	269	371	**939**
Behavior	0	0	0	**0**
Cooking and Laundry	1,058	1,254	1,044	**3,356**
Flexible Load Management	0	17	9	**26**
Health and Safety	1	0	0	**1**
Hot Water	619	597	628	**1,844**
Lighting	34,390	12,661	10,467	**57,518**
Motors and Motor Controls	738	644	1,036	**2,418**
Office Equipment/Electronics	43	0	0	**43**
Refrigeration	1,381	1,352	774	**3,507**
Space Heating	1,632	1,158	1,073	**3,863**
Thermal Shell	535	539	66,260	**67,334**
Transportation	0	5	93	**98**
Ventilation	78	208	106	**392**
Water conservation	23	41	61	**125**

Tables 14- 17 Provide Thermal Targets for new Residential and Commercial Heat Pumps and Heat Pump Hot Water Heaters; the regional LEAP targets provided by the Public Service Department showing the Baseline trajectory and the Climate Action Plan Mitigation State approach (CAP) are available in full in the supplement. These original targets over emphasized the electrification of the thermal sector for the region and undervalue the role of efficient wood stoves. These targets were adjusted for the region (methodology in the supplement). Based on Table 13 above and the current pace of projects is maintained, CVPRC is likely on track to meet the heat pump target (approximately 1270 a year needed per year over the next 25 years to make the target), but only at around 1/3 of the adoption rate needed to meet the heat pump hot water heater. While on target for heat pumps, rising electric rates and particularly the ability of existing infrastructure and systems to integrate a large electric demand increase from the thermal sector are major concerns (see below for grid and infrastructure conditions and limitations).

Tables 14-17

CAP Mitigation Regional **Residential** New Cold Climate Heat Pumps						
Technology	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
ASHP 2 Head	423	2,549	4,686	6,836	8,995	10,093
ASHP Central	658	3,964	7,311	10,705	14,155	15,727
ASHP HE	622	3,743	6,882	10,039	13,210	14,821
GSHP HE	77	463	851	1,241	1,633	1,832
Total	**1,780**	**10,720**	**19,730**	**28,820**	**37,993**	**42,473**

Regional **Residential** New Heat Pump Water Heaters (Number of Units)						
Scenario	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
Baseline Scenario	483	569	573	578	581	593
CAP Mitigation	483	7,046	15,213	23,465	31,809	32,196

Baseline Regional **Commercial** New Cold Climate Heat Pumps						
	2020	**2025**	**2030**	**2035**	**2040**	**2050**
New CCHP	316	960	1,827	2,333	2,580	2,710

CAP Mitigation Regional **Commercial** New Cold Climate Heat Pumps						
	2020	**2025**	**2030**	**2035**	**2040**	**2050**
New CCHP	316	5,682	11,298	17,184	21,120	21,977

Table 18 CAP Mitigation Regional Residential Thermal Demand (Thousands MMBTUs)

CAP Mitigation Regional **Residential** Thermal Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	120	264	376	487	595	633
HP	1	136	231	322	413	453
HPWH	2	23	49	76	103	104
Electric Resistance	40	29	21	14	8	7
~~Wood~~	~~910~~	~~733~~	~~535~~	~~400~~	~~286~~	~~182~~
Propane	475	375	273	183	101	67
Wood Pellets	225	69	57	50	45	42
Biodiesel	-	51	224	285	245	176
Heating Oil	1,140	827	404	140	-	-
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**2,870**	**2,318**	**1,869**	**1,544**	**1,272**	**1,100**

Table 19 Targets for Residential High Efficiency Wood Heat Conversions

	2025	2030	2035	2040	2050
Existing Wood (homes)	4000	3200	2400	1600	800
New High Efficiency Wood Heat (homes)	0	800	1600	2400	3200
% converted	0%	20%	40%	60%	80%
Total Cords Used	22730	19725	16691	13656	10621
Thousands MMBTUs	454.608	394.507	333.813	273.120	212.427

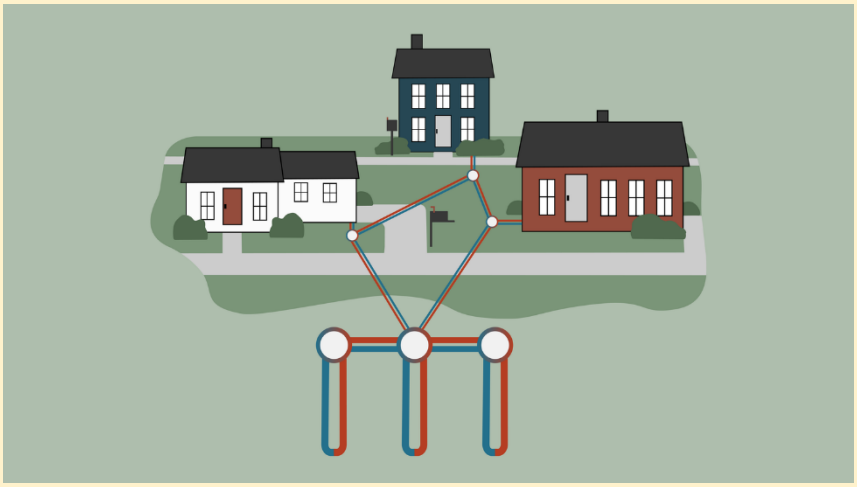
Table 19 provides a new target developed by CVRPC in recognition of the role wood heating plays in the region and can continue to do so as part of our energy policy and goals, specifically cord wood. These targets focus on the conversion of aged and/or inefficient woodstoves (cord wood) to high efficiency replacements. These targets are based on the constants used in current use estimates (see above and supplement), Efficiency Vermont projections that advanced wood heat conversion reduces fuel use by approximately 1/3 which was further reduced to 2/3 fuel use per home based on weatherization and conversion of some wood heating use from primary to secondary heating source (thus reflecting an average per household of 5.69 cords per year to 1.9 cords). While data on wood heating is coarse, see detailed discussion above, this target uses current use as a starting point at 2025, and strives for 20% of households to convert per target year through to 80% in 2050 (these leaves room for the unknown number of existing high efficiency wood stoves, etc). These targets increase the demand from wood per the LEAP targets provided by the Department of Public Service for the target 2050 but reflects a significantly lower estimation of demand in all previous years. CVRPC is working with the Department of Public Service and other partners to refine these LEAP targets to better reflect current use (see supplement). Despite this, the pairing of these targets for residential heating remain in

line with the region's approach: a transition from fossil fuels and inefficient heating types (e.g. electric resistance) towards residential heating demand dominated by high efficiency electric and cord wood technologies (whether combined or not at a household level).

Building Energy Standards	Clean Heat Standard	Wasteheat Recovery	District Heating Systems	Ground Source Heat Pumps

Weatherization and fuel switching are two core components of CVRP's multi-pronged approach to meeting thermal and electric sector goals but the above are also key for our region. CVRPC is working with municipalities, regional, and state partners to integrate these into the 2025 comprehensive regional plan update including energy targets and analyses (including Infrastructure, Housing, and Healthy Communities Chapters).

Maximize Infrastructure Investments: Wasteheat Recovery



Many Vermont communities are taking advantage of new levels of state and federal funding to install, expand, and/or upgrade local water and wastewater systems. Integrating wasteheat recovery into wastewater systems is a terrific way to maximize the benefits of such an investment by recovering heat from wastewater to make potable hot water and to heat buildings (wastewater can also be used as a heat sink to cool buildings). Wastewater is a continuous and existing source of thermal energy; the average residential wastewater temperature is 70°F while commercial and industrial wastewater can be up to 140°F or higher. Heat recovery systems are simple, low maintenance, offer lower, predictable customer heating and cooling bills, and are scalable from one building/facility to much larger community or district thermal energy networks.

For more on how Thermal Energy Networks can be key opportunities to meet local infrastructure needs while reducing energy burden, GHG emissions, and thermal sector energy demand visit Vermont Community Geothermal Alliance for toolkits and more information.)

CONSERVATION AND EFFICIENCY

Goal: Increase conservation of energy by individuals, organizations, and municipalities. Reducing the amount of energy needed to support existing and future systems is critical to reducing GHG emissions, operations costs, and energy burdens, while optimizing the use of renewable generation and storage.

Strategy
Connect municipalities, including residents, businesses, and other interested parties, with organizations, state programs (including Weatherization Assistance Program), incentives/rebates (Energy Efficiency Utility and Distribution Utilities), and best practices in weatherization, HVAC, efficient design, appliances, lighting, decarbonization, etc. ● Programs and opportunities included in CVRPC weekly newsletters, and quarterly digests. ● Updated materials in town buildings. ● Collaborates with partners to increase regional participation and facilitates training and information sessions for municipalities and local energy champions. ● Support drawdown of IRA and other federal monies ● Maximize participation in income-based programs (Partners Efficiency Vermont, Distribution Utilities, Capstone Community Action, VEEP (Vermont Energy Education Program), BGS (Buildings and General Services) (Buildings and General Services), PSD (Public Service Department), VLCT, VCLN, VCRD (Vermont Council on Rural Development))
Coordinate and support municipal residential weatherization campaigns including WindowDressers Community Builds, Button Up!, establishment of revolving loan funds to cover up front costs for residents, etc. ● streamline outreach and recruitment ● connect municipalities and communities to existing resources and partners ● maximize incentive and rebate use; federal funding drawdown ● establish town: town leadership development for program expansion ● connect to stable funding sources (Partners include WindowDressers, Efficiency Vermont, Capstone Community Action, ReSOURCE)
Support existing, and the development of, municipal energy committees and coordinators to establish and implement municipal energy goals.
Provide technical assistance to municipalities and encourage municipal bylaws that promote energy conservation and the development of renewable energy resources
Support State, utility, and other energy and conservation program development to facilitate weatherization, fuel, switching, and increased energy savings and comfort within Central Vermont housing and other buildings stock ● Advocate for models that are most accessible for underserved residents especially low-income households, those on fixed incomes, and renters- that cover up front costs, minimal eligibility requirements and administration, and can meet acute needs (at point of failure) ● Promote program commitments for allocating program funds and benefits based on energy equity metrics
Develop a summary of needs and measures across municipal buildings & facilities via the Municipal Energy

Resilience Grant Program assessment reports:
- Establish municipal energy use baselines
- Model project development and develop funding stacks
- Support implementation

Goal: Promote climate-ready, resiliency, and energy efficiency in the design, construction, renovation, operation, and retrofitting of systems for buildings and structures. Energy efficient building designs provide benefits to the owners and occupants by reducing the amount of energy needed to heat, cool, and maintain the mechanical systems within the building. Establishing and promoting energy efficiency in design, construction, retrofits, and renovations will ensure new buildings and building practices will be more efficient into the future. These efficiencies can also lead to conservation of energy which can promote cost savings and affordability for owners and renters.

Strategy
Promote Vermont's Residential and Commercial Energy Building Standers (RBES/CBES) for new construction and existing building additions, alternations, renovations, repairs, and retrofits. ● provide education and support to interested municipalities to adopt stretch code, hire code officials, and/or host educational training ● support regular state code updates and update necessary materials/trainings/best practices to newest adopted standards ● Host and facilitate building science/standards training and education opportunities for local officials, zoning administrators, and relevant workforce development groups to promote the distribution of code information to permit applications and ensure code compliance. ● Promote benchmarking for commercial buildings.
Work with municipalities to develop local energy codes, education programs, and/or promoting energy efficient site design, "net-zero ready"[7] best practices (e.g., solar/EVSE ready), and renewable energy generation and energy storage use in new construction projects that require an Act 250 permit (or writ large) ● Review local zoning bylaws and offer technical assistance to development review boards when evaluating the energy, climate, and health implications of site plans for proposed developments. ● Work with housing and energy efficiency organizations to promote and improve the regional supply of affordable, high efficiency manufactured housing, such as Zero Energy Modular homes. ● promote the use of landscaping for energy efficiency ● promote the use of incentives (e.g., density bonuses) to developments located in identified growth areas that exceed stretch code
Support municipal building and facilities to establish energy use baseline and tracking, identify energy efficiency, fuel switching, EVSE, renewable energy & storage, and resiliency measures, and support implementation
Support the identification of waste heat recovery opportunities, thermal resources, and the siting of infill development in proximity to maximize capture and use to reduce electricity load from electrification of heating sector ● Wastewater systems ● Grocery Stores, Ice Rinks, IT centers, food, and drink production/processing, etc.

[7] https://publicservice.vermont.gov/sites/dps/files/documents/VT%20Energy%20Code%20Roadmap11-19_8_FINAL.pdf

Work with community organizations or existing businesses to identify available information regarding the use of landscaping for energy efficiency including the importance of tree canopies, pervious surfaces, and similar design practices.
Work with community organizations or existing businesses to identify available information regarding the use of landscaping for energy efficiency including the importance of tree canopies, pervious surfaces, and similar design practices.
Develop regional GHG emissions inventory.

Goal: Identify ways to decrease the use of fossil fuels for heating.

Strategy
Decrease fossil fuel heating and increase affordable electrification by working with Energy Committees and other Central Vermont Energy Network partners to raise awareness among homeowners, renters, landlords, developers, etc. on the benefits of fossil-fuel-free technology such as cold-climate heat pumps, advanced wood heating and geothermal systems. Examples include thermal-led combined heat and power (CHP), biomass district heating and biogas generation (capturing the methane produced by landfills or farms and using it instead of fossil fuels).
Support upgrade and trade-out programs and incentives for retiring outdated, higher-emission, polluting wood burning stoves and boilers.
Identify potential locations throughout the region that could benefit from district heating projects based on building density, proximity to resources such as biomass, or status as a use by right where applicable.
Work with interested municipalities to evaluate and amend, as necessary, local regulations to ensure district heating or similar centralized renewable generation facilities such as biogas or bio-digesters are permitted in appropriate locations.
Identify sources of renewable materials such as biomass, farm waste, or food waste (such as schools, restaurants, or food processors) to determine supply of alternative fuels that may be available for district heating or other heating alternatives for homes or businesses.
Support the identification of waste heat recovery opportunities, thermal resources, and the siting of infill development in proximity to maximize capture and use to reduce electricity load from electrification of heating sector e.g. Wastewater systems, Grocery Stores, Ice Rinks, IT centers, food, and drink production/processing, etc.
Work with state agencies to identify and inventory known sources and supplies of woody biomass that do not contribute to the spread of Federal or state identified invasive species, nor conflict with conservation and climate resilience goals, and make this information available to the public as appropriate.
Identify opportunities to integrate energy storage technologies such as on site generation & storage into capital planning projects to support micro-grid systems and diversify emergency back-up power resources. ● Provide opportunities for community education and engagement around the role of renewable energy generation and storage in emergency management (recovery & response) as well as the costs, benefits, and challenges associated with these technologies.
Due to the rural nature of Central Vermont, identify and map large farm operations that may provide a sustained source of materials that could be used for bio-digesters.

Transportation Sector:

Transportation is the second largest use of energy in Central Vermont, accounting for a little less than a third of total usage measured in MMBTUs (see Table 4). Table 20 provides an overview of light duty (passenger) vehicles and use in the region. The vast majority of residents in the state, including Central Vermont, use personal vehicles for their daily travel needs. Approximately 3.5% of 43,506 light duty vehicles in Central Vermont electric vehicles including all electric and plug-in hybrid electric vehicles registered by January 2024 (Drive Electric Vermont[8]). The total number of vehicles in the region has decreased slightly, while the number of EVs (Electric Vehicles) has increased quickly in the last few years, increasing by approximately 40% in 2023 alone coincident with the expansion of state, utility, and federal incentive programs.

Table 20. Current Regional Transportation Energy Use

Transportation Data	Regional Data			Regional Data 2011-2015 (ACS)
Fuel Type	Internal Combustion Engine (ICE)	Electric Powered (EV)	**Total**	Internal Combustion Engine (ICE)
Total # of Light Duty Vehicles	41,989	1,517	**43,506**	45,584
Average Miles per Vehicle	12,500	9,000		287,500 (12,500/vehicle)
Total Miles Traveled	524,862,500	13,653,000	**538,515,500**	567,650,000
Total Use per Year	23,857,386 gallons	4,551,000 kWh		30,518,817
Transportation MMBTUs	2,701,858	15,528	**2,717,386**	3,396,000
Average Cost per unit	$3.37/gallon	$0.2109/kWh		$2.31
Cost per Year	$80,399,391	$959,806	**$81,359,197**	$70,488,465

Source: Municipal Consumption Tool (Department of Public Service) which uses Table DP04, 2021 ACS 5-Year Estimate used to estimate the count of vehicles associate with area housing units, and State DMV data averages; cost per gallon of gas was taken from EAN Annual Progress Report 2023. EV data was provided by Drive Electric based off DMV registrations as of January 2024. Comparable public transportation and medium and heavy-duty vehicle data is not available, additional information is provided in the Transportation Chapter.

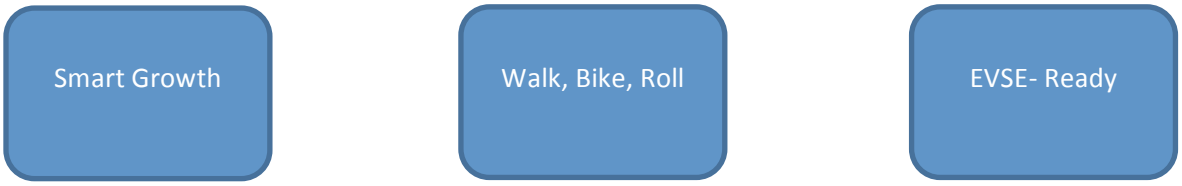
Table 21. EV Registrations by Town

County	**EV Registration Snapshot Jan, 2023**			**EV Registration Snapshot as of Jan 8, 2024**			**Increase 2023 to 2024**	
Municipality	**All-Electric Vehicles**	**Plug-in Hybrid Electric Vehicles**	**Total EVs**	**All-Electric Vehicles**	**Plug-in Hybrid Electric Vehicles**	**Total EVs**	**Count**	**%**

[8] http://www.driveelectricvt.com/buying-guide/why-go-electric

Washington County Total	569	487	1056	**896**	**580**	**1476**	**420**	**40%**
Barre City	53	55	108	88	73	161	53	49%
Barre Town	5	9	14	9	16	25	11	79%
Berlin	23	15	38	32	22	54	16	42%
Cabot	4	7	11	4	8	12	1	9%
Calais	20	19	39	33	20	53	14	36%
Duxbury	4	2	6	9	3	12	6	100%
East Montpelier	21	12	33	28	18	46	13	39%
Fayston	2	5	7	3	4	7	0	0%
Marshfield	12	11	23	18	14	32	9	39%
Middlesex	28	20	48	41	20	61	13	27%
Montpelier	164	150	314	257	151	408	94	30%
Moretown	29	7	36	38	17	55	19	53%
Northfield	20	20	40	36	22	58	18	45%
Plainfield	20	26	46	35	37	72	26	57%
Roxbury	2	1	3	4	0	4	1	33%
Waitsfield	41	26	67	66	31	97	30	45%
Warren	34	22	56	51	33	84	28	50%
Waterbury	75	69	144	126	81	207	63	44%
Woodbury	0	2	2	0	2	2	0	0%
Worcester	12	9	21	18	8	26	5	24%
Orange County Total				**267**	**203**	**470**		
Orange	3	0	3	5	1	6	3	100%
Washington	5	2	7	5	3	8	1	14%
Williamstown	11	8	19	15	12	27	8	42%

REGIONAL TOTAL	**2023**	**1085**	**2024**	**1517**	**432**	**40%**



CVRP's Multi-Pronged Approach to the Transportation Sector includes Smart Growth, and Walk, Bike, Roll initiatives in addition to fleet electrification/EV adoption (see Land Use, Transportation, and Health Communities Chapters for more detailed discussion of smart growth and walk, bike, roll)

As of spring 2024, there are nearly 400 public EV charging stations across the state[9], though not widely distributed throughout Central Vermont. In Central Vermont public chargers can be found in Cabot, Plainfield, Middlesex, Berlin, Northfield, and Roxbury located at schools, municipal buildings, and food coops with; with higher density of chargers located in the Mad River Valley (many at ski resorts), Waterbury, and Montpelier (see map). While many EV drivers across the state charge at home (typically overnight), increasingly workplace and public charging infrastructure has been identified as key to support longer trips/commutes, visitors, or those without charging access at home. CVRPC continues to encourage municipalities and local businesses to install EV charging stations at convenient and desirable locations including workplaces, schools, community centers, recreation sites, libraries, multi-unit buildings, etc., where users could park for several hours in our regional downtowns, village centers, and other designated growth area (e.g. Vt Community Charging program[10]; become a host or solicit community hosts[11]).

Equity considerations must be thoughtfully integrated throughout ESVE planning process to ensure benefits and costs are fairly distributed. Historically, clean energy and transportation innovations have not been deployed evenly across communities -- resulting in higher energy burden and rural, lower-income communities being left behind. EVSE equity concerns that can come up include a project's affordability, accessibility, reliability, location, safety, and related employment and economic opportunities. Drive Electric's Charging Installation Guide provides thorough guidance and workflow for Vermonters and Vermont communities, CVRPC recommends when integrating EVSE into new builds and parking lot upgrades alike, that proximity to electrical panel, zoning setbacks, and other technical considerations are made in addition to including EVSE supported handicap spots.

The VTrans NEVI (National Electric Vehicle Infrastructure) program and the U.S. Department of Transportation's Toolkit for Planning and Funding Rural Electric Mobility Infrastructure offers helpful equity planning considerations and strategies relevant to Central Vermont. When assessing where EV charging stations should be located, engagement with rural, underserved, and high energy burden communities is essential to prevent delayed and diminished access to clean energy and transportation infrastructure vital to a

[9] https://www.driveelectricvt.com/about-evs/charging-map?gad_source=1&gclid=CjwKCAjwtqmwBhBVEiwAL-WAYU8qVxhVDK55M5TSzltPA6SYiVI69Np0Ns-JkkqeFql6e-6UIHCP8xoCsgEQAvD_BwE
[10] https://www.chargevermont.com/
[11] https://survey123.arcgis.com/share/8c15711e4e404a7ca9ed3979640b0121

healthy economy. Furthermore EVSE-Ready requirements for new buildings can be explored at the municipal level (see Climate Change and Land Use).

According to the U.S. Department of Energy (DOE), over the long term, EV ownership is usually less expensive than ownership of fossil-fuel vehicles. Additionally, low operation costs make some EVs less expensive on a monthly basis compared to equivalent fossil-fuel vehicles (when the vehicle purchase is financed). Therefore, increased EV adoption in Central Vermont could contribute to community-wide reductions in transportation energy cost burdens. As stated by Drive Electric Vermont, "It costs less to own an EV. Plugging in is like paying $1.50 a gallon, and EVs need less maintenance than gasoline cars." Like fossil fuel vehicles, how cars handle in Vermont's winter and mud seasons varies from make to model. Opportunities for medium and heavy-duty vehicles are expanding; CVRPC strongly encourages municipalities and other fleet operators in the region to consider low diesel and alternative fuel options when replacing these in their fleet to take advantage of State and federal incentive programs[12].

In addition, fossil fuel and GHG emissions reduction, long term financial, and other benefits to EV adoption, bidirectional EVs can be employed as mobile battery storage adding resilience benefits and demand-response capabilities to a community's building infrastructure and provide energy to external load (discharge) when paired with capable EVSE. Bidirectional vehicles can provide backup power to communities through vehicle to building (V2B) charging as a microgrid, or provide power to grid through vehicle to grid (V2G) charging. Both V2B and V2G can complement other distributed energy resources (DERs), or supplement diesel generators as backup power and a mobile source at that. This is a particularly important aspect to EVs and EVSE for municipal operations (especially town garages), schools, libraries, and other locations that provide critical social and physical infrastructure on a daily, emergency, and recovery basis.

Transportation Targets

Tables 22-25 present targets for the adoption of EVs (replacement of fossil fuel vehicles), include a business-as-usual baseline and the CAP mitigation targets towards meeting State goals. While Central Vermont is on track for our 2025 goal, and in fact surpassed it, targets increase rapidly thereafter. CVRPC continues to support municipalities, other fleet operators especially schools, and town energy committees to promote education and participation in State, Utility, and Federal incentive programs. See the supplement for additional transportation targets including medium- and heavy-duty vehicles and non-road energy demand; CVRPC is

[12] Drive Electric provides the most comprehensive and up to date snap shot of State, Distribution Utilitiy, and Federal incentives, rebates, and inclusions: https://www.driveelectricvt.com/?gad_source=1&gclid=CjwKCAjwtqmwBhBVEiwAL-WAYbmxAzFQ9-5GP2WHd7oP5AzQhS3OPMRCUhERxSZwW2b9d0Fv9rEvyhoCuDIQAvD_BwE , State Diesel Emissions Reduction Assistance Program https://dec.vermont.gov/air-quality/mobile-sources/diesel-emissions/vt-diesel-grant#:~:text=The%20Vermont%20Diesel%20Emissions%20Reduction,diesel%2Dpowered%20engines%20and%20the ; Vermont Clean Cities Coalition provides direct support to municipalities https://cleancities.energy.gov/coalitions/vermont#:~:text=The%20Vermont%20Clean%20Cities%20works,advanced%20vehicle%20technologies%20in%20transportation

working to pull together municipal fleet inventories to better adjust these targets and provide municipalities municipal fleet recommendations.

Towards Municipal Transportation Targets

- Vehicle Inventory
- Annual data per vehicle
  - Vehicle Miles Traveled (VMT)
  - Gallons fuel used
  - MPG
- Replacement Schedule

Baseline Regional **Passenger Car EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	22	797	1,717	3,688	7,073	14,681
Plug In Hybrid	55	215	244	368	602	1,106
Total	**77**	**1,012**	**1,961**	**4,056**	**7,675**	**15,788**

CAP Mitigation Regional **Passenger Car EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	22	1,093	4,719	11,272	17,892	26,546
Plug In Hybrid	55	208	195	160	101	36
Total	**77**	**1,301**	**4,913**	**11,431**	**17,994**	**26,582**

Baseline Regional **Light Duty Truck EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	3	173	375	870	1,937	4,871
Plug In Hybrid	33	128	260	527	1,021	2,413
Total	**36**	**301**	**635**	**1,397**	**2,959**	**7,284**

CAP Mitigation Regional **Light Duty Truck EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	3	1,163	6,926	16,289	24,669	33,219
Plug In Hybrid	33	122	169	161	107	40
Total	**36**	**1,285**	**7,095**	**16,450**	**24,776**	**33,259**

REDUCING TRANSPORTATION ENERGY DEMAND AND GHG EMISSIONS

Goal: Promote the shift away from single-occupancy vehicle trips to reduce congestion, impacts to local facilities, and support alternative options for transportation needs.

Strategy
Promote Transportation Demand Management (TDM) and Ridesharing Programs: ● Promote and support the Go!Vermont program that links travelers to a variety of transportation resources and mobility options ● Develop recommended criteria for supporting public and ridesharing infrastructure integrating health equity recommendations such as curb cuts, cross walks, raised and sheltered bus stops/benches, accessible transit stop sitting, etc.   ○ identify key gaps in accessibility of existing public transit infrastructure ● Work with regional partners such as VTrans to ensure inventories of park & ride locations and conditions are up-to-date and are consistent with the State Park & Ride Plan. This may include occupancy studies or user surveys to assess specific needs ● Identify Park & Ride facilities that are near or over capacity to ensure future planning will accommodate expansions, upgrades, modifications, or alternative locations are identified as appropriate ● Support employer programs to encourage telecommuting, carpooling, vanpooling, walking, and biking for employee commute trips (including flexible work hours, remote work options, discounted transit fair, health bonuses, etc.) ● Work with utility companies and municipalities to inventory and map infrastructure such as fiber optic cable to identify gaps that may prohibit information accessibility or telecommuting options
Follow the 2023 Vermont Transportation Equity Framework to help decision makers plan for and prioritize projects, ensure accurate representation in decision making, and enhance the equitable delivery of services.
Support regional infrastructure projects that provide commute alternatives including rail, multi-town greenways/paths, etc. Ensure continued support for inter-municipal and inter-regional public transit. ● Work with municipalities to evaluate and determine the feasibility of intermodal transit facilities in appropriate regional locations that can be supported by infrastructure, population, and resources.
Work with VTrans and Green Mountain Transit to identify future growth areas or development centers to ensure public transit will be accommodated in these locations including access to park & ride locations when appropriate.
Work with public transit providers and other partners to identify underserved communities including unhoused community members, rural areas, low-income neighborhoods, night shift work sites, etc. to identify transit opportunities in these locations (and connected to critical services)
Assist municipalities, regional partners, state agencies, and development community to identify incentives that encourage the inclusion of public transit in land development plans such as reduction in parking requirements, reduced local permit fees, or the like.
Develop clear policy to require large scale developments to consult transit providers regarding the need to include transit, multi-modal, and EVSE infrastructure within development proposals.
Work with regional partners and municipalities to establish a comprehensive transportation plan that incorporates policies and implementation regarding the expansion of public transit that considers locations

Strategy
of park & ride facilities; public facilities such as schools, libraries, health services, wrap around services (shelters, food banks/pantries, addiction recovery services) and government buildings; or other activity centers and uses throughout the Region and identifies possible funding sources to support implementation and the Region's future land use planning efforts.
Provide technical assistance to transit providers as appropriate regarding land use, infrastructure, and future planning considerations to help plan for service needs.

Goal: Promote the shift away from gas/diesel vehicles to electric or non-fossil fuel transportation options to reduce dependency on non-renewable fuel sources for transportation. GWSA

Strategy
Work with municipalities to ensure land use regulations do not prohibit the installation of electric vehicle supply equipment (EVSE, aka charging stations) or similar alternative fuel technologies (such as biodiesel) and identify model language that can be considered by municipalities to support these uses
Promote EVSE ready building practices and retrofits (electrical panel needs); promote the use of EV Meter Socket Adapters to mitigate common obstacles to adoption and enable bidirectional EVSE for charging, vehicle to grid configurations, connection to solar and stationary storage, etc.
Consult with Vermont Energy Investment Corporation's Drive Electric program and other regional/state partners including VTrans, Vermont Clean Cities Coalition, and EmPower to coordinate multi-scale funding, program development, and implementation and stay up to date on current technology trends and opportunities to provide guidance to municipalities. ● Disseminate Drive Electric fleet electrification resources, funding, and technical assistance opportunities; participate in quarterly stakeholder meetings ● Conduct outreach and provide technical assistance to municipalities to participate in State EVSE and fleet electrification programs (via support to ACCD and DHCD (Department of Housing & Community Development), VTrans, and Drive Electric) ● Promote EPA (Environmental Protection Agency) Clean School Bus Program with schools and municipal champions; provide technical assistance around bi-directional options which can be integrated into back-up and emergency power plans ● Support and expand the use of electric powered buses and vans among the public and private transportation providers serving the region ○ including Meals on Wheels, MyRide, Gopher, and other rural transit programs centering frontline communities' needs
Identify businesses and municipalities in the region that operate large fleets of vehicles to provide assistance evaluating the possibility of integrating electric, low-emissions, and/or alternative fuel vehicles into their fleet
Provide training to local zoning and development review boards to consider infrastructure for alternative transportation in their review of site plans.
Support and encourage municipalities and businesses to install EV charging stations at convenient and desirable locations, such as in front of restaurants, stores, tourist and recreational destinations, and community sites like Town Halls and libraries, where users would want to park for several hours. Explore and pursue incentives to defray the cost of installation and administration so that users pay only for electricity.

Strategy
• promote the integration of EVSE with solar generation including but not limited to solar carports
Support municipal transportation asset sharing and procurement: • develop equipment and culvert inventories • develop study and plan for regional sand/gravel resources to reduce costs and vehicle miles traveled especially in high demand conditions (mud season, disaster recovery, etc.)
Support DriveElectric and VTrans to maintain inventory of existing EVSE, condition, and recruit potential site hosts; identify infrastructure gaps and facilitate region-wide access for EV operators • develop template criteria for EVSE location prioritization to improve access and equity
Support and expand access to fluid biofuels for use in commercial vehicles and heavy equipment in addition to electrification
Consider regulations that would EVSE to be included in large scale developments as appropriate

Goal: Facilitate the development of walking, biking, and rolling infrastructure to provide alternative and multi-modal transportation options for communities and to promote interconnection within the region's transit systems. Walking, biking, and rolling provide critical alternatives to motorized vehicle travel. Ensuring a safe, efficient, and convenient infrastructure exists to promote walking/biking/rolling is essential to the future growth and sustainability of the Region's municipalities. Furthermore, in addition to decreases in fossil fuel use and GHG emissions, there are substantial co-benefits to this infrastructure related to public health, accessibility, and emergency management.

Strategy
Provide technical and grant writing assistance to municipalities who plan for multi-modal transportation and better connectivity with alternative transportation modes. Prioritize implementing the strategies and priorities identified in the Vermont Health Equity Planning Toolkit that are relevant to the region. • develop project prioritization criteria that integrate health equity considerations
Working with municipalities to update municipal road standards (for maintenance and new construction) to reflect Complete Streets principles. • evaluate local regulations and recommend changes as needed to come in line complete streets legislation (19 V.S.A §309d) (done?) • provide regular updates and training to municipalities • review state transportation projects to ensure Complete Streets are implemented
Develop model regulations to be evaluated by municipalities that require walk/bike/roll infrastructure in downtowns, village centers, growth areas, or locations that propose high density development patterns • Ensure that site plans include adequate bike and pedestrian infrastructure and safety measures, through participation in the Act 250 hearing process
Work with municipalities and regional partners to developing a walk/bike/roll master plan: • conduct gap analyses and high priority projects that connect residents with diverse needs to food assets, schools, public transit, libraries, etc. • identifies implementation strategies and matching funding stacks

Strategy
• coordinate with and integrate existing community-supporting organizations and non-profits; center underserved communities in decision making, prioritization, and planning (Key partners include Capstone, Central Vermont Mobility Committee; Center for Independent Living, PrideRidesVT, FreeRide, LocalMotion, GMT, etc.)
Evaluate land use patterns to ensure walk/bike/roll connection feasibility between key land uses such as schools, parks/greenways, commercial areas, and neighborhoods
Work with cycling advocacy groups such as Local Motion, FreeRide, and PrideRidesVT, by hosting safe on-road cycling workshops and raising awareness about the viability of micro-mobility (such as electric bikes and scooters).

Electric Sector-Current Use

The Central Vermont Region currently uses approximately 469,522[13] megawatt hours of electricity on an annual basis across the residential, commercial, and industrial sectors (see Table below for use by sector and supplement for use by town and by sector).

Table 26 Current Regional Electricity Consumption

CVRPC Electricity Consumption	2016 CVRPC Regional Plan	kWh Usage by Year (Efficiency VT)		
Sector	2016 Plan	2020	2021	2022
Commercial & Industrial	353,117,000	239,531,296	247,455,287	255,723,111
Residential	241,268,000	203,571,494	211,580,064	213,799,098
Total	**594,385,000**	**443,102,791**	**459,035,351**	**469,522,209**
Average Residential Use		6,520	6,734	6,765

Data Source: Efficiency Vermont Regional Summary Report for CVRPC, June 2023.

As a comparison to Central Vermont's 6,765kWh per year, the US average residential electricity usage was 10,632kWh in 2021, an average of about 886kWh per month (EIA). Electricity consumption is expected to increase as electrification continues to be a central approach of the State to meeting GWSA targets and transitioning away from fossil fuels given that Vermont is rapidly decarbonizing its electric sector resources (see Chapter 2 Infrastructure). Fuel switching in the thermal sector and switching to alternative fuels and electric vehicles in the transportation sector are both discussed in the following sections. As electric consumption is projected to rise, the most useful targets include those around energy efficiency and conservation, critical to ensuring electrification has the intended outcome from the ground up to the State's legally binding GWSA goals. It is of note, however, that since the 2018 Enhanced Energy Plan, reported electricity consumption in central Vermont has declined by approximately 20% overall (approximately 11% decrease in the residential sector and 28% in the commercial and industrial sectors)- it is difficult to know if this is associated with changes in usage over the pandemic, a lack of consistent reporting from the DUs to Efficiency Vermont, or evidence of the successful implementation of efficiency and conservation measures (see below). Most likely, it is a mixture of all three.

Existing electricity infrastructure is detailed in the Infrastructure Chapter excerpt. Efficiency and conservation measures are integrated into the previous two sections. Electricity efficiencies were embedded into the 20year load forecast used in the updated LEAP model, thus are not an output of their own (and why the Public Service Department removed the Electric Sector tab of the Analysis &

[13] incomplete demand data is known at least for Woodbury from Efficiency Vermont's annual regional data report; strengthening relationships with our Distribution Utilities directly will ensure more accurate and comprehensive data will underlie future planning efforts. This total is thus an underestimate of total demand (use).

Targets Tool). Additional targets will be made available at the regional and municipal scales via CVRPC's website once the Public Service Department determines an appropriate path forward for treating those targets. CVRPC did not find it necessary to add additional targets pre-empting a statewide, RPC-supported, approach is developed, given especially the focus on weatherization and efficient residential heating systems above that fits well with the region's vision and current approach.

MAPPING RESOURCES AND SITING ENERGY INFRASTRUCTURE

Several over-arching goals frame this section and supporting analyses. CVRPC acknowledges it has a role to play providing its share of renewable energy generation to meet State goals of meeting 25% of demand with renewable energy generated in state and 90% renewable energy by 2050-CVRPC integrated an assumption of 25% energy demand in state generation into its analyses underpinning this section of the plan. There are also significant local benefits if distributed energy projects are developed with intentionality and community collaboration:

Community Benefits

- Cost savings (direct & indirect)
- Creative ownership models; incorporate affordability, educational, and dual use programs
- Investment in physical and social infrastructure
- Meet increased demand and expand needs met (e.g. cooling & warming centers)
- Energy Resilience, Reliability,

Environmental Benefits:

- Support electrification of thermal and transportation sectors to go further faster and be accessibly to all
- Reduce fossil fuel use and GHG Emissions
- Resilience and Reliability (increased severe storms and outages)

Financial Benefits:

- Reduce Municipal costs (direct and indirect)
- Draw down funding for investment in social and physical infrastructure
- Reduce community energy burdens
- Municipal tax
- Resilience of operations

This section allows the region to consider land and resource availability for different types of renewable energy generation and thus their suitability based on size, type, and proximity to demand in addition to location based environmental and social considerations. This section combines resource information with specific known and possible constraints to the development of renewable energy generation at the State, Regional, and local levels. The mapping section also provides the opportunity to identify preferred locations for renewable energy development and areas that are unsuitable for development of any kind. In addition, the maps identify existing infrastructure to support renewable energy development. While we will continue to largely refer to renewable energy generation generally, or to specific types, often in combination with storage, these discussions also extend to the development of transmission and distribution infrastructure as well whether or not in association with a generation/storage project.

This plan is intended to be a starting point and not the only basis for siting and project development. CVRPC intends for these mapping products and targets to catalyze collaboration; CVRPC encourages municipalities and communities to take an active role in project development to support their needs and demonstrate the types of projects that work well for them within their existing and future visioning for their own community. Furthermore, CVRPC encourages developers and distribution utilities to reach out early and often when considering developing a project within the region and to work with communities and their priorities which may favor resilience and reliability concerns (integration with storage, ability to function as a micro-grid), alternative site choices, community benefit agreements to support municipal and/or residential energy programs, educational opportunities, dual use opportunities, etc. Preferred site (types), preferred project characteristics, land use policy, renewable energy generation targets, key issues and community priorities will be discussed below after a review of known and possible constraints.

Potential Municipal Roles

- Policy: update zoning and plans to remove barrier and integrate priorities
- Community Outreach: support local partnerships and share information; develop committee/coordinator role; project working groups, etc.
- Investment: participate/host project
- Ownership/Project Development

CVRPC and ACRPC Energy Planners led a three-part workshop series in 2023 on Municipal Solar- see for more information and resources: https://centralvtplanning.org/programs/energy/webinars-and-workshops/

Future Renewable Energy Generation

The siting and generation of renewable resources is a critical part to identifying whether or not the region can meet its share of the state's renewable energy goals by 2050. The following analyses determine where resources are available throughout the region to ensure no one municipality is unduly burdened with supporting more than should be reasonably anticipated. Finally, this information will better position the region and its municipalities to evaluate the renewable energy generation options that are available to meet these goals.

CVRPC's objective is to ensure that energy generation, distribution and transmission facilities are located, designed, and correctly sized to support the Region's community and economic needs, which increasingly means it must be reliable, resilient, and affordable as well as sustainable to reduce operational costs and Green House Gas emission contributions (further reducing long-term costs). At the State level, supporting policies and programs are being revisited to consider key issues including adequate electricity, affordability of rates, cost-effective and efficient use of resources, economic vitality, environmental justice and energy equity, reliability, security, sustainability and limiting negative environmental impacts. Many, if not all of these, apply to the

regional and municipal, as well as the state level. However, priorities may differ, given the unique characteristics of each region.

Long-term energy resilience (adaptability, affordability, and crucially reliability) is critical to supporting thriving communities in Central Vermont. CVRPC advocates for the regional and municipal scales to be considered in the planning of local generation and energy transformation policies, as local communities experience

- Increasing duration and frequency of outages (especially in our rural communities),
- Increasingly disparate electric rates and opportunities to invest in on site renewable generation and storage alternatives based on distribution utility territory and proximity to energy infrastructure,
- Increased reliance on municipal and community hubs to provide critical care and resources.

Investing in infrastructure choices that maximize co-benefits and energy efficiency in complementary infrastructure such as capturing waste heat and/or creating thermal energy networks will reduce demand on existing electric infrastructure and further support cost and emissions reductions.

Section 248 and Project Review

Known & Possible Constraints

Act 174 outlined a set of State known and possible constraints which extend to renewable energy generation project development in addition to other types of infrastructure and development. These constraints are integrated into regional and local map products along with additional regional and local constraints, to identify base and prime resource areas primarily, but not exclusively, for solar and wind development. These terms can be misleading- base and prime resource potential areas are not to be confused with preferred sites (see below) nor are they designated for development, they just identify the lack of conditions that would prohibit or seriously complicate renewable energy development when evaluating land use potential. These map products are intended as a starting point in early project development and foremost to assess the region's ability to meet renewable energy targets and integrate energy planning into broader land use planning (see below). In coordination with the RPCs, the Department of Public Service, Vermont Center for Geographic Information, and the Agency of Natural Resources have created statewide layers that represent the best available known and possible constraints detailed in the Act 174 Energy Planning Mapping Standards for Regional and Municipal Plans (available in the Act174 tab of DHCD's Vermont Planning Atlas):

Base (e.g., ground mount solar and wind)- identifies areas that have no known constraints, but 1 or more possible constraints,

Prime (e.g., ground mount solar and wind)- identifies areas that have no known nor possible constraints.

In addition, they developed a Rooftop Solar Potential layer, which accounts for roof orientation and size (though not existing generation, roof age, nor condition). These layers account for technical suitability factors, such as slope and orientation, elevation and wind speeds, and access and proximity to grid-related infrastructure. These layers and data inputs serve as the basis for further CVRPC analyses which integrates regional constraints,

regional and municipal considerations, regional data, and priorities to develop the resource potential area map products, calculate available land resources while balancing other priority land uses, etc.

Constraints are separated into two main categories: known and possible. Known constraints are land characteristics that are unsuitable for development including the development of renewable resources (see Summary Table below). Similarly, the State identified a list of possible constraints, which identify areas where additional analysis would need to occur in order to determine if development of renewable energy resources (or any development) is appropriate (e.g., has minimum negative impacts). In some cases, conditions may be prohibitive, but in others the conditions may be suitable for renewable energy development on a project-by-project and site-specific basis. The supplement provides definitions for the known, possible, and regional constraints that are included on the maps and discussed here. These definitions include source information and, in several instances, provide insight to the inclusion of the constraint.

Table 27 Summary of State Known and Possible Constraints

State	
Known Constraints	Possible Constraints
• Vernal Pools (confirmed) • DEC River Corridors • FEMA (Federal Emergency Management Agency) Floodways • State-Significant Natural Communities and Rare, Threatened and Endangered Species • National Wilderness Areas • Class 1 and Class 2 Wetlands • Regionally or Locally Identified Critical Resources	• Vernal Pools (potential and probable) • (Prime) Agricultural Soils • FEMA Special Flood Hazard Areas • Protected Lands (State fee lands and private conservation lands) • Act 250 Agricultural Soil Mitigation areas • Deer Wintering Areas (DWA) • Highest Priority Interior Forest Blocks, Connectivity Blocks, Physical Landscape Blocks, Surface and Riparian Areas (ANR) • Hydric Soils • Regionally or Locally Identified Resources

See Supplement for Descriptions of State Known and Possible Constraints; Act 174 Planning Atlas for layer sources.

In addition to the State's known and possible constraints, CVRPC identified additional regional possible constraints in the development of the previous plan consistent with the region's land use policies in general. While these constraints are considered possible; they were integrated unilaterally into all map products and layers as they did not unduly constrain the potential layers. CVRPC intends to conduct further analysis in collaboration with municipalities to refine these regional constraints and clarify local constraints for comprehensive integration. CVRPC is also developing a pilot thermal energy resource map to support the consideration of thermal energy networks (thermal sector, not for electricity generation; focused on existing buildings & facilities, not geothermal potential).

Table 28 Summary of Regional Possible Constraints

Regional Possible Constraints
• Elevations Above 2500 ft: excludes rooftop and associated with existing development • Slopes Greater than 25%: excludes rooftop and associated with existing development (unless presents new concerns for landslides) • Municipal Owned Lands; excludes rooftop and associated with existing development • 250ft Lake Shore Protection Buffers, excludes rooftop and hydroelectric facilities

CVRPC is working to integrate local constraints into mapping products, as a number of towns are currently in the process of developing their first enhanced energy plans, this process is timely and local constraints will be more comprehensively integrated in the Fall 2024/2025 regional plan update. This will allow the municipalities to use local insight and knowledge to evaluate and establish their own criteria for identifying locally preferred or unsuitable locations and they are encouraged to do so not only in broad site types but to the parcel level where it supports their energy goals- this can include siting for all resource technology types. Furthermore, CVRPC is in the process of developing a tool for municipalities to use during their own Enhanced Energy Planning processes to determine the potential impact of adding additional constraints or better yet, preferred sites to the maps. CVRPC is furthermore, committed to integrating mapping tools into the project review process and the project development process to support quick evaluations for discussions including highlighting areas with different numbers of possible constraints, working to identify preferred sites, mapping existing preferred site types and project characteristics, etc. Local Constraints include:

- slightly lower elevation maxima (1800ft in Northfield, 1700ft in Waitsfield),
- prohibit development in specific conservation, forest reserve, and historic districts (Fayston, Northfield, Waitsfield), active farmland (East Montpelier, Northfield, Waitsfield), and flood hazard areas and river corridors (East Montpelier),
- discourage placement in green fields.

Additional local considerations/policies:

- no limitation on siting residential scale projects as long as owner will take reasonable measures to site/screen ground-mounted installations to minimize visual and noise impacts (Berlin),
- limit projects from exceeding 1 acre, scaled to meet approximate proximate demand (Calais),
- preferences for screening.

Changes to regional priorities, as well as municipal and state priorities, are likely to impact constraints (and preferred siting) in the future as we comprehensively reassess how to maximize meeting our goals associated with housing needs, forest and land conservation, and flood and climate resilience in addition to renewable energy development,

Renewable Energy Generation Targets and Resources Available

In order to better understand how the region can provide its share of renewable energy generation to meet the state goals of 90% renewable energy by 2050 and 25% of demand generated in state, the potential for

renewable energy generation needs to be quantified. Table 29 provides an overview of the potential renewable energy generation for Central Vermont based on the prime and base resource areas that have been identified. Renewable generation potential is calculated from mapping completed by the Central Vermont Regional Planning Commission and is based on the Regional Determination Standards and associated guidance documents developed by the Department of Public Service (including the Generations Scenario Tool). As discussed in the section on the electric sector, the region's 2022 electricity demand was 469,516MWh in 2022 according to Efficiency Vermont, which is projected to increase based on increase in demand from the electrification of the thermal and transportation sectors as described above, in addition to modest population increase. Offsetting this demand via weatherization and energy efficiency can be significantly boosted via storage, flexible load management, and importantly via opportunities to capture and utilize waste heat and integrate thermal energy networks into new building including housing, wastewater and water systems, and other new infrastructure (see thermal sector above).

The Central Vermont Regional Energy Plan identifies specific areas where resource areas exist for renewable energy generation. These areas focus on wind, solar, and hydroelectric as they are locationally constrained. Other renewable energy generation such as woody biomass, biogas, and other renewable technologies do not require specific conditions for the location of the generation facility, however they do require resources such as wood or other organics to provide the needed fuel- there are no existing such plants for renewable electricity generation nor plans for them, however wood does play an important role in heating across our region, as could ground source heat pumps which will be considered in future updates to the mapping products.

Table 29. Potential New Regional Renewable Energy Generation

	Existing Renewable Generation (MW)	Multiplier (distribution across technology type)	Incremental Regional Capacity Target (MW)		Resource Available (MW)	Prime Land Available (Acres)
			25% IN-STATE	50% IN STATE		
Ground Mount Solar	41.7	25%	31	84.7	1500.4	10,503
Rooftop Solar		50%	64.2	175.3	162.7	244
Wind	0.24	20%	16.6	45.2	867.6	34,795
Hydroelectric	26	5%	1.9	5.1	1.9	N/A
Biomass (Wood, methane, farm biogas)	0	0	0	0	0	0
Total Renewable Generation Potential	68	100%	113.7MW	310.4	2532.7	45,452

Source: Central Vermont Regional Planning Commission & Department of Public Service (via Generation Scenarios Tool, see methodology in supplement). Municipal tables will be available online May 2024. NOTE: while energy targets are provided in MWh, capacity targets are provided in MW- default outputs are provided here for consistency and comparison across regions. Values in orange exceed resources

available although hydroelectric potentials are not yet well integrated into state planning tools and merit further consideration. Furthermore, our capacity target for the 50% in state scenario, in purple, would also exceed our Distribution Headroom.

The constraints outlined above have been evaluated to ensure sufficient resource area exist to meet the region's share of the state's renewable energy targets. As noted, the regional constraints are included as "possible" therefore development of renewable resources could occur in these locations after an analysis of the specific site has been concluded. Additionally, multiple technologies could be used to meet the region's target, the distribution of new generation across technology type was set based on precedent for the type in the area, technical difficulty and cost, as well as community appetite- a conservative estimate[14] was used to reflect previous trends but it should be noted that CVRPC has found community members and municipalities to be open to a diverse range of technology types, with especially scale but also project location and community benefits to be key determinants of support (see Infrastructure Chapter and for an in depth discussion Fall 2023 CVRPC SAY WATT: The Future of Vermont Electricity Report).

Generations Scenario Tool was set to meeting the Region's incremental regional energy target via 25% Ground Mount Solar, 50% Rooftop Solar, 20% Wind, and 5% Hydro. Natural Gas is set to 0% as there is no natural gas infrastructure in the region and Vermont's primary supplier, VGS (Vermont Gas Systems), is not only not looking to expand their territory for natural gas but is also exploring work conversion into geothermal and other technologies. Furthermore, Biomass (for electricity generation) was set to 0% as after the Moretown Landfill closed it seems there is little appetite for a project in the region. Note that landfills are included as preferred sites though, and this could change in future analyses if a project is developed. These inputs were set to maximize rooftop solar as a key preferred site. The table below identifies regional targets for new renewable electric energy generation; in addition to the target for 2050, the table includes intermediate years to help track progress towards that goal.

Table 30 Incremental Regional Targets for New Renewable Electric Energy Generation (MWh)

Target Year	2032	2040	2050
New Renewable Electric Energy Generation (25% In-State)	72,547	134,458	163,093
New Renewable Electric Energy Generation (50% In-State)	264,211	388,034	445,307

Source: Central Vermont Regional Planning Commission & Department of Public Service (via Generation Scenarios Tool, see methodology in supplement). Municipal breakouts available online May 2024.

These analyses and tables show that Central Vermont has more than sufficient potential renewable energy resources available, even with a conservative estimation, to meet 25% of demand met by in-state renewable generation (different distributions across technology type are also certainly possible**). This includes sufficient**

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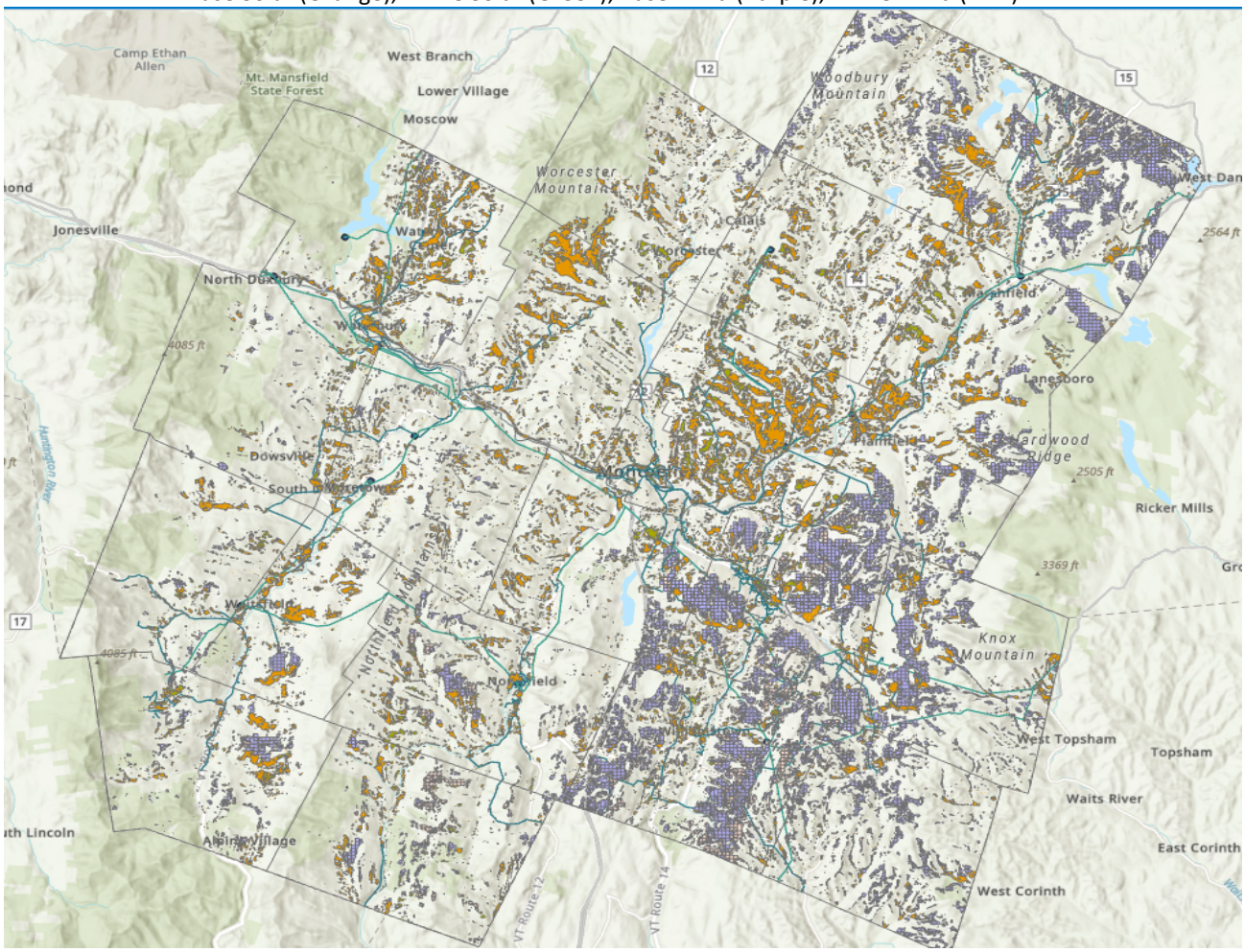
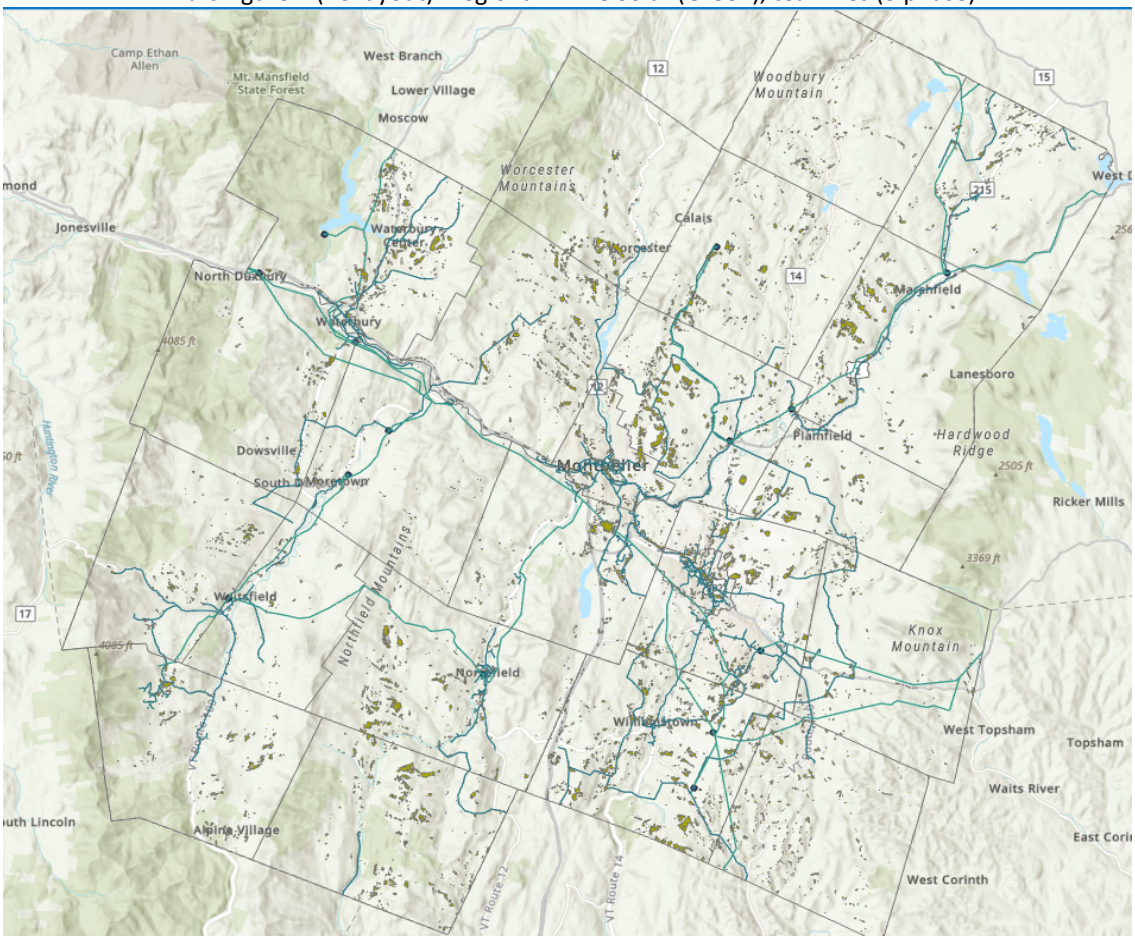
resource available for each technology type for each municipality. Maintaining this at the municipal level becomes more difficult if rooftop solar is changed to account for more than 50% of the share of new generation, although certainly CVRPC supports refining this analysis to add different distributions by municipality and maximizing our strengths across the region. If that in-state amount is raised to 50% we do over run our existing resource potential for rooftop solar and hydroelectric with the current distribution of generation across technology types. The Generations Scenario Tool analyses do not take into account storage and offsetting electric demand from the thermal sector via cord wood, waste heat recovery, and geothermal which all key pieces of Central Vermont's approach to the energy transition. These would reduce the incremental energy targets required and total new renewable energy generation capacity needed which further emphasizes CVRPC's confidence that as a region we can not only achieve but comfortably exceed a 25% match if we wanted to set a regional target concerning a % of our regional demand in the future. Lastly, the potential energy generation for Central Vermont could increase if we include biomass, biogas, and methane, however we do not currently have any such sites located in the region, therefore calculating a potential for generation would be difficult.

There are significant challenges to meeting these goals and targets however when it comes to our energy infrastructure. It should be noted that the Department of Public Service was unable to provide some capacity information for substations in our region based on a lack of data from Distribution Utilities. The capacity targets for Calais, Orange, Plainfield, Washington, and Williamstown exceed the distribution headroom allotted for that town in the tool. Barre City, Berlin, Cabot, Calais, East Montpelier, Middlesex, Montpelier, Northfield, Washington, and Worcester all show concerns that the capacity targets exceeds grid headroom. CVRPC is working the Department of Public Service, Distribution Utilities, and other RPCs (Regional Planning Commission) to assess the severity of these limitations and ensure that missing data is provided and not contributing to these shortcomings. Limitations particularly in our distribution infrastructure are a known and significant challenge for Central Vermont and will be discussed below (and at great length in the planned Winter 2025 additional update).

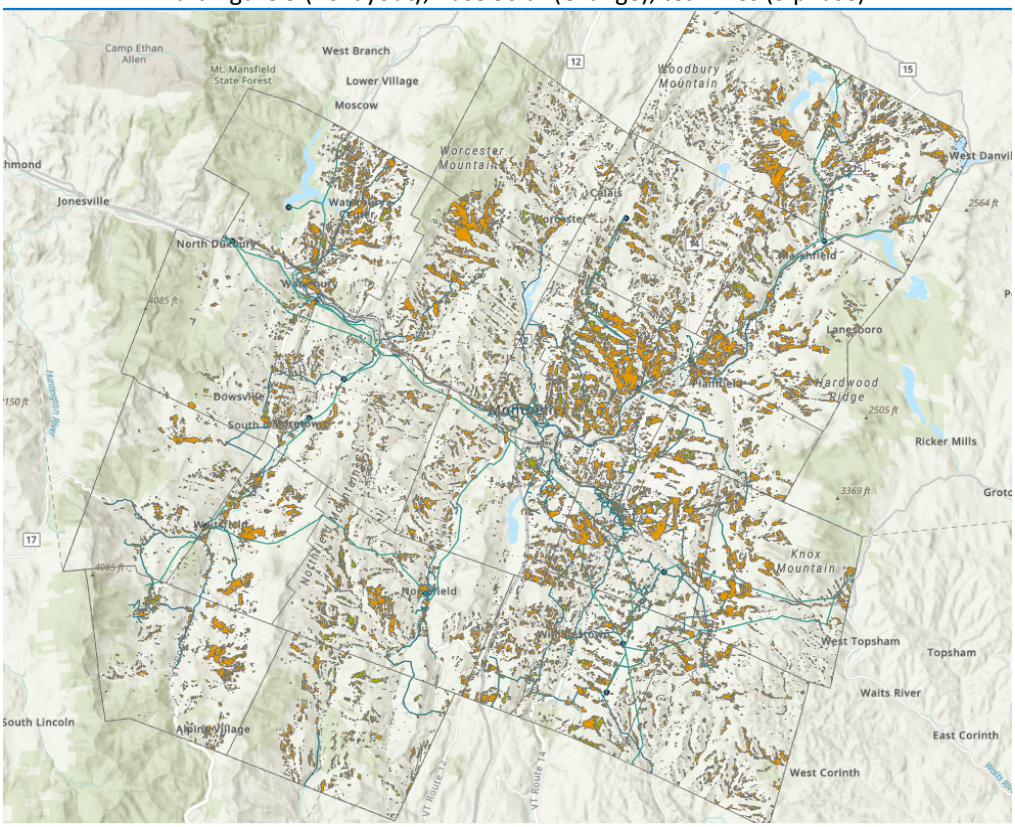
Draft Figure 3 (no layout): Regional Solar and Wind Resource Potential Aggregate Regional Land Base Solar (Orange), Prime Solar (Green), Base Wind (Purple), Prime Wind (Pink)



Draft Figure 4 (no layout): Regional Prime Solar (Green), teal lines (3 phase)

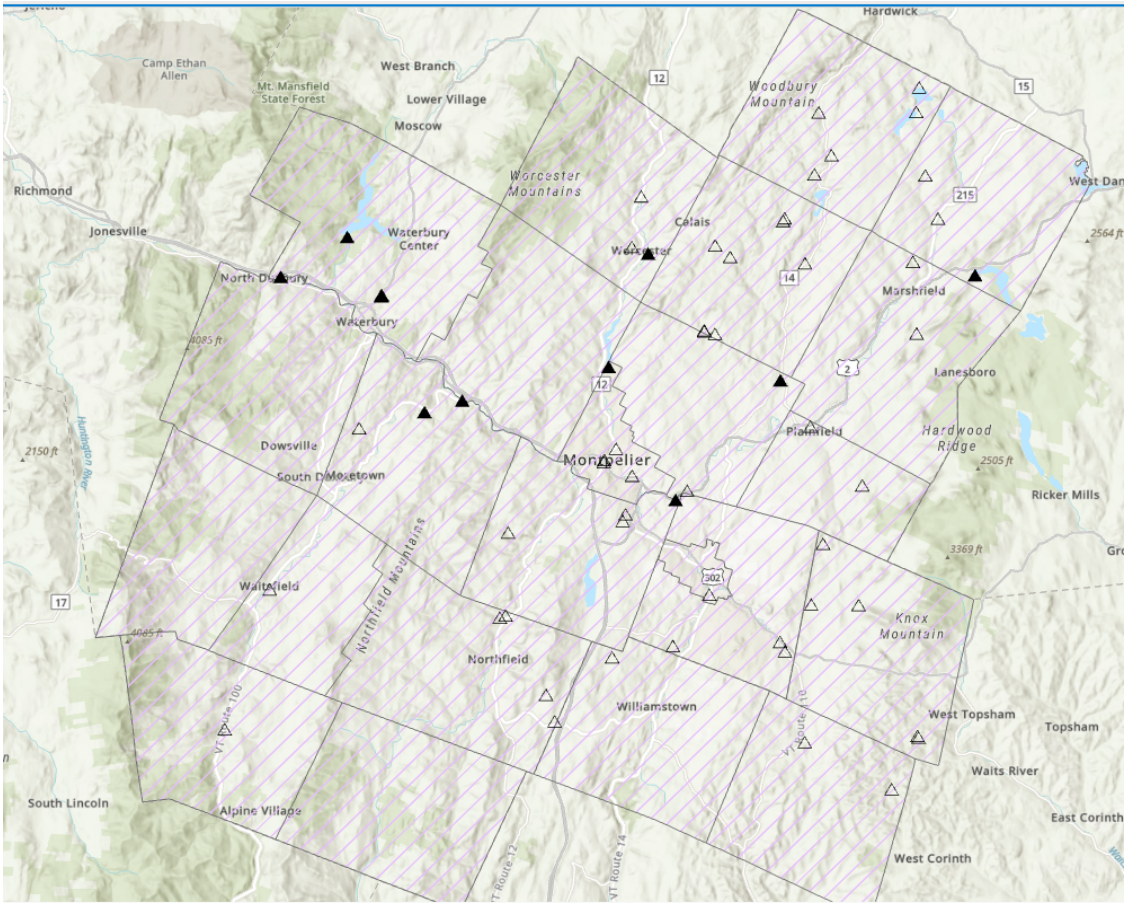


Draft Figure 5 (no layout); Base Solar (Orange); teal lines (3 phase)



Municipal Rooftop potential has also been mapped and will be available online Spring 2024 both in a viewer at the regional scale and in draft maps for each municipality. In the interim rooftop potential can be viewed in the Act 174 tab of the DHDC Planning Atlas, and a webinar walking through recommended ways to use it is available on the webinar and workshops page of the CVRPC webpage.

Draft Figure 6(no layout) Existing and Potential Hydroelectric Facilities
black triangles existing hydroelectric; empty triangles potential according to early 2000s state study/report)



Finally, the Central Vermont Regional Energy Plan supports the development of renewable energy generation technology that will not result in an undue adverse impact on the built or natural environment or conflict with identified regional policies. Similar to constraint mapping, it was decided that the region should not limit the extent to which municipalities can plan for their energy future. Due to the diverse nature of Central Vermont, including urban and rural areas, there was no way to develop a consistent regional policy that would be equitable to all the municipalities, therefore all renewable energy generation types (both current and developed through future advances in technology or innovations in the industry) may be considered for application in Central Vermont.

Preferred Sites (Types and Project Characteristics)

Thus far regional and municipal plans have not identified sites to the parcel level as preferred for renewable energy generation, instead defining site types. With the first round of the municipal enhanced energy plans entering their first update phase and a number of towns developing new plans, CVRPC is working with municipalities to best maximize on the opportunity to define additional, and for the first time, map, preferred sites and shape the form and benefits of implementation in our region. We anticipate optimizing the utility via specificity of these planning efforts for all stakeholders will have lasting impacts on investment in and across our

region (including the deployment of storage and 3-phase power) and thus the reliability, resilience, affordability, and accessibility of our energy infrastructure, the energy burden of our residents, and the ability for our communities and businesses to thrive (in addition to meeting our regional demand and contributing towards the state's energy and climate goals).

Did you know?

Proposed projects between 150kW-500kW must be a preferred site to participate in net-metering.

Most Regional and Town Plans use the State Preferred Site list as their "base", frequent additions are noted to the right. The Region adopts the state's preferred site list and provides additional preferred site types and project characteristics below. These are in line with the region's broader land use approach to reducing GHG emissions and conserving energy while investing in shared community infrastructure including encouraging smart and intentional growth; reducing dispersed development that would disrupt forest blocks and wildlife corridors, working lands, and further exacerbate rural infrastructure gaps. Regional preferred sites and project characteristics also prioritize encouraging projects that would be collaborative with local communities and meet existing needs especially regarding resilience and reliability. This includes encouraging projects sited at or near critical social and physical infrastructure, paired with storage, and structured to either directly engage with a local off taker or have explicit community benefit agreements[15]. Limiting vegetation impact and encouraging projects to employ construction techniques to reduce the embodied carbon of projects are further in line with regional and state energy and conservation goals.

State Preferred Sites	Additional Regional Preferences
• Rooftops and Impervious Surfaces (e.g. Parking Lots) • Gravel Pit, Quarry, or Similar Mineral Resource Extraction Site (Lawful and Reclaimed) • Brownfield Sites • Sanitary landfills • National Priorities List (e.g. Superfund Sites) • On same parcel or directly adjacent to customer allocated more than 50% of the net-metering system's electrical output • **A site identified in municipal plan or joint**	• Proximity to use: density centers including designated downtowns, village centers, new town centers, growth centers, and neighborhood development areas; commercial and industrial areas; adjacent to large farms • Schools, Libraries, Municipal buildings facilities, and critical community spaces, • Solar Carports • Location served by existing roads and energy infrastructure (e.g. 3 phase) OR addresses existing gap • Designated a preferred site in Town Plan or by

[15] Dual land use opportunities (agrivoltaics), educational opportunities, community solar, low income programs, component of lease payment to community revolving loan fund to support upfront costs of residential weatherization, integration of meter adaptors to add micro-grid operation options.

letter of support from municipality and RPC (Regional Planning Commission)	Town leadership (as consistent with broader planning)
Preferred Regional Project Characteristics	
• Minimize vegetation impact especially forest clearing and fragmentation; plant screen trees & pollinator habitats • Combined with storage; micro-grid potential or functions • Creates dual land use opportunities (e.g. agrivoltaics) • Includes design/build techniques that reduce embedded carbon of program (e.g. alternatives to concrete pylons) • Engage community in development process (early) • Local off-taker and/or community benefit agreement	

Figure 7 PLACEHOLDER shows State Preferred Sites as a "base"

Libraries are critical physical and social infrastructure in the region. There are 14 libraries found throughout our region (11 municipal, 3 incorporated). In addition to library and educational services, our libraries provide community members with internet, computer, and printer access (including 24-hour Wi-Fi in most cases), reliable food distribution and meals, provide bike repair/rentals, art and school supplies in addition to educational programming, resources on mental and physical health, support navigating state and federal resources, free tax services, social meeting rooms and clubs, and more. Furthermore, libraries offer cooling and warming during business hours, and increasingly, adopting policies for extended use during extreme weather conditions.

Libraries are an essential resource for all community members especially those with acute needs in day-to-day, emergency, and recovery conditions. Our regions libraries are thus considered important community stakeholders with significant insight into local needs as well as ideal locations for community infrastructure investment including but not limited to: flood mitigation, sidewalk/recreation projects, on-site energy generation and storage projects, and more.

So where are projects being located?

Many of the projects in terms of numbers are small residential scale (many rooftop but not all)- important to consider that siting guidelines are best developed with clear references to different scales.

Total from State Energy Programs	MW	# Projects	
Generation <15kW Category I	14.69856	2233	Many are rooftop as residential scale
Generation 15kW to <150kW (Category II)	6.56739	184	Generally includes Municipal/Community Scale (not limited to)
Generation 150kW to <500kW (Category III)	6.18665	23	Currently have to be preferred sites to participate in net metering
Generation 500kW+	22.944	23	Most Standard Offer projects are 1-2.2MW
Total (not regional total):	50.3966	2463	

Noted trends in current project development (Figure to be added)

- projects that have been co-developed by municipalities/schools are often preferred site types and are typically smaller from residential to community scale,
- projects that are developer/DU led typically are larger, many do develop at least some green field space, some are on landfills/gravel pits

CVRPC thus identifies a critical need to connect stakeholders and their planning processes:

- work with Distribution Utilities to establish annual data updates for local and regional planning processes, understand short, medium, and long term infrastructure improvement plans, and provide regional summaries for integration into integrated resource planning efforts
- encourage towns to highlight opportunities and mechanisms for project development in town plans and website; encourage Dus and developers to consult towns and town plans early on in project development

Proximity to existing energy infrastructure with interconnection capacity (and for projects larger than 15kW 3 phase power) is a known priority for distribution utilities and many developers to reduce their short-term project costs and manage system limitations. While some municipalities do and may list these as additional

preferred site criteria[16], the region does not limit preferred sites by these technical considerations but instead encourages closer collaboration with our distribution utilities:

- 3 phase power is not available throughout our region's designated growth centers, excluding some of our more rural designated areas adds additional barriers to the very locations where renewable energy generation projects might could play an even more important role supporting local economic and community development (see Figure 2 Infrastructure Excerpt),
- Known capacity and interconnection concerns (see below) have already resulted in significant curtailment of projects especially in the southeast quarter of our region; focusing on concentrating projects in the fewer and fewer areas without such constraints is an incomplete and short-sighted approach that may unduly burden communities with remaining capacity while also severely limiting many of our municipalities and their residents from not only meeting their energy goals but drawing down federal and state investment to support energy infrastructure, energy resilience, and energy independence in their communities.

Thus below, this plan highlights both those "low-hanging" interconnection opportunities that DUs and developers may find most suitable to encourage community engagement and project development, and encourages DUs and developers to consider community needs and project priorities in their planned infrastructure improvements and potential expansions.

CVRPC acknowledges there is a tendency for preferred sites at all scales to favor small and medium projects, while this is in line with many municipal and community preferences and many regional priorities, it requires new models for how projects may be aggregated to take advantage of economies of scale, for local and state investment, as well as increased capacity at DUs for interconnections and load demand management (which may be viewed as both an opportunity and burden). It is also important to remember that preferred site designation is required for projects 150kW-500kW to participate in net metering and while we have comparatively few projects at this scale in our region (see below, approximately 23) they do provide approximately 10% of our region's existing generation. **Not having preferred site status does not prevent the project from being implemented, it just excludes it from the financial incentives providing via the net-metering program**. The best way for projects of this scale (and really all projects but especially this scale and larger) to attain preferred site status is to outreach early and often with the town and community including local energy committees and coordinators. Furthermore, CVRPC does encourage municipalities to work with local landowners and the broader community to consider potential and parcel-specific opportunities for large projects- only 23 projects out of the region's 2463 and counting renewable energy generation projects are 500kW and more, yet they contribute 1/3 of our region's total nameplate generation. As the state continues to electrify and move towards 25% of demand produced by in state renewable energy generation, it is important to consider and direct where these large scale projects may be located and how they fit into local and regional visioning of our communities. To this end CVRPC has begun to analyze potential resource areas (Figures above) to identify contiguous areas that may meet basic technical requirements and facilitate community conversations around development and use for renewable energy generation.

[16] For example Middlesex and Northfield Enhanced Energy Plans do include language such as within 1 mile of 3-phase power and locations served by existing roads and energy infrastructure; CVRPC supports municipal inclusion of these technical priorities with due consideration

Did you know?

Black, Indigenous, People of Color, (BIPOC), as well as low-income, and rural Vermonters have largely been left out from major economic, social, and environmental benefits associated with investments in climate resilience and renewable energy infrastructure. BIPOC Vermonters were seven times more likely to have gone without heat in the past year, over two times more likely to have difficulty affording electricity, and seven times less likely to own solar panels than white Vermonters (Act 154 Sec 1.10), while rural and low-income communities consistently carry the highest energy burden.

CVRPC is updating both resources used to support project review at the regional level and materials to support municipal and community project development- want to learn how to get involved and change these trends in our region for the better? Get involved with your local energy committee, planning commission, and reach out to your RPC town representative!

Key Issue: Grid Capacity and Infrastructure Needs

In addition to identifying and calculating possible generation of renewable energy based on resources and constraints, the analyses and mapping attempted to incorporate existing infrastructure and data. Three phase power and substations are included in the resource potential maps, distribution and transmission data was integrated into the Generations Scenario Tool, and additional data such as customer count and composition, use data, existing generation projects, and outages were requested and summarized. There are significant gaps in publicly available data and the data supplied to and requested by CVRPC for planning purposes. It will be important to have accurate and up-to-date inventories of existing facilities to ensure upgrades or improvements are targeted to most effectively support additional electric loads on the grid. CVRPC is working diligently with stakeholders to remedy these gaps as well as update standards and works towards regular data sharing. The following section summarizes some of the key known issues throughout specifically our electricity infrastructure with the caveat that the following update will include a more comprehensive treatment and focus on enhancing energy resilience and reliability in Central VT:

- Flexible resources and load management,
- strategic deployment of storage in the region,
- offset future demand with storage, wasteheat recovery, and geothermal,
- non-fossil fuel based back up power options,
- and micro-grid development.

Some Central Vermont communities have extremely limited or no three-phase power but do have prime resource areas to support renewable energy development. While, as previously noted, smaller generation projects (including residential and some municipal and small businesses) can typically be accommodated by single transmission even when not located close to load, but medium and larger scale projects rely on three phase power. In data provided by the Public Service Department, Central Vermont's transmission capacity is limited to approximately 41.5 MW with transmission grid upgrade costs estimated at $40.1 million (see supplement). Again, there are significant and rapidly evolving opportunities to mitigate some, but certainly not all, of these upgrades and costs. While CVRPC conducts further analyses to help municipalities understand how

these limitations may impact their own energy planning, the region also recognizes that significant investment in our energy infrastructure is required to support thriving communities in our region and these costs should not be born by those who are already most burdened by infrastructure challenges which furthermore limit their access to draw down federal and state funds to participate in a just transition. CVRPC again emphasizes the importance of integrating energy into land use planning and working with energy stakeholders to ensure that that energy planning not only is consistency with local regulations and visioning but accounts for targeted growth and likely demand.
Further engagement with VELCO's Long Range Transmission planning process, our Distribution Utilities' integrated resource planning processes, and the State's own energy planning will strengthen these efforts at all scales. The Department of Public Service highlights this, including the role of RPCs, in the 2022 Vermont Comprehensive Energy Plan (pg 87).

Resilience and Reliability

The State's "Electrify Everything" approach does raise specific concerns for some of our municipalities and communities given these interconnection limitations, rural infrastructure gaps, and annual longer term outages.

CVRPC continues to advocate for wider scale policies and programs to address reliability and local resilience (the most recent Renewable Energy Standard Update included a series of technical analyses, none of the scenarios modeled yielded significant reliability benefits). CVRPC also supports municipalities, affordable housing partners, community groups, and businesses to consider integrating on-site energy generation, storage, and back-up power into their capital improvement planning.

There are several substations that presently pose significant barriers to expanding renewable generation in our region (brief summary below). For the substations in GMP territory, substation transformer capacity can be viewed on their Solar Interconnection Map[17] which highlights circuits based on having at least 20%, less than 20%, less than 10%, or severe limitations (higher costs and delayed interconnections)(although two GMP feeders that serve Roxbury, Northfield, and Woodbury are blank due to lack of data from municipal utilities). For other distribution utilities, it is harder to plan in real time based on potential technical limitations due to lack of publicly available data. While our region has approximately 267.5MW of Distribution Headroom according to data supplied by the Department of Public Service in the Generations Scenario Tool which is well above our Capacity Target for 25% in state generation, although not sufficient for the 50% in state generation scenario. While this headroom is ample at a regional glance, there are issues at the municipal scale including, as noted above, that Calais, Orange, Plainfield, Washington, and Williamstown have capacity targets that exceed their distribution headroom. These town's capacity targets exceed provided distribution headroom by less than 1MW in 3 cases (Calais, Orange, and Plainfield), by 1MW in Washington, and by 4.2MW in Williamstown which hosts 2 of the region's largest solar arrays (utility owned). Depending on the size of the proposed projects, these may or may not present significant interconnection barriers but are representative of the longer term challenges we face in implementing our energy goals. Distribution headroom is not provided for Northfield, Roxbury, and Woodbury. CVRPC continues to work with DUs on data gaps and to integrate their Integrated Resource Planning

[17] https://www.arcgis.com/apps/webappviewer/index.html?id=4eaec2b58c4c4820b24c408a95ee8956

into regional and municipal planning and project development and to advocate that regional and municipal energy planning and goals in turn are considered in their Integrated Resource Planning Processes. Key issues included:

- Many substations across our region, regardless of utility territory, must be upgraded to address transmission ground-fault overvoltage (TGFOV) concerns (see figure below), these are subject to an additional Tariff fee of $47 per kW of AC capacity authorized by VT PUC Docket #19-0441-TF.
- Two such systems in WEC (Washington Electric Coop) territory have issues that are so severe that they are currently objecting to any further interconnection and the risk that it could adversely affect system stability and reliability. This severely impacts the portions of Barre Town, Berlin, Northfield, Orange, Roxbury, Washington, and Williamstown that are in WEC territory. Existing substation voltage regulators and transformers have to be upsized which in turn requires support structure adjustments. A timeline has not been established for such a project.
- Summer loading in the Woodbury Lakes area creates a sizeable circuit imbalance and an imbalance on the Hardwick Substation transformer for several months of the year, converting from a V-phase to a full three phase feeder along with additional reliability improvements is including in Hardwick Electrics 2021 Integrated Resource Plan.

In the short term, costs of additional renewable energy infrastructure will be lowest in areas that do not have TGFOV tariff fess and with substation transformers that have at least 20% capacity remaining (although the tariff fees are a key mechanism for paying for necessary updates to DU infrastructure). In the long term many of these infrastructure upgrades are necessary and inevitable; again, better coordination among planning efforts can help our region transition and make sure no one is unduly burden by cost or left out.

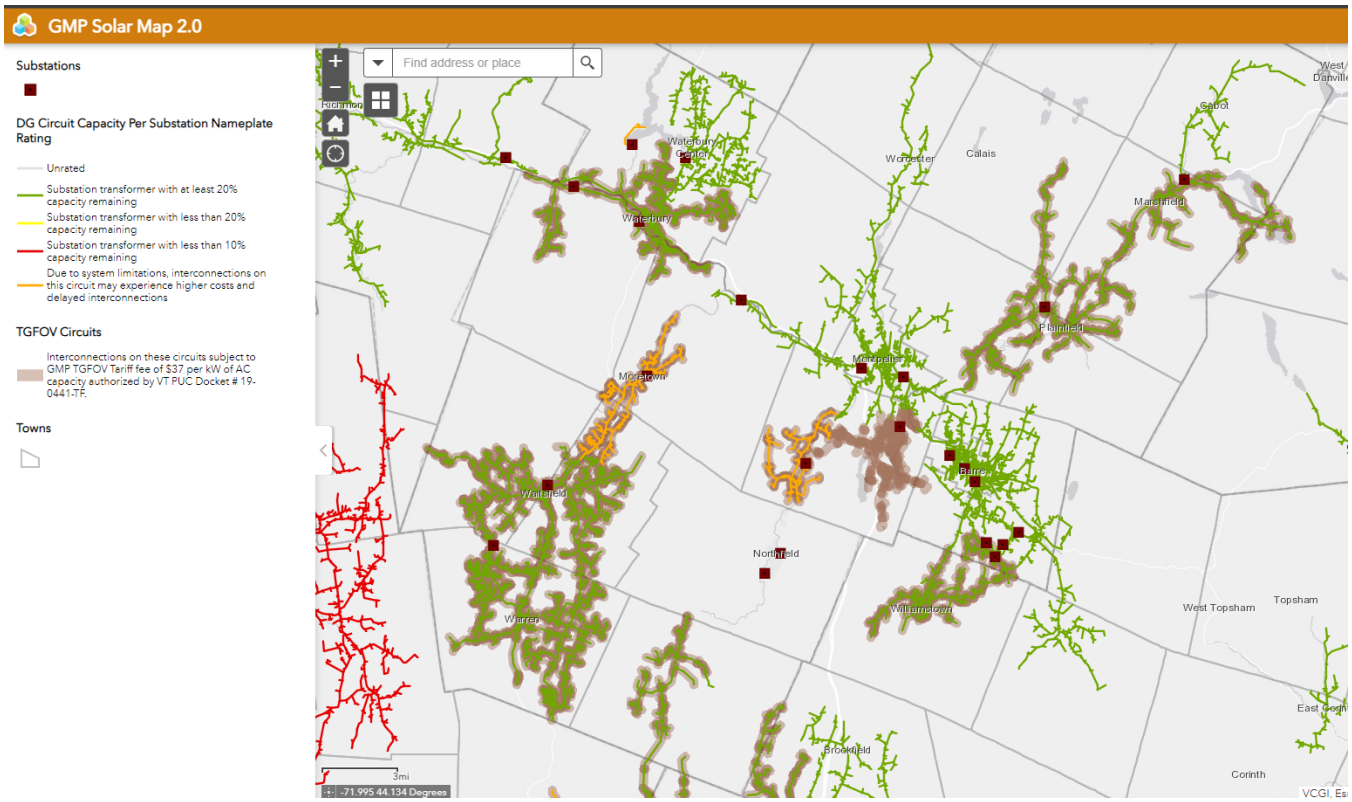


Figure 8 : Snapshot of CVRPC territory via GMP's Solar Map- lines circuits with brown shading have transmission ground-fault overvoltage (TGFOV) concerns, those in yellow have less than 20% capacity remaining.

Storage is another key and rapidly changing area for future planning[18]. At the grid scale most storage is generally currently 3-6hours of very big amounts of energy, while critical to keep continue power supply at the transmission and distribution scales, these don't address many of the reliability and resilience, not to mention seasonal, challenges we face in Central Vermont. Diversified and complimentary generation sources- for example solar with daytime and summer peaks paired with wind with night and winter peaks- is one component of planning for seasonality and reliability and important to keep in mind when thinking about the types of infrastructure to plan for. Distributed storage, smaller scale typically chemical storage (battery) tied to renewable generation is currently the dominant approach in our region. DUs are integrating grid tied storage systems at the customer scale; ensuring that this approach allows for the provision of back-up power in outage events for those with on-site generation is a key way that Central Vermont can enhance resilience in our region and ensure every community has the ability to meet critical needs and operations.

Changes in Technology

As noted previously, the state's comprehensive energy plan and subsequently the Central Vermont Regional Energy Plan are both written with electricity as the primary power source. This direction includes renewable energy technology that exists today such as wind, solar, hydroelectric, biomass, and biogas. As technologies change and advancements are made in both efficiency and sources of renewable energy generation, the region's municipalities will need to be flexible and adaptable to these changes.

With this in mind, the Central Vermont Regional Energy Plan acknowledges and recommends consideration for changes in technology that do not limit renewable energy development to known sources. This concept will need to be continually revisited to ensure current technologies are considered and outdated technologies are not recommended. Examples of CVRPC's commitment to working on solutions that fit well for different communities in our region include our emphasis on exploring the role waste heat recovery and geothermal can play in energy conservation and reducing thermal electric demand, continued emphasis on cord wood and efficient wood stoves over pellet and wood chips as key accessible and affordable sources of residential heat, and a fierce determination to emphasize the need for local reliability and resilience considerations at the broader scale of state and NE regional energy planning. CVRPC is committed to helping municipalities explore fossil fuel free alternatives to back-up power which have the added benefit of capitalizing on existing funding to meet a common municipal demand that lacks existing funding. Furthermore, CVRPC sees great potential in the application of existing technologies includes bi-directional EV chargers, power storage, mobile solar generators, and Meter-Socket Adapters to be integrated into existing and new energy systems across our region at all scales to transform our region into one dotted with micro-grid capabilities. This is key as we face increasingly extreme weather and storm events, resulting in many of our communities experiencing outages of longer duration (up to 8 days) annually (See Climate Chapter for the role of on-site generation and storage in municipal buildings and facilities and Community Resilience Hubs).

[18] The Vermont Public Utility Commission had an excellent series of Energy Storage Systems Workshops in late Fall 2023, for an excellent introduction to energy storage technologies, the role of energy storage in transforming the grid, storage policy at the state and federal level, interconnection, and more access them at https://energy.sandia.gov/programs/energy-storage/policy-and-outreach/regulatory-webinars/vermont-public-utility-commission-energy-storage-systems-workshops/.

Highlight on Meter Socket-Adapters

Meter Socket Adapters	Solar MSA	EV MSA	IslandDER MSA
Function	interconnects solar PV to the home	connects Level 2 EVSE to the home	connects multi-DER configurations: ● Solar PV ● EVSE ● Energy Storage Systems
Common barrier addressed:	● connecting to problematic/difficult to access service panels ● expensive service upgrades due to overfill ● undersized service panels	● mitigates undersized service panels that require costly replacement ● enables bidirectional EVSE for charging and vehicle to grid (V2G) configurations ● data-out version enables multi DER applications including solar+stationary storage	● avoids problematic service panels and costly service upgrades ● enables bidirectional EVSE for charging and V2H V2G, V2X applications ● streamline, most cost effective whole-house disconnect during grid outages for microgrid operation
Future directions:	● data out feature enables solar + storage for advanced grid functions ● devalued net-metering (NEM 3.0) ● partial-home backup		

Land Use Policies

Towns and regions have experience with, and see the direct local impacts of, land use planning. This includes planning for shared and beneficial infrastructure of many kinds, such as roads and industrial and commercial developments. Energy infrastructure, including generators, similarly serves a public purpose, while also creating both costs and benefits that are not distributed evenly. Energy planning is not just about electricity generation, however. Over half of Vermont's energy use is for heat and transportation, and local and regional decisions regarding buildings, roads, and other built infrastructure also have significant energy implications. For example, building a home or commercial building in a particular location will have implications for the energy required to travel to and from that building for decades. Given the pressing economic and environmental challenges associated with the use of fossil fuels, all aspects of planning must be undertaken with energy implications in mind. Municipal and regional planning that addresses all of these factors will improve Vermonters' quality of life. Act 174 provides an opportunity for regions and municipalities – from the planning commissions and selectboards to energy committees and citizens – to shape and inform their own energy future, as well as the energy future of the entire state.

Rural development patterns directly impact transportation energy usage, especially regarding individual behaviors. With limited transit infrastructure, the region is dominated by single-occupancy fossil-fuel vehicles. Residents typically commute to disparate labor market areas, reducing opportunities for carpooling. VTrans offers guidance and grant assistance to municipalities who wish to establish park and rides on municipal, state, or leased property on or near state highways, as well as other TDM options. Mixed-use, higher density neighborhoods encourage more pedestrian and micro-mobility options. The following land use and mobility principles encourage not only reduced transportation energy consumption, but also offer important health equity benefits:

- Encourage the location of new development in or near traditional village and city centers to reduce both sprawl and the number of vehicle miles driven.
- Support transit-oriented development that fosters the expansion of public transportation, micro-mobility (e.g., bikes, e-bikes/scooters), and rail use.
- Encourage the construction of Park and Ride facilities to support carpool and rideshare efforts.
- Encourage the expansion of bicycle and pedestrian facilities such as safe sidewalks and bike lanes, as well as secure parking options for micro-mobility.
- Promote the development of EV charging stations (also known as electric vehicle supply equipment, or EVSE) in Central village centers and downtowns. Especially where resilience benefits can fill backup power gaps.

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

Pathways: Development and Siting of Renewable Energy Resources

Strategy
Develop summary of municipal distributed energy projects established via the Municipal Energy Resilience Grant Program assessment reports: • Support project development and implementation
Develop siting and project guidelines based on project size, type, and community needs.
Assist interested municipalities to review regulations and develop updates as appropriate that would support the development of community scale infrastructure for renewable energy generation, storage, and micro-grids.
Support municipalities to identify and understand the co-benefits complementary infrastructure such as capturing waste heat and/or creating thermal energy networks can provide which will reduce demand on existing electric infrastructure and further support cost and emissions reductions. • Identify project opportunities and resources for implementation, • Develop thermal energy resource map to support the consideration of thermal energy network (focused existing building and facilities, proposed projects, and potential for infill.
Conduct further analyses in collaboration with municipalities to refine regional constraints and clarify local constraints so they can also be integrated into local and regional mapping.
Develop preferred siting map:

Strategy
• State preferred site types • Regional preferred site types • Municipal preferred site types • Additional preferred parcels (develop hosting interest form and community based process)
Develop tool for municipalities to use during their own Enhanced Energy Planning processes to determine the potential impact of adding additional constraints or better yet, preferred sites to the maps.
Integrate mapping tools into the project review process and the project development process to support quick evaluations for discussions including highlighting areas with different numbers of possible constraints, working to identify preferred sites, mapping existing preferred site types and project characteristics, etc.
Develop resources for towns and developers, which identify opportunities to maximize goals associated with housing needs, forest and land conservation, flood and climate resilience, and renewable energy development and energy infrastructure.
Work with the Department of Public Service and other RPCs to integrate straoge and thermal sector offsets to forecasted electric demand (via advanced woodheat, waste heat recovery, geothermal, etc) into modeling and generations scenario tool.
Work with municipalities, distribution and transmission utilities, the Department of Public Service, and others to support the deployment of storage, extension of 3-phase power, the hardening and/or advanced reconductoring of electric lines, etc. targest both those most burdened by reliability and resilience issues (typically more rural residents) as well as our designated growth areas.
Work with Distribution Utilities to establish annual data updates for local and regional planning processes, understand short, medium, and long term infrastructure improvement plans, and provide regional summaries for integration into integrated resource planning efforts.
Encourage towns to highlight opportunities and mechanisms for project development in town plans and website; encourage DUs and developers to consult towns and town plans early on in project development.
Analyze potential resource areas to identify contiguous areas that may meet basic technical requirements and facilitate community conversations around development and use for renewable energy generation.
Better coordination among planning efforts can help our region transition and make sure no one is unduly burden by cost or left out: • Integrate energy into land use planning and working with energy stakeholders to ensure that that energy planning not only is consistency with local regulations and visioning but accounts for targeted growth and likely demand; • Advocate for broader policies and programs to address reliability and local resilience; • Supports municipalities, affordable housing partners, community groups, and businesses to consider integrating on-site energy generation, storage, and back-up power into their capital improvement planning; • work with DUs on data gaps and to integrate their Integrated Resource Planning into regional and municipal planning and project development and to advocate that regional and municipal energy planning and goals in turn are considered in their Integrated Resource Planning Processes

Strategy
Support municipalities establish fossil fuel free alternatives to back-up power which have the added benefit of capitalizing on existing funding to meet a common municipal demand that lacks existing funding. • Provide support and education around existing technologies including how bi-directional EV chargers, power storage, mobile solar generators, and Meter-Socket Adapters can be integrated into existing and new energy systems across our region at all scales to transform our region into one dotted with micro-grid capabilities.

Re-adopted Pathways for evaluation in subsequent 2025 Regional Enhanced Energy Plan Update

Policy: Evaluate generation from existing renewable energy generation by municipality including the identification of constraints, resource areas, and existing infrastructure by energy type. Identifying and mapping existing renewable energy generation facilities throughout the region will provide a baseline to determine the generation that currently exists. This information can provide a better understanding for where developments are currently being established and can help prioritize assistance that may be needed at the municipal level. Additionally, mapping existing constraints will provide municipalities with a better understanding of resources that are available within their community.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Provide regular updates to municipalities regarding existing generation facilities to maintain an up-to-date inventory of locations.	CVRPC, Department of Public Service, Distribution Utilities	On-going	Updated maps provided as requested
2	Provide regular mapping updates to municipalities regarding known and possible constraints to ensure consistency with state guidelines on renewable energy siting.	CVRPC, State Agencies	On-going	Updated maps provided as necessary
3	Update regional maps to reflect changes at the municipal level regarding preferred or unsuitable locations for renewable energy generation.	CVRPC, Municipalities	On-going	Maps and information updated as necessary
4	Work with state agencies to map locations of woody biomass to evaluate cord wood acquisition for residential heating and ensure it is in line with conservation and forest corridor priorities	CVRPC, State Agencies	On-going	Specific locations are identified and mapped

Policy: Evaluate generation from potential renewable energy generation by municipality including the identification of constraints, resource areas, and existing infrastructure by energy type. Identifying and mapping potential renewable energy generation throughout the region will provide municipalities with

information regarding available land area where renewable energy generation could be located. This information can be used to help municipalities prioritize and evaluate where future renewable generation could or should occur based on municipal land use policies and constraints to meet their own, regional, and state needs and goals.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Evaluate known, possible, and regionally identified constraints to ensure up-to-date information is available for future planning purposes.	CVRPC, State Agencies	On-going	Constraints will be evaluated and mapped as necessary
2	Update information on utility infrastructure including existing and proposed transmission facilities to ensure accurate data exists.	CVRPC, Utility Providers	On-going	Utility information s updated and mapped as necessary
3	Evaluate and update preferred and unsuitable locations for future renewable energy generation siting as needed based on state, regional, and municipal policies and plans.	CVRPC, Municipalities, State Agencies	On-going	Preferred and prohibited locations are evaluated and mapped as necessary
4	Update generation potential based on future land developments, changes to land uses, or updates to priority areas as identified by state, regional, or municipal actions.	CVRPC, Municipalities, State Agencies	On-going	Generation potential is updated as necessary
5	Work with municipalities, as requested, to evaluate and prioritize future renewable energy generation technologies and locations to best suit municipal needs and policies.	CVRPC, Municipalities	On-going	Locations and technologies will be evaluated and prioritized

Patterns and Densities of Land Use Likely to Result in Conservation of Energy

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY	MEASURE
1	Evaluate municipal regulations to ensure higher density development patterns are located in regional and town centers to maintain existing settlement patterns and do not inadvertently promote sprawling development.	CVRPC, Municipalities	Medium On-going	Regulations are evaluated as needed and recommendations are included

2	Assist municipalities to identify future growth areas that can accommodate development needs while meeting smart growth principles and respecting historic settlement patterns of compact villages, neighborhoods, and urban centers as appropriate.	CVRPC, Municipalities	Medium On-going	Assistance provided and areas identified
3	Assist municipalities in preparing information necessary to acquire or maintain state designations including statutory requirements.	CVRPC, Municipalities, ACCD	Low On-going	State designations are maintained or acquired
4	Work with municipalities and regional partners to inventory and map existing infrastructure such as water and wastewater to evaluate capacity and development potential, integrating wasteheat recovery considerations into siting and design.	CVRPC, Municipalities	Medium 3 to 5 years	Infrastructure mapped and updated as needed
5	Work with communities to evaluate their land development regulations to ensure these regulations (including scale, massing, building height, and minimum lot size) are suitable to support density in appropriate locations and in proximity to needed infrastructure that is consistent with community character.	CVRPC	Low 5 to 10 years	Regulations evaluated and updated as appropriate
6	Develop or make available model ordinances related to Planned Unit Developments, for review and consideration by municipalities as a way to establish compact development patterns outside of existing growth areas.	CVRPC	Low 5 to 10 years	Model regulations developed

IMPLEMENTATION ACTION		RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
7	Provide information related to available funding opportunities (including sources and programs) for municipal infrastructure projects or improvements that will promote or support development density or compact development patterns.	CVRPC, State Agencies	High 1 to 3 years	Information on funding collected and available
8	Work with interested municipalities to create policies that incentivize development in designated growth areas with opportunities that could expedite land development reviews, permitting, or other regulatory processes	CVRPC, Municipalities, State Agencies	High 1 to 3 years	Regulations & processes updated as appropriate

	as appropriate.			
9	Assist interested municipalities to review regulations and develop updates as appropriate that would support the development of community scale infrastructure for renewable energy generation and conservation.	CVRPC, Municipalities	Medium 3 to 5 years	Regulations updated as appropriate
10	Work with interested municipalities to ensure adequate land exists for agricultural uses as a way to encourage local food production.	CVRPC, Municipalities	Medium 3 to 5 years	Regulations updated as appropriate
11	Work with municipalities and the Agency of Agriculture, Food & Markets to ensure prime farmland inventories are up-to-date and mapped.	CVRPC, Agency of Agriculture, Food, & Markets, municipalities	On-going	Prime agricultural land inventories are updated and mapped
12	Support amendments to local regulations that encourage local food production through regulatory and non-regulatory approaches that focus development and preserve agricultural opportunities.	CVRPC, Municipalities, Agency of Agriculture, Food, & Markets	Medium 3 to 5 years	Regulations are updated as appropriate

Policy: Strongly prioritize development in compact, mixed-use centers when feasible and appropriate; and identify ways to make compact development more feasible throughout Central Vermont. Compact development patterns create opportunities whereby land uses that support where people live, work, and recreate, are all within close proximity. This not only creates a greater sense of place but it provides opportunities to walk, bike, or utilize public transit as the primary mode of transportation. Additionally, compact development patterns can promote conservation of energy through the redevelopment of underutilized spaces therefore including more energy efficient building designs.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Provide information to municipalities regarding alternative land use regulations such as form-based codes and identify communities where similar regulations have been successfully implemented including rural or non-urban scale regulations.	CVRPC	Low 5 to 10 years	Workshops or other informational sessions conducted

2	Evaluate municipal regulations and recommend amendments that will support and encourage infill development, redevelopment, adaptive reuse of existing buildings such as historic structures, and reuse of "brownfield" sites	CVRPC, Municipalities, Regional Partners	High 1 to 3 years	Regulations evaluated and recommendations made as appropriate
3	Provide information to municipalities on capital planning, public investment strategies, or state and federal programs that support infill development within core community areas.	CVRPC, State Partners	High 1 to 3 years	Workshops or other informational sessions conducted
4	Evaluate roadways in existing villages, downtowns, or municipal activity centers to identify conflict points between motorized and non-motorized modes of travel and recommend options to promote walkable and bike friendly centers that encourage alternative transportation choices	CVRPC, VTrans, Municipalities	Medium 3 to 5 years	Evaluations completed as needed and ecommendations provided
5	Work with municipalities to identify priority development zones, growth areas, or locations where high demand for electric loads exist or are planned (such as industrial parks) to ensure current planning acknowledges future needs.	CVRPC, Municipalities, State Partners	High 1 to 3 years	Locations are identified and incentives established as appropriate

Regional LEAP Targets

These are the original targets provided to CVRPC by the Department of Public Service; these were disaggregated from the State targets based on the table below.

Overview - LEAP Regionalization for Regional Planning Commission Enhanced Energy Planning

As part of the development of Vermont's Comprehensive Energy Plan (CEP) and Climate Action Plan (CAP), Stockholm Environment Institute (SEI) and Northeast States for Coordinated Air Use Management (NESCAUM) developed a scenario model of Vermont's energy consumption and emissions and used the model to construct pathways to meet statutory greenhouse gas (GHG) reduction obligations under the state's Global Warming Solutions Act (GWSA). The model was built using SEI's Low Emissions Analysis Platform (LEAP), a software tool for energy system modeling and emissions accounting. The model contains a representation of residential, commercial, industrial and transport energy use at a state level.

In order to support enhanced energy planning at the regional and municipal levels, the Department has undertaken an effort to "regionalize" final energy demand outputs from the statewide LEAP modeling for four core sectors: residential, commercial, industrial, and transportation. This workbook includes a simple disaggregation of those results for each of the regions based on key drivers of energy demand. This has been done for:

1. The **Baseline** (business-as-usual) scenario developed to estimate Vermont/regional energy demand under normal policy and programmatic conditions and
2. The **Central GWSA Mitigation ("CAP Mitigation")** scenario developed to meet the state's GHG reduction requirements.

Share of Statewide:	CVRPC	Source	Used for:
Population	10.2%	Generation Scenario Tool (for consistency)	Share of non-road transportation. Note: All transportation related natural gas demand was allocated to CCRPC
Housing Units	11.1%	Data submitted via RPCs in data template - almost all from the American Community Survey	Residential non-natural gas energy demand & technology adoption (total and thermal energy use, new CCHPs)
Commercial Floorspace	11.2%	Data submitted via RPCs in data template - almost all used SQ FT / Employee * Number of Employees Method; SQFT/Employee from Jim Sullivan (BCRC), Number of Employees from VDOL and/or Census	Commercial non-natural gas energy demand & technology adoption (total consumption, new CCHPs)
Passenger Cars	10.0%	DMV Registration Database	On-Road Transportation Energy Use (Passenger Car, Light Trucks, Medium and Heavy Duty). Note: All transportation related natural gas demand was allocated to
Light Trucks	10.5%		
Medium Duty	9.4%		

Vehicles			CCRPC
Heavy Duty Vehicles	9.8%		
NAICS Codes	8.9%	Census Data on NAICS Manufacturing Codes (31-33)	Industrial Data
Natural Gas - Residential	0.0%	VGS Historical Usage Data	Residential, Commercial, and Industrial Sector Natural Gas Usage
Natural Gas - Commercial	0.0%		
Natural Gas - Industrial	0.0%		

Resources

Full details of the LEAP Model methods, data sources and assumptions may be found as **Appendix D to the 2022 Comprehensive Energy Plan**: https://publicservice.vermont.gov/content/2022-cep-analysis-greenhouse-gas-emission-reduction-pathways-vermont

Appendix E to the Comprehensive Energy Plan also provides a summary of the report in Appendix D in slide format, although please note that some assumptions in the modelling were revised following the issuing the of the Comprehensive Energy Plan: https://publicservice.vermont.gov/sites/dps/files/documents/CEP_AppendixE_LEAPModelingSlides.pdf

The **Vermont Pathways Report** prepared for the Agency of Natural Resources also provides information on the analysis done using the model, including some of the revisions made after the CEP was publised (see Table 1 pg 1): https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2022-03/Pathways%20Analysis%20Report_Version%202.0.pdf

Regional LEAP targets were disaggregated using each municipality's share of current regional energy use, municipal disaggregation factors were calculated for transportation (Light Duty Vehicles), residential thermal, commercial thermal, residential electric, and commercial electric. Additional methods and municipal breakouts can be found on CVRPC's website as municipal breakouts are published throughout the Spring of 2024.

Baseline Total Regional **Residential** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	797	636	691	725	743	758
Wood	910	872	752	685	657	635
Propane	699	619	580	558	552	552
Wood Pellets	225	76	66	61	59	58
Biodiesel	-	-	-	-	-	-
Heating Oil	1,214	1,115	982	906	874	848
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**3,845**	**3,318**	**3,071**	**2,935**	**2,885**	**2,852**

CAP Mitigation Total Regional **Residential** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	797	719	837	955	1,071	1,114
Wood	910	733	535	400	286	182
Propane	699	520	378	248	125	93
Wood Pellets	225	69	57	50	45	42
Biodiesel	-	55	251	336	321	254
Heating Oil	1,214	898	453	165	-	-
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**3,845**	**2,994**	**2,511**	**2,154**	**1,849**	**1,683**

Baseline Regional **Residential** Thermal Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	120	184	236	269	284	293
HP	1	70	125	155	169	175
HPWH	2	2	2	2	2	2
Electric Resistance	40	34	30	27	26	26
Wood	910	872	752	685	657	635
Propane	475	442	402	380	373	372
Wood Pellets	225	76	66	61	59	58
Biodiesel	-	-	-	-	-	-
Heating Oil	1,140	1,040	906	830	797	771
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**2,870**	**2,614**	**2,363**	**2,224**	**2,170**	**2,129**

CAP Mitigation Regional **Residential** Thermal Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	120	264	376	487	595	633
HP	1	136	231	322	413	453
HPWH	2	23	49	76	103	104
Electric Resistance	40	29	21	14	8	7
Wood	910	733	535	400	286	182
Propane	475	375	273	183	101	67
Wood Pellets	225	69	57	50	45	42
Biodiesel	-	51	224	285	245	176
Heating Oil	1,140	827	404	140	-	-
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**2,870**	**2,318**	**1,869**	**1,544**	**1,272**	**1,100**

Baseline Regional **Residential** New Cold Climate Heat Pumps						
Technology	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
ASHP 2 Head	397	1,200	2,278	2,911	3,218	3,381
ASHP Central	607	1,835	3,483	4,451	4,919	5,169
ASHP HE	583	1,763	3,346	4,275	4,725	4,964
GSHP HE	72	218	414	528	584	614
Total	**1,658**	**5,017**	**9,521**	**12,166**	**13,446**	**14,127**

CAP Mitigation Regional **Residential** New Cold Climate Heat Pumps						
Technology	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
ASHP 2 Head	423	2,549	4,686	6,836	8,995	10,093
ASHP Central	658	3,964	7,311	10,705	14,155	15,727
ASHP HE	622	3,743	6,882	10,039	13,210	14,821
GSHP HE	77	463	851	1,241	1,633	1,832
Total	**1,780**	**10,720**	**19,730**	**28,820**	**37,993**	**42,473**

Regional **Residential** New Retrofits (Number of Housing Units)						
Scenario	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
Baseline Scenario	1,378	2,847	4,205	5,496	6,833	9,658
CAP Mitigation	2,202	7,758	13,314	16,767	20,219	27,125

Regional **Residential** New Heat Pump Water Heaters (Number of Units)						
Scenario	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**
Baseline Scenario	483	569	573	578	581	593
CAP Mitigation	483	7,046	15,213	23,465	31,809	32,196

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Baseline Total Regional **Commercial** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	771	749	756	759	755	747
Gasoline	74	83	85	87	88	92
Kerosene	1	1	1	1	1	1
Wood	184	194	206	219	230	262
Ethanol	5	6	6	6	6	6
Solar	19	50	51	52	53	55
Heat	-	-	-	-	-	-
Propane	472	329	320	316	330	346
Residual Fuel Oil	12	5	5	5	5	5
Wood Pellets	-	-	-	-	-	-
Biodiesel	-	-	-	-	-	-
Heating Oil	535	309	268	233	203	161
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**2,073**	**1,723**	**1,697**	**1,677**	**1,672**	**1,675**

CAP Mitigation Total Regional **Commercial** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	771	816	890	963	1,007	995
Gasoline	74	83	85	87	88	92
Kerosene	1	1	0	0	-	-
Wood	184	194	206	219	230	262
Ethanol	5	6	6	6	6	6
Solar	19	50	51	52	53	55
Heat	-	-	38	57	96	96
Propane	472	258	164	74	4	2
Residual Fuel Oil	12	5	5	5	5	5
Wood Pellets	-	10	20	30	39	46
Biodiesel	-	16	74	111	150	156
Heating Oil	535	256	133	55	-	-
Biogas	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-
Total	**2,073**	**1,693**	**1,673**	**1,659**	**1,679**	**1,716**

Baseline Regional **Commercial** New Cold Climate Heat Pumps						
	2020	**2025**	**2030**	**2035**	**2040**	**2050**
New CCHP	316	960	1,827	2,333	2,580	2,710

CAP Mitigation Regional **Commercial** New Cold Climate Heat Pumps						
	2020	**2025**	**2030**	**2035**	**2040**	**2050**
New CCHP	316	5,682	11,298	17,184	21,120	21,977

Baseline Total Regional **Industrial** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	432	420	408	392	397	416
Natural Gas	-	-	-	-	-	-
Gasoline	43	41	42	42	43	45
Kerosene	1	2	2	2	2	2
Diesel	267	295	287	285	286	290
LPG	26	26	25	25	25	24
Wood	32	18	18	18	19	20
Biogas	-	-	-	-	-	-
Ethanol	3	3	3	4	4	4
Lubricants	15	11	11	11	11	12
Biodiesel	-	19	25	25	25	22
Residual Fuel Oil	15	9	9	10	10	10
Wood Waste Solids	8	1	2	2	2	2
Asphalt and Road Oil	411	301	307	313	319	332
Total	**1,253**	**1,146**	**1,139**	**1,129**	**1,143**	**1,179**

CAP Mitigation Total Regional **Industrial** Sector Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	432	420	408	392	397	416
Natural Gas	-	-	-	-	-	-
Gasoline	43	41	41	41	42	44
Kerosene	1	2	2	2	2	2
Diesel	267	212	143	72	-	-
LPG	26	26	25	25	25	24
Wood	32	18	18	18	19	20
Biogas	-	-	-	-	-	-
Ethanol	3	4	4	5	5	5
Lubricants	15	11	11	11	11	12
Biodiesel	-	102	169	238	312	312
Residual Fuel Oil	15	9	9	10	10	10
Wood Waste Solids	8	1	2	2	2	2
Asphalt and Road Oil	411	301	307	313	319	332
Total	**1,253**	**1,146**	**1,139**	**1,129**	**1,143**	**1,179**

Baseline Total Regional **Passenger Car** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	1	15	28	60	116	228
Gasoline	1,059	782	704	634	545	376
Diesel	8	3	2	1	1	1
Ethanol	72	60	56	52	46	34
CNG	-	-	-	-	-	-
Biodiesel	0	0	0	0	0	0
Total	**1,139**	**861**	**790**	**748**	**708**	**639**

CAP Mitigation Total Regional **Passenger Car** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	1	19	73	168	257	347
Gasoline	1,059	751	575	365	196	48
Diesel	8	3	2	1	1	0
Ethanol	72	64	55	38	23	5
CNG	-	-	-	-	-	-
Biodiesel	0	0	0	0	0	0
Total	**1,139**	**838**	**705**	**572**	**477**	**400**

Baseline Regional **Passenger Car EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	22	797	1,717	3,688	7,073	14,681
Plug In Hybrid	55	215	244	368	602	1,106
Total	**77**	**1,012**	**1,961**	**4,056**	**7,675**	**15,788**

CAP Mitigation Regional **Passenger Car EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	22	1,093	4,719	11,272	17,892	26,546
Plug In Hybrid	55	208	195	160	101	36
Total	**77**	**1,301**	**4,913**	**11,431**	**17,994**	**26,582**

Baseline Total Regional **Light Truck** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	0	5	10	22	48	112
Natural Gas	-	-	-	-	-	-
Gasoline	2,306	2,066	1,820	1,625	1,442	1,192
Diesel	44	42	45	46	43	38
Ethanol	158	160	146	134	123	108
CNG	-	-	-	-	-	-
Biodiesel	1	3	4	4	4	3
Total	**2,509**	**2,275**	**2,024**	**1,832**	**1,660**	**1,453**

CAP Mitigation Total Regional **Light Truck** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	0	25	138	313	455	552
Natural Gas	-	-	-	-	-	-
Gasoline	2,306	1,965	1,453	892	456	119
Diesel	44	38	32	22	10	3
Ethanol	158	169	139	94	53	14
CNG	1	0	0	0	0	0
Biodiesel	1	3	3	3	2	1
Total	**2,510**	**2,200**	**1,766**	**1,324**	**975**	**688**

Baseline Regional **Light Duty Truck EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	3	173	375	870	1,937	4,871
Plug In Hybrid	33	128	260	527	1,021	2,413
Total	**36**	**301**	**635**	**1,397**	**2,959**	**7,284**

CAP Mitigation Regional **Light Duty Truck EV and PHEV Stock** (Number of Vehicles)						
Vehicle Type	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Battery Electric	3	1,163	6,926	16,289	24,669	33,219
Plug In Hybrid	33	122	169	161	107	40
Total	**36**	**1,285**	**7,095**	**16,450**	**24,776**	**33,259**

Baseline Total Regional **Medium Duty** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	-	0	0	1	1	1
Natural Gas	-	-	-	-	-	-
Gasoline	111	213	239	268	301	350
Diesel	168	278	302	325	347	379
LPG	1	3	4	5	6	8
Ethanol	8	17	19	22	26	32
Biodiesel	6	18	26	28	31	28
Total	**294**	**528**	**591**	**649**	**711**	**798**

CAP Mitigation Regional **Medium Duty** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	-	26	101	217	330	463
Natural Gas	-	-	-	-	-	-
Gasoline	111	193	172	128	86	34
Diesel	168	249	210	142	82	28
LPG	1	3	3	2	1	0
Ethanol	8	17	17	14	10	4
Biodiesel	6	18	21	18	13	7
Total	**294**	**505**	**524**	**521**	**523**	**536**

Baseline Regional **Heavy Duty** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	-	0	0	0	0	0
Natural Gas	-	-	-	-	-	-
Gasoline	0	0	0	0	0	0
Diesel	718	370	269	215	191	163
Ethanol	0	0	0	0	0	0
Biodiesel	24	24	23	19	17	12
Total	**742**	**394**	**292**	**233**	**208**	**176**

CAP Mitigation Regional **Heavy Duty** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Electricity	-	12	47	99	145	181
Natural Gas	-	-	-	-	-	-
Gasoline	0	0	0	0	0	0
Diesel	718	347	210	111	57	12
Ethanol	0	0	0	0	0	0
Biodiesel	24	25	21	14	9	3
Total	**742**	**384**	**278**	**225**	**211**	**195**

Baseline Regional **Non-Road** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Diesel	114	108	109	109	110	111
Biodiesel	4	7	9	10	10	8
Avgas	4	5	5	5	5	5
Jet Kerosene	148	148	149	150	151	152
Sustainable Aviation Fuel	-	-	-	-	-	-
Gasoline	40	36	37	37	37	37
Ethanol	3	3	3	3	3	4
Lubricants	31	24	24	24	25	25
Natural Gas	-	-	-	-	-	-
Total	**344**	**332**	**336**	**338**	**340**	**342**

CAP Mitigation Regional **Non-Road** Final Energy Demand (Thousand MMBTUs)						
Fuel	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Diesel	114	108	109	109	110	111
Biodiesel	4	8	11	14	18	26
Avgas	4	5	5	5	5	5
Jet Kerosene	148	146	134	122	110	86
Sustainable Aviation Fuel	-	2	15	28	40	66
Gasoline	40	36	37	37	37	37
Ethanol	3	3	4	4	4	4
Lubricants	31	24	24	24	25	25
Natural Gas	-	-	-	-	-	-
Total	**344**	**333**	**338**	**343**	**349**	**360**

Baseline Regional **Greenhouse Gas Emissions** (Thousand Metric Tonnes CO2e)						
Sector	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Transportation	356	308	281	262	244	216
Residential	138	125	112	105	102	100
Commercial	77	51	48	45	44	43
Industrial	27	28	28	27	28	28
Electricity	28	29	22	19	28	51
Total	626	540	491	458	446	437

CAP Mitigation Regional **Greenhouse Gas Emissions** (Thousand Metric Tonnes CO2e)						
Sector	**2015**	**2025**	**2030**	**2035**	**2040**	**2050**
Transportation	356	292	224	148	88	37
Residential	138	102	60	30	10	7
Commercial	77	43	28	17	9	9
Industrial	27	22	17	12	6	7
Electricity	28	31	39	48	34	10
Total	626	490	368	255	147	70

Capstone Weatherization Central Vermont 2020-2023

Town Totals	2020	2020						2021	2021						2022	2022						2023	2023					
	Total Homes	Multi Family Buildings	Multi Family Units	Single Family Homes	Occupants	kWh Savings	MMBTU Savings	Total Homes	Multi Family Buildings	Multi Family Units	Single Family Homes	Occupants	kWh Savings	MMBTU Savings	Total Homes	Multi Family Buildings	Multi Family Units	Single Family Homes	Occupants	kWh Savings	MMBTU Savings	Total Homes	Multi Family Buildings	Multi Family Units	Single Family Homes	Occupants	kWh Savings	MMBTU Savings
Barre City	20			20	44		530.75	25	9	4	21	37	3902.88	710.39	19	8	8	11	39	1865	586.17	38	7	11	27	69	8435.38	1519.96
Barre Town	10	8	3	7	18	145.5	837.31	14			14	34		433.98	11	5	8	3	17	8467	1040.36	11			11	23		361.96
Berlin	3			3	4		91.32	3			3	4		40.02	12	15	10	2	17	27650.35	366.88	8			8	22		307.24
Cabot	1			1	5		53.17	2			2	3		64.97	6			6	15		299.88	8			8	10		252.04
Calais	2			2	3		99.83	2			2	6		67.31	3			3	4		104.11	9	8	3	6	19	93766.02	781.62
Duxbury	0			0	0		0.00	0			0	0		0.00	1			1	1		42.51	1			1	1		13.07
East Montpelier	5			5	6		153.83	2			2	3		31.36	3			3	5		448.32	6			6	10		247.79
Fayston	1			1	1		8.15	0			0	0		0.00	2			2	2		106.66	0			0	0		0.00
Marshfield	1			1	5		90.71	2			2	4		24.43	2			2	4		53.14	2			2	2		57.67
Middlesex	2			2	2		110.84	0			0	0		0.00	1			1	1		9.47	5			5	7		241.58
Montpelier	10	4	5	5	13	380.78	82.12	16	15	6	10	27	1408	428.42	17	9	6	11	32	132	752.30	28	19	20	8	36	4090.33	1106.17
Moretown	2			2	2		42.55	2			2	3		44.51	3			3	4		261.37	1			1	3		17.10
Northfield	5			5	8		108.69	29	9	20	9	50	1330	196.57	14			14	39		486.82	10			10	24		461.47
Orange	2			2	5		37.92	3			3	9		42.40	2			2	5		71.84	6			6	12		275.08

Plainfield	1			1	2		18.87	3			3	6		104.90	2			2	5		83.93	3			3	4		127.20
Roxbury	2			2	4		77.70	0			0	0		0.00	1			1	5		32.18	1			1	1		69.65
Waitsfield	1			1	2		35.67	2			2	2		47.14	0			0	0		0.00	0			0	0		0.00
Warren	0			0	0		0.00	2			2	5		42.96	1			1	1		12.61	0			0	0		0.00
Washington	1			1	3		10.20	3			3	5		90.32	0			0	0		0.00	4			4	8		219.25
Waterbury	4			4	5		102.28	1			1	1		30.94	3			3	4		60.57	7			7	10		192.24
Williamstown	4			4	11		135.88	28	4	22	6	51	42998.43	165.70	4			4	11		215.52	14	3	3	11	36		430.90
Woodbury	0			0	0		0.00	1			1	4		38.70	3			3	5		153.77	3			3	8		51.26
Worcester	1			1	3		52.27	3			3	3		238.14	2			2	4		32.54	8	4	4	4	21	352	182.06
Regional Total	**78**	12	8	70	**146**	**526.28**	**2680.07**	**143**	37	52	91	**257**	**49639.31**	**2843.15**	**112**	37	32	80	**220**	**38114.35**	**5220.97**	**173**	41	41	132	**326**	**10663.73**	**6915.32**

Methodology Supplements

S

Methodology: Municipal 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. Lastly, up-to-date supplement can be found on the CVRPC webpage along with municipal breakouts for targets which will be published throughout the Spring 2024 and update as municipalities adjust for their own enhanced energy planning needs.

Vermont's Regional Planning Commissions have been tasked with developing reasonable estimates for local consumption across the transportation, heating, and electric energy sectors. While these estimates use 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 our region's current energy use patterns, the cost drivers, and what we need to do to achieve long-range energy goals. Note, estimates and targets are frequently given in British Thermal Units (BTUs) and millions of BTUs (MMBTUs) in order to allow for comparison between different energy types.

Current residential and commercial & industrial electricity usage data is provided by Efficiency Vermont (both municipal and regional totals- see supplement), transportation and thermal sector data is estimated via the Municipal Consumption Tool which pulls from a variety of sources including the Vermont Department of Public Service, American Community Survey, Vermont Department of Labor, the Vermont Department of Motor Vehicles, and DriveElectric (VEIC) (see supplement for specifics). Using the regionalized LEAP results provided by the Department of Public Service, targets are established to provide milestones for thermal efficiency; renewable energy use; and conversion of thermal and transportation energy from fossil fuel based to renewable resources. These milestones are intended to help the region measure progress towards the overall goals and are not identified as requirements. **Regional LEAP targets were disaggregated using each municipality's share of current regional energy use, municipal disaggregation factors were calculated for transportation (Light Duty Vehicles), residential thermal, commercial thermal, residential electric, and commercial electric.** Targets are established for the years 2025, 2035, and 2050 which coincide with the State Comprehensive Energy Plan (update 2022). Targets include both a "business as usual" baseline and the CAP (Climate Action Plan) mitigation scenario targets. While a summary of results is included below and referenced throughout this chapter, a walkthrough of the methods, data sources, and interim steps are included in the supplement and accompanying tools and supporting resources hosted by the Department of Public Service. Furthermore, full details of the LEAP Model methods, data sources and assumptions may be found as Appendix

D to the 2022 Comprehensive Energy Plan[1]. Municipal analyses and targets will be made available on the CVRPC website and in the supplement.

Residential Heating Energy Use and Cost Estimates

The following explains the series of steps that CVRPC has taken to calculate estimates of Residential Heating Energy use, square footage, and costs for the Central Vermont region. According to the Department of Public Service, residences in New England use somewhere about 45,000 to 80,000 BTUs of heat energy per square foot annually, averaging statewide at about 110 MMBTUs 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.

Caveats:

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

1. **Data (ACS 2022 5-Year Estimates used)**
    a. B25117 Tenure by House Heating Fuel,
    b. B25010: Average Household Size of Occupied Units by Tenure,
    c. DP04 Selected Housing Characteristics,
    d. Total Housing Units.
    e. These data can be downloaded into an excel spreadsheet, CSV, or other file type. CVRPC did this by town and aggregated them in excel (Tables).

House heating fuel is categorized on the ACS questionnaire as follows:

Utility Gas: This category includes gas piped underground from a central system to serve the neighborhood. The only utility in Vermont that delivers gas in this manner (i.e. natural gas) is Vermont Gas, and its service area is well outside of our region. A small number of ACS respondents indicated that they heated with "utility gas." It is most likely that they confused this source with bottled, tank or LP gas. We therefore made adjustments to account for this error.
Bottled, Tank, or LP Gas: This category includes liquid propane gas stored in bottles or tanks that are refilled or exchanged when empty. This is the second most dominant heat source for owner- and renter-occupied homes.
Electricity: This category includes electricity that is generally supplied by means of above or underground electric power lines. Census data does not distinguish between types of electric heat (e.g. resistance vs. heat pumps). We assume that additional homes in this category since he last plan and in the future are new heat pumps and not new resistance heat.
Fuel Oil, Kerosene, etc.: This category includes fuel oil, kerosene, gasoline, alcohol, and other combustible liquids. This category (oil) is the leading source of heat in the region overall, and for both owner- and renter-occupied homes.
Coal or coke: This category includes coal or coke that is usually distributed by truck. Some households in our region use anthracite in stove, furnaces, and boilers. There are very few of these, if any, still in the region, as the margin of error suggests potential to be zero.

[1] https://publicservice.vermont.gov/content/2022-cep-analysis-greenhouse-gas-emission-reduction-pathways-vermont

Wood: This category includes purchased wood, wood cut by household members on their property or elsewhere, driftwood, sawmill or construction scraps, or the like. Wood is a close third largest source of heat in the region for owner-occupied homes, much of which is likely cordwood.
Solar Energy: This category includes heat provided by sunlight that is collected, stored, and actively distributed to most of the rooms. It is difficult to anticipate what residents mean when they select this option given new technology; thus we combine with other fuel.
Other Fuel: This category includes all other fuels not specified elsewhere. This category very likely consists of non-fossil fuel sources, but it is difficult to make further assumptions.

2. **Determine total square footage of housing by tenure:** For renter households, multiply the average household occupancy (e.g. 2.24 people) by **500 sq ft per person** (this number is a constant; it comes from the US Census Bureau's 2011 American Housing Survey and represents the national average size of a housing rental housing unit per occupant). For owner households, multiply the average occupancy by **800 sq ft per person** (from the same report). This provides an estimate—albeit, a very rough one—for the total square footage of occupied housing.
   Note: This is one of several areas where the methods could be improved in the future as these are only very broad estimates.

3. **Square Footage by Fuel Type:** In order to estimate the amount of space being heated by each fuel, the percentage of each fuel type was generated for owner- and renter-occupied households. Once the fuel use as percentages of total Renter and Owner households were calculated, the percentage for each fuel was multiplied by the total estimated square footage calculated in step 2.

4. **Energy Required for Heating:** This step is very simple. CVRPC used a basic estimate to take square footage and turn it into a calculation of the energy required for heating. The Department of Public Service cites a range of estimates for heat energy intensities per square foot from 45,000BTUs to 80,000BTUs for poorly insulated, leaky buildings for example pre-1940s housing units among others. Given the aging housing stock across the region, CVRPC used 60,000 BTUs as a generic estimate of the annual energy required to heat one square foot of housing annually in Vermont. In other words, all of the total square footages were multiplied by 60,000 BTUs/square feet.

   Note: In the future CVRPC might account for energy efficiency here, based on the number of buildings that have been weatherized or the percentage of buildings built in each decade (assuming that older buildings are less energy efficient in general when not weatherized). But for the purpose of consistency with initial calculations—the goal of which is to establish a general understanding of energy use in our regions—and without a good baseline of total homes weatherized, this method seems sufficient.

5. **Convert to units of fuel and determine cost:** The total Energy required for each fuel type was divided by the Energy generated from one unit of that fuel type. CVRPC used the following estimates of energy/unit and cost per unit estimates below (Units used divided by cost per Unit). Note, ACS does not account for wood pellet use, a conversion and cost estimate is included in the table below so that municipalities who wish to account for pellet use may do so.

Fuel Type	Standard Unit	BTUs	Cost	Total Regional Cost (Current Use)	Source (cost/unit)
Fuel Oil, kerosene, etc.	Gallon	140,000	$4.133	40,869,208.29	Vermont Average Residential-EIA (March 2024)
Bottled, tank, or LP gas (propane)	Gallon	91,000	$3.575	30,470,927.14	Vermont Average Residential-EIA (March 2024)
Coal or coke	Ton	19,590,000	$500	44,949.46	VT newspapers and quote VT&NH suppliers
Wood (seasoned)	Cord	20,000,000	$350	7,709,887.50	(275 green-450 kiln dried) VT newspapers and quoted VT suppliers
Wood Pellets	Ton	16,400,000	$405		Vermont wood/pick-up; Energy Co-op of VT
Electricity	Kilowatt hour	3,414	$0.2109	3,939,594.36	**VT State Energy Profile, US Energy Information Administration**
Other Fuel (includes solar)				4,142,353.99	
Regional Total Cost				$87,176,920.74	

6. **Determine energy use for seasonal units:** There is no corresponding ACS data on heating sources of vacation/second/seasonal homes, though for several of the towns in the Central Vermont region, these make up a significant portion of overall homes. The Department of Public Service guidelines suggest that on average, seasonal homes account for about 5% of the thermal energy used in a year-round home (for example a seasonal camp may not have a central heating system, but it still may use propane to heat the water, have a woodstove or fireplace for unseasonably cool nights, etc.). This guidance does not quite match the Central Vermont region as several communities with many seasonal residents use their properties throughout the winter specifically and/or for more than occasional use. Thus, for estimation purposes we assigned 10% to seasonal units in the towns on the eastern half of the region featuring many lakes with summer seasonal population influx, and 25% for those on the western half of the region proximate to the region's winter recreation areas. Here is the formula for calculating MMBTUs for seasonal units:

Number of seasonal units (ACS) x Average MMBTUs per Owner-Occupied Unit (110) x 0.1 (or 0.25) = Total MMBTUs Seasonal

7. **Final Data Combination:** Results were combined and displayed.

Methodology for Commercial Estimates

This table uses a worksheet, Municipal Consumption, created by the Department of Public Service, which uses data from the Vermont Department of Labor's Economic and Labor Market Information web site:

http://www.vtlmi.info. The worksheet determines the municipality's share of the regional commercial building stock and applies assumptions from the Energy Information Institute's Survey of Commercial Uses. The estimate does not include industrial uses, which are highly variable.

Transportation Estimates

This data was developed using the Department of Public Service's Municipal Consumption worksheet. The total number of vehicles comes from American Community Survey (ACS) 5-Year Estimates. Average annual VMTs, accounts for slightly longer-than-average commutes and more incidental trips in the rural and commuter parts of our region. Total vehicle miles travelled assumes an average fuel economy of 22 miles per gallon. Registered EVs was determined by the Vermont Energy Investment Corporation (Drive Electric) and uses a low midpoint between the Dept. of Public Service's average of 7,000 VMTs per EV annually and the average of 12,000 for ICE vehicles taking into account early trends in EV adoption including reducing trips in adverse weather and co-incidence of alternative transportation modes as well as the high % of our region who is retired and thus without a daily commute.

Electricity Estimates

Efficiency Vermont has compiled three years of data, based on that provided (variously) by utilities serving the region.

Thermal Efficiency & Fuel Switching Targets (Residential & Commercial)

Targets for thermal efficiency of residential and commercial structures are based on a methodology developed by the regional Long-range Energy Alternatives Planning (LEAP) analysis carried out by the Department of Public Service and then disaggregated using municipal share of regional energy use determined via the Municipal Consumption Tool and then converted where appropriate with accepted measure conversions provided in the Analysis and Targets Aid Bottom Up tool. Residential targets use the mean MMBTUs for occupied households in the municipality, which were calculated by CVRPC. Commercial targets use the data from the Vermont Department of Labor. Data in this table represent the percentages of municipal households and commercial establishments that will need to be weatherized in the target years. The targets are cumulative. Targets assume a 6% increase in number of housing units/commercial establishments over each period. Weatherization projects are assumed to achieve an average of 25% reduction in MMBTUs for residential units and 20% for commercial establishments, although some weatherization projects can actually achieve deeper savings. As with thermal efficiency targets, these targets assume a 6% increase in number of housing units/commercial establishments over each period.

Advanced Wood Heat Target Creation

The regional CAP LEAP targets provided by the Public Service Department (Table 20) are paired with the targets for heat pump and heat pump hot water heaters model the state's general electrification policy with all other fuel types, other than biodiesel, decreasing dramatically. As discussed, Central Vermont approach to the thermal sector, specifically for residential and commercial heat, incorporates the sustained use of wood (cord wood) (stand alone or in combination with heat pumps). The following describes an adjustment to the LEAP targets and the addition of a target for converting inefficient wood stoves to high efficiency wood stoves.

Residential Heating from Table 5 for region is 2,788,000 plus seasonal/vacation/secondary residences from table 7 97,201.5= 2,885,201.5 Thousand MMBTU

Wood Heat
Table 5 441,000 Thousand MMBTU region + seasonal/vacation/secondary residences (14% wood across region) of 92,201.5

Table 19 provides a new target developed by CVRPC in recognition of the role wood heating plays in the region and can continue to do so as part of our energy policy and goals, specifically cord wood. These targets focus on the conversion of aged and/or inefficient woodstoves (cord wood) to high efficiency replacements. These targets are based on the constants used in current use estimates (see above and supplement), Efficiency Vermont projections that advanced wood heat conversion reduces fuel use by approximately 1/3 which was further reduced to 2/3 fuel use per home based on weatherization and conversion of some wood heating use from primary to secondary heating source (thus reflecting an average per household of 5.69 cords per year to 1.9 cords). While data on wood heating is coarse, see detailed discussion above, this target uses current use as a starting point at 2025, and strives for 20% of households to convert per target year through to 80% in 2050 (these leaves room for the unknown number of existing high efficiency wood stoves, etc). These targets increase the demand from wood per the LEAP targets provided by the Department of Public Service for the target 2050 but reflects a significantly lower estimation of demand in all previous years. CVRPC is working with the Department of Public Service and other partners to refine these LEAP targets to better reflect current use (see supplement). Despite this, the pairing of these targets for residential heating remain in line with the region's approach: a transition from fossil fuels and inefficient heating types (e.g. electric resistance) towards residential heating demand dominated by high efficiency electric and cord wood technologies (whether combined or not at a household level).

In the future CVRPC will work towards incorporating further adjustments to the targets associated with incorporating district heating, thermal energy networks, and geothermal.

Electrical Efficiency Targets

Efficiency and conservation measures are integrated into the thermal sector targets. Electricity efficiencies were embedded into the 20year load forecast used in the updated LEAP model, thus are not an output of their own (and why the Public Service Department removed the Electric Sector tab of the updated Analysis & Targets Tool). Additional targets will be made available at the regional and municipal scales via CVRPC's website once the Public Service Department determines an appropriate path forward for treating those targets. CVRPC did not find it necessary to add additional targets pre-empting a statewide, RPC-supported, approach is developed, given especially the focus on weatherization and efficient residential heating systems above that fits well with the region's vision and current approach.

Fuel Switching Transportation Targets

This table displays a target for switching from fossil fuel-based vehicles to EVs. This target is calculated using the Regional LEAP data and disaggregated the regional target based on the municipal share of current vehicles (light duty only). The targets are cumulative.

Methodology: Municipal Energy Generation, Existing and Potential

Existing Renewable Energy Generation

Significant effort was made to aggregate the most comprehensive list of existing renewable energy generation sites possible for the region. The Department of Public Service periodically provides an updated Distributed Generation Inventory which includes projects that have been submitted to the Public Utility Commission and are less than <5MW. CVRPC worked with both the Department of Public Service and Distribution Utilities (DUs) to conduct significant data cleaning of DU source data to address significant challenges in previous iterations including spelling errors, differences in notation and space, village and non-town names, incorrect zip codes, etc. while these may sound like minor inconveniences, it was impossible to attribute over 300 projects to either Barre City or Barre Town due to such issues which have now been resolved. The data however is still incomplete for smaller DUs.

CVRPC added a column for municipality and aggregated projects by town, removing inactive projects, and splitting existing and proposed plants. Projects were split two ways, first into town tabs then by generation and storage, resource type, size, and sorted by DU; secondly all CVRPC projects were split by Generation and Storage, Size, Resource Type, and sorted for Town and DU. Distribution Utility Integrated Resource Plans where then skimmed for missing assets of all types, and furthermore for hydroelectric facilities, Federal Energy Regulatory Commission records and Low Impact Hydropower Institute records were compared, as were town plans and the State Comprehensive Energy Plan to identify additional plants. Projects were then split into Category I-III by size (e.g. Table X), and totals could be calculated including regional and municipal totals of generation by tech type and size, number of generation projects by tech type and size, municipal shares of regional totals, storage capacity by town and size, etc. Estimated annual MWh output per installed MW nameplate capacity were calculated using constants provided in the table below which are consistent with those used by the Public Service Department and in the Generation Scenarios Tool, except for hydroelectric which was taken directly from DU IRPs, FERC, and LIHI records.

As the Department of Public Service embarks on a data initiative, CVRPC is dedicated to supporting their efforts to address outstanding data integrity issues and improve the reliability and availability of a single consistent data source. Unfortunately, though hope was long held out, the Energy Action Dashboard was officially updated leaving aside the difficulty task of updating and hosting the much-beloved and crowd -sourced Energy Atlas that is unfortunately 7+ years out of date.

Capacity Factor is the ratio of actual electrical energy output over a given period of time to the theoretical maximum over that same period (the theoretical maximum energy output of a given installation being continuous operation at full nameplate capacity over the relevant time period).

Renewable Energy Generation Outputs & Capacity Factors

Resource	Capacity Factor	Annual MWh output per installed MW
Ground Mount Solar	15%	1,314
Rooftop Solar	14.5%	1,270
Wind	22.5%	1,971
Utility Scale Wind	30%	2,628

Hydroelectric	50%	4,380
Natural Gas	75%	6,570
Biomass	70%	6,132

Source: Central Vermont Regional Planning Commission & Department of Public Service (Generations Scenarios Tool)

State Energy Planning Data: Known and Possible Constraints; Calculating Renewable Energy Potential

Prime and base layers taking into consideration the State's known and possible constraints as well as draft ground-mounted solar, rooftop solar, and wind potential layers can be downloaded from the recently updated Act 174 tab of the Vermont Planning Atlas maintained by the Agency Of Commerce and Community Development (2022 updates https://vcgi.vermont.gov/data-release/act-174-statewide-energy-planning-data-updated-known-and-possible-constraints). While CVRPC did use these as a starting point, these layers had to be divided by town boundaries, redundancies between rooftop solar (and building footprints broadly) and ground mount had to be removed, etc. before additional considerations including regional possible constraints could be added and analyses conducted. CVRPC is working to integrate possible local constraints in next 2025 comprehensive Regional Plan Update.

CVRPC is in the process of developing a tool for municipalities to use during their own Enhanced Energy Planning processes to determine the potential impact of adding additional constraints or better yet, preferred sites to the maps. CVRPC is furthermore, committed to integrating mapping tools into the project review process and the project development process to support quick evaluations for discussions including highlighting areas with different numbers of possible constraints, working to identify preferred sites, mapping existing preferred site types and project characteristics, etc.

Ground-Mounted Solar Energy Potential

The methodology for estimating ground-mounted solar electricity potential is to divide the number of acres available as prime and base resources by 8 acres per MW for prime solar; 60 acres per MW is used for base solar to account for the presence of possible constraints that reduce the land usable for solar panels. The annual electricity production is then estimated using the formula below. Solar MWh of energy = (number of MW) * (8760 hours per year) * (0.15 capacity factor).

Calculating Rooftop Solar Energy Potential

Rooftop solar potential data is sourced from the Vermont Center for Geographic Information (VCGI) dataset named Town Rooftop Solar Potential – Act 174 2022. As explained in the release notes, these estimates use a geographic information system (GIS) model of building footprints to determine the total surface area of rooftops suitable for solar photovoltaic panels (accounting for amount of solar radiation, slope, aspect, shading of nearby objects, and minimum size of rooftop viable for solar panels). Using published data for solar radiation, the VCGI data also estimates an annual solar energy production potential for each suitable rooftop, summarized by municipality, applying a capacity factor of 13.76% as published by the U.S. Environmental

Protection Agency. The total system capacity in megawatts is then estimated using the formula below. Rooftop MW of capacity = (number of annual MW) ÷ ((0.145 capacity factor) * (8760 hours per year)). This was further curtailed by CVRPC to provide a conservative estimate as roof and condition could not be integrated at this point in analyses.

Calculating Wind Energy Potential

The methodology for estimating wind electricity potential is to divide the number of acres available as prime and base resources by 25 acres per MW. There is no reduced land factor for base wind since possible constraints have a lesser impact on actual equipment siting due to the vertical nature of wind turbines. Then to estimate the amount of production using the formula below. Wind MWh of energy = (number of MW) * (8760 hours per year) * (0.225 capacity factor)

Calculating Renewable Energy Generation Targets- see CVRPC website and municipal breakouts

Municipalization: Land: 20%, Existing Generation: 10%, Demand: 50%, Population: 20%

	Existing Renewable Generation (MW)	Multiplier (distribution across technology type)	Incremental Regional Capacity Target (MW)		Resource Available (MW)	Prime Land Available (Acres)
			25% IN-STATE	50% IN STATE		
Ground Mount Solar	41.7	25%	31	84.7	1500.4	10,503
Rooftop Solar		50%	64.2	175.3	162.7	244
Wind	0.24	20%	16.6	45.2	867.6	34,795
Hydroelectric	26	5%	1.9	5.1	1.9	N/A
Biomass (Wood, methane, farm biogas)	0	0	0	0	0	0
Total Renewable Generation Potential	68	100%	113.7MW	310.4	2532.7	45,452

State Known and Possible Constraint Definitions and Descriptions

The following is a list of the known, possible, and regional constraints that were used and referenced in the mapping section of this document. A definition of the constraint including source of the data is provided. As discussed in the report, RPCs supported a coordinated effort by the Department of Public Service, VCGI, and ANR to aggregate these layers which are now available via the Act 174 tab of the DHCD Planning Atlas (https://vcgi.vermont.gov/data-release/act-174-statewide-energy-planning-data-updated-known-and-possible-constraints).

Known Constraints

Vernal Pools (confirmed and unconfirmed layers) –

Source: Vermont Fish and Wildlife, 2009 - present

Vernal pools are temporary pools of water that provide habitat for distinctive plants and animals. Data was collected remotely using color infrared aerial photo interpretation. “Potential” vernal pools were mapped and available for the purpose of confirming whether vernal pool habitat was present through site visits. This layer represents both those sites which have not yet been field-visited or verified as vernal pools, and those that have.

Department of Environmental Conservation (DEC) River Corridors –

Source: DEC Watershed Management District Rivers Program, January 2015

River corridors are delineated to provide for the least erosive meandering and floodplain geometry toward which a river will evolve over time. River corridor maps guide State actions to protect, restore and maintain naturally stable meanders and riparian areas to minimize erosion hazards. Land within and immediately abutting a river corridor may be at higher risk to fluvial erosion during floods.
River corridors encompass an area around and adjacent to the present channel where fluvial erosion, channel evolution and down-valley meander migration are most likely to occur. River corridor widths are calculated to represent the narrowest band of valley bottom and riparian land necessary to accommodate the least erosive channel and floodplain geometry that would be created and maintained naturally within a given valley setting.

Federal Emergency Management Agency (FEMA) Floodways –

Source: FEMA Floodway included in Zones AE – FEMA Map Service Center

These are areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

State-significant Natural Communities and Rare, Threatened, and Endangered Species – *Source: Vermont Fish and Wildlife, National Heritage Inventory*

The Vermont Fish and Wildlife Department's Natural Heritage Inventory (NHI) maintains a database of rare, threatened and endangered species and natural (plant) communities in Vermont. The Element Occurrence (EO) records that form the core of the Natural Heritage Inventory database include information on the location, status, characteristics, numbers, condition, and distribution of elements of biological diversity using established Natural Heritage Methodology developed by NatureServe and The Nature Conservancy.
An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is,

or was, present. An EO should have practical conservation value for the Element as evidenced by potential (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation).

National Wilderness Areas –

Source: United States Department of Agriculture Forest Service
A parcel of Forest Service land congressionally designated as wilderness.

Class 1 and Class 2 Wetlands –

Source: Vermont Significant Wetland Inventory (VSWI) and advisory layers
The State of Vermont protects wetlands which provide significant functions and values and also protects a buffer zone directly adjacent to significant wetlands. Wetlands in Vermont are classified as Class I, II, or III based on the significance of the functions and values they provide. Class I and Class II wetlands provide significant functions and values and are protected by the Vermont Wetland Rules. Any activity within a Class I or II wetland or buffer zone which is not exempt or considered an "allowed use" under the Vermont Wetland Rules requires a permit.
Class I wetlands have been determined to be, based on their functions and values, exceptional or irreplaceable in its contribution to Vermont's natural heritage and, therefore, merits the highest level of protection. All wetlands contiguous to wetlands shown on the VSWI maps are presumed to be Class II wetlands, unless identified as Class I or III wetlands, or unless determined otherwise by the Secretary or Panel pursuant to Section 8 of the Vermont Wetland Rules.

Possible Constraints

Agricultural Soils –

Source: Natural Resources Conservation Service (NRCS)
“Primary agricultural soils” are defined as “soil map units with the best combination of physical and chemical characteristics that have a potential for growing food, feed, and forage crops, have sufficient moisture and drainage, plant nutrients or responsiveness to fertilizers, few limitations for cultivation or limitations which may be easily overcome, and an average slope that does not exceed 15 percent. Present uses may be cropland, pasture, regenerating forests, forestland, or other agricultural or silvicultural uses.
The soils must be of a size and location, relative to adjoining land uses, so that those soils will be capable, following removal of any identified limitations, of supporting or contributing to an economic or commercial agricultural operation. Unless contradicted by the qualifications stated above, primary agricultural soils include important farmland soils map units with a rating of prime, statewide, or local importance as defined by the Natural Resources Conservation Service of the United States Department of Agriculture.

FEMA Special Flood Hazard Areas -

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA) on National Flood Insurance Program (NFIP) maps. The SFHA is the area where the NFIP's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

Protected Lands –

State fee land and private conservation lands are considered protected lands. Other state level, non-profit and regional entities also contribute to this dataset. The Vermont Protected Lands Database is based on an updated version of the original Protected Lands Coding Scheme reflecting decisions made by the Protected Lands Database Work Group to plan for a sustainable update process for this important geospatial data layer.

Act 250 Ag Mitigation Parcels –

Source: Vermont Department of Agriculture

All projects reducing the potential of primary agricultural soils on a project tract are required to provide "suitable mitigation," either "onsite or offsite," which is dependent on the location of the project. This constraint layer includes all parcels in the Act 250 Ag Mitigation Program as of 2006.

Deer Wintering Areas (DWA) –

Source: Vermont Department of Fish and Wildlife

Deer winter habitat is critical to the long-term survival of white-tailed deer (Odocoileus virginianus) in Vermont. Being near the northern extreme of the white-tailed deer's range, functional winter habitats are essential to maintain stable populations of deer in many years when and where yarding conditions occur. Consequently, deer wintering areas are considered under Act 250 and other local, state, and federal regulations that require the protection of important wildlife habitats. DWAs are generally characterized by rather dense softwood (conifer) cover, such as hemlock, balsam fir, red spruce, or white pine. Occasionally DWAs are found in mixed forest with a strong softwood component or even on found west facing hardwood slopes in conjunction with softwood cover. The DWA were mapped on mylar overlays on topographic maps and based on small scale aerial photos.

Vermont Conservation Design include the following Highest Priority Forest Blocks: Connectivity, Interior, and Physical Landscape Diversity –

Source: Vermont Department of Fish and Wildlife

The lands and waters identified in this constraint are the areas of the state that are of highest priority for maintaining ecological integrity. Together, these lands comprise a connected landscape of large and intact forested habitat, healthy aquatic and riparian systems, and a full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend.

Hydric Soils –

Source: Natural Resources Conservation Service

A hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. This constraint layer includes soils that have hydric named components in the map unit.

Appendix 2 – Housing Targets

CVRPC Regional Plan Readoption Assessment Report

Housing Targets

Per 24 V.S.A. § 4348a(a)(9), CVRPC has completed a comprehensive housing targets assessment with a planning horizon of 2030. This housing assessment is meant to be a stand-in for the Statewide Housing Needs Assessment to be completed by the Department of Housing and Community Development. This is an interim measure until the State assessment is complete. Most of the regional housing discussion, including goals and policies to identify the location, quality, types, and costs of housing is included in the 2016 CVRPC Regional Plan. This assessment has the limited purpose of discussing the median housing and transportation cost for Central Vermont communities and of providing regional and municipal housing targets. The analysis is based exclusively on data from the 2020 census. This assessment is based on four primary data points: the growth rate of households in Central Vermont, the natural rate of housing unit destruction, a healthy vacancy rate of 5%, and the estimated number homeless households in Central Vermont. By focusing on these factors, CVRPC tries to develop a rough understanding of the evolving housing landscape, set regional and local housing targets, and hopes to facilitate informed decision-making to address the diverse housing needs of the community over the next decade. Based on this assessment, the region has a target of 1,267 new or replacement housing units for Central Vermonters of all backgrounds.

Vermont statute states that RPCs create a policy to for households to avoid spending greater than 30% of their income on housing and not more than 15% of their income on transportation costs. The 2016 CVRPC Regional Plan established the objective of strategically planning population growth around dense mixed-use core areas. A thorough examination of household expenditures on housing and transportation, as illustrated below, reinforces the finding that housing and transportation constitute a relatively smaller proportion of household budgets in the downtown areas of Central Vermont compared to households in lower density census tracts. According to the data presented, only certain parts of Montpelier and Barre City have a combined cost burden of less than 45% of household income for these two expenses. Nevertheless, it is crucial to highlight that across Central Vermont, median spending on transportation never falls below the state identified threshold of 15% of household income, indicating that density and access to services and transit alone is not enough to bring transportation costs below 15%.

		Percent of Area Median Income Spent on:		
Municipality(ies)	**Tract #**	**Housing and Transportation**	**Housing**	**Transportation**
Orange/Washington	9591	54%	26%	28%
Orange/Washington	9591	53%	25%	28%
Williamstown	9592	54%	27%	27%
Marshfield/Cabot/ Plainfield	9540	53%	26%	27%
Woodbury/Calais	9541	57%	30%	27%
Worcester/Middlesex	9542	58%	30%	28%

Waterbury	9543	60%	35%	25%
Duxbury/Moretown	9544	58%	31%	27%
Berlin	9545	51%	28%	23%
Montpelier	9546	56%	34%	22%
Montpelier	9547	49%	27%	22%
Montpelier	9548	40%	23%	18%
Montpelier	9549	47%	26%	21%
East Montpelier	9550	60%	34%	26%
Barre City	9551	38%	19%	19%
Barre City	9552	40%	21%	19%
Barre Town	9553	53%	27%	27%
Barre Town	9554	46%	21%	25%
Roxbury/Northfield	9555	50%	25%	25%
Warren	9556	57%	31%	26%
Waitsfield	9557	54%	30%	25%
Fayston	9558	63%	35%	27%

Source: 2019 Housing and Transportation Index – Center for Neighborhood Technology

For much of the Central Vermont planning area, housing costs exceed the affordability threshold of 30% of household income. To establish housing needs, 24 V.S.A. § 4348a(a)(9) states regional planning commissions shall estimate total needed housing and disaggregate targets by municipality. CVRPC developed the following targets based on the theory that if new housing is built to accommodate the rate at which the number of households grew between 2010 and 2020, replace housing units that are being removed from the housing stock through natural destruction, and elevate the regional vacancy rate to 5%, this supply-side action would help depress housing costs and increase housing affordability. For this assessment, a healthy vacancy rate for non-seasonal housing was set at 5%.

housing units needed to accommodate new households
\+ # of housing units needed to replace deteriorated housing units
\+ # of housing units needed to elevate the vacancy rate to 5%

Total # of new housing units to meet demand by 2030

Based on this analysis, CVRPC estimates that by 2030 an additional 521 housing units are needed to accommodate the growth in the number of households and elevate the vacancy rate to 5%. While 450 housing units are needed to replace the destruction of existing housing units. Therefore, a total of 971 new housing units need to be built by 2030 to relieve current pressure on the housing market. This analysis begins to estimate regional need. However, it relies on a number of assumptions, namely that the creation of new housing will improve affordability. CVRPC will continue to work to integrate this analysis into the work that has already been completed as part of the 2016 CVRPC Regional Plan.

These numbers are further broken out by census tract below.

Census Tract	Town(s)	Housing Units Needed for 2030
Census Tract 9591.01	Orange/Washington	27
Census Tract 9592	Williamstown	48
Census Tract 9540	Cabot/Marshfield/ Plainfield	64
Census Tract 9541	Calais/Woodbury	41
Census Tract 9542	Middlesex/ Worcester	42
Census Tract 9543	Waterbury	82
Census Tract 9544	Duxbury/Moretown	45
Census Tract 9545	Berlin	43
Census Tract 9546	Montpelier	38
Census Tract 9547	Montpelier	23
Census Tract 9548	Montpelier	37
Census Tract 9549	Montpelier	25
Census Tract 9550	East Montpelier	41
Census Tract 9551	Barre City	64
Census Tract 9552	Barre City	64
Census Tract 9553	Barre Town	63
Census Tract 9554	Barre Town	60
Census Tract 9555.01	Northfield	26
Census Tract 9555.02	Northfield/Roxbury	56
Census Tract 9556	Warren	36
Census Tract 9557	Waitsfield	25
Census Tract 9558	Fayston	21
	CVRPC TOTAL	**971**

The above calculation of housing need does not include new housing for Central Vermonters experiencing homelessness. Housing aimed at addressing homelessness is considered at the regional level in this analysis. This approach acknowledges the complexity of homelessness and the frequent need for additional services. New construction is often not enough. Therefore, CVRPC recognizes that housing designed to alleviate homelessness should likely be situated where supportive services are already available, rather than evenly distributed across the region.

According to the 2022 Point in Time (PIT) counts conducted by the Vermont Coalition to End Homelessness, there are 296 households experiencing homelessness in the Central Vermont planning area. Of these, approximately 51 are households with children. This count includes figures for Washington County and a proportional estimate for the three CVRPC municipalities in Orange County. Consequently, there is a need to create an additional mix of 296 housing units to support this population.

When considering the combined factors of low vacancy rates, the increasing number of households, natural destruction of housing units, and the results of the PIT homelessness survey, the projected

target for total new housing units in Central Vermont by the year 2030 is 1,267. This figure accounts for a blend of affordable and market-rate housing to accommodate all demographics.