ENERGY

Energy use is essential and deeply embedded in all aspects of daily life for lighting, heating and cooling buildings, transporting people and goods; nearly everything we do requires energy. We have understood for at least fifty years that human dependence on fossil fuels is not sustainable. Only now are we beginning to grapple with climate change resulting from burning fossil fuels. Changing the ways we generate and use energy will be an incremental process as utility infrastructure and technology, the building stock, transportation systems and land use patterns adapt to a new energy regime. There is an active grassroots effort in Vermont and around the world to act locally in addressing climate change. This consumer and activist led movement confronts the day-to-day decision-making of state and national governments and global corporations. This chapter provides an understanding of current energy use by Norwich residents and businesses in the context of Vermont's 90% renewable by 2050 goal. This chapter describes the current setting for energy use in Norwich, and then moves to a consideration of how much renewable energy Norwich can generate. Policies and objectives focus on those decisions directly within the control of the town, assuming the current regulatory scope and commitment of resources. Opportunities for promoting changes in consumer behavior with existing town volunteer resources are also identified. Assumptions made in the Vermont 2016 Comprehensive Energy Plan (CEP) and the shortcomings in available data are noted to encourage more rigorous planning at the state level, where the vast majority of decisions regarding energy markets (fossil fuel and renewable) are made.

Current Energy Use

The accepted estimate of the total amount of energy being used in Norwich is from the Community Energy Dashboard (https://www.vtenergydashboard.org/my-community/norwich/progress) which suggests that in 2016 (the latest year actual use figures are available) 508,115 MMBTUs (million BTUs) were consumed town-wide for electricity, thermal (heating and cooling buildings), and transportation as shown in figure xx pxx). Energy use in Norwich reflects the settlement pattern, which is dominated by low density residential lots, and little or no industry or commercial activity.

In developing this chapter, the town relied upon:

- 2017 Two Rivers Ottauquechee Regional Commission (TRORC) energy plan in general and the following specific sources of information about energy use in Norwich
- The Energy Action Network's Community Energy Dashboard, which tracks the progress of each Vermont community towards the state's goal of meeting 90% of local energy needs through efficiency and renewable energy by 2050.
- The Act 174 Supplement prepared for Norwich by TRORC is incorporated into this plan and included in Appendix B.

Green Mountain Power (GMP) as a utility regulated by the VT Public Utilities Commission (PUC) provides detailed statistics about electricity generation and use as part of fulfilling their license to operate. Current commercial transportation energy use and future needs were not assessed by TRORC as part of Act 174 energy planning. The published figures for thermal and transportation energy use are rough estimates based on statewide averages and Census data. More reliable and accurate data about thermal and transportation energy use at the local level is needed for town energy planning to be meaningful and effective. Using the data provided suggests that in 2016 48.8% of fossil fuel use (or 176,974 MMBTUs) was devoted to transportation uses.

Renewable Energy Resources

Vermont's Renewable Energy Goal

Greenhouse gas emissions caused by human activity are driving global climate change. Vermont adopted a goal in 2011 to obtain 90% of the total energy used in the state (electricity, thermal, transportation) from renewable sources by 2050. Advisory targets have been set for each Vermont municipality to reduce overall fossil fuel use and transition to renewable sources by 2050. The energy use and conservation targets for Norwich are shown in Norwich's Energy Targets Figure xx. Specific targets for renewable energy generation are included in Appendix X, Energy Targets and Conservation Goals

Efforts to meet the state's 90% by 2050 goal face two significant challenges – redirecting thermal and transportation energy demand to renewable (primarily electric) sources, and the severely circumscribed authority of municipalities to affect energy use outcomes. Energy products (including efficiency and renewable alternatives) are allocated via markets. The power to regulate these markets is reserved to states and the US federal government. Municipalities are best understood as institutional consumers, they have no jurisdiction over the structure and daily operation of energy markets. In the case of Norwich the town is a very small consumer even compared to the local school districts and large regional employers. For instance, purchasing and capital decisions made by Norwich are unlikely to be visible on the Energy Dashboard. The powers that municipalities do have mostly pertain to regulation of land use (in VT an authority granted to municipalities by state statute and further constrained by case law). Land use patterns in Norwich have been consistent for many decades, and the rate of development is exceedingly slow. It is reasonable to conclude that changing land use patterns will not play a major role in achieving the targets within the timeframes identified by the VT CEP.

Norwich obtains 57% of its electricity from renewable sources (based on GMP's renewable portfolio and on-site local generation), 0.5% below the 2016 target. Converting current electricity use to renewable sources has been relatively straightforward in response to state policies such as the Renewable Energy Standard, which required utilities to procure 55% of their electricity from renewable sources in 2017. That figure will increase incrementally to 75% by 2032. Conversion of transportation and thermal energy (the majority of energy used in Norwich), to renewable sources will be more costly and disruptive to existing systems. These transitions are beyond the regulatory scope of the municipality, and thus the Town will only influence the outcome at the margin.

Potential for Renewable Energy Generation

Act 174 Maps. As required by the state under Act 174, TRORC has mapped areas of Norwich that have potential for renewable energy generation as discussed in Appendix x, Energy Mapping, shown on page *-*.

The maps for solar potential were derived from analyzing aspect (with south facing landforms most suitable for solar generation).The maps do not use key features including: current land use and lot boundaries, extent of forest cover, proximity to roads, distance to electric distribution (particularly 3 phase power and transmission infrastructure, or the ability of the power grid to take additional load). Each of these factors presents serious limitations to utility scale (> 500 kW) solar energy development.

At present, the most salient factors for determining where commercial renewable energy projects may feasibly be located is proximity to the existing power grid (three-phase power and transmission lines) and the capacity of the grid to accommodate additional load. As of 2019, the GMP Solar map 2.0 indicated that there were system limitations on the circuit along the Thetford Norwich border and to the far west of Norwich where the grid for Sharon has severe limitations. Power draw and generation are so small in Norwich that no substation is required and there is only minimal three phase power. Under current grid conditions Norwich can continue to add small-scale generation sites without challenging the safe function of the grid (i.e. households approximating self-sufficiency in power generation), but infrastructure upgrades would be required for larger community net-metered or utility-scale projects.

Wind Power. According to the Energy Action Network's Community Energy Dashboard there are no wind energy projects installed in Norwich as of 2018. There is no meaningful potential for utility-scale wind generation in Norwich given current turbine technology, which generally requires an average wind speed of at least 6 meters per second. Only two locations in Norwich are identified through the Act 174 mapping process with wind speeds at 6 meters per second or above (accessed via turbines set between 50 and 70 meters high). One site identified is near Griggs Mountain and is therefore heavily constrained. The other is Gile Mountain off Chapel Hill Rd on the Sharon town-line south of the Town forest. These sites are not currently accessible from roads suitable for this scale of development, nor to a power transmission line.

Solar Power. The Energy Action Network's Community Energy Dashboard identifies 217 small sites in Norwich which altogether produced less than 1 MMBTUs of electricity – more projects of this scale and type are likely. Norwich is ranked 80th out of 250 towns in Vermont for solar electric energy generation.

Any large scale development of solar energy will require proximity to a substation and three phase power. Norwich has no substation and very limited phase three power. Using the Act 174 mapping methodology 6, 341 acres out of a total 28, 620 acres in Norwich has solar potential (southern facing slopes). But, 22,116 acres (or 77%) of Norwich is forested. About 67% of the area identified as having solar potential is currently under forest. Aside from the economic cost of clearing, the release of carbon from cleared lands would diminish the climate change benefits of utility scale solar development. The mapping of solar potential erroneously includes the Right of Way (ROW) for interstate 191 and other lands not available for development. For Norwich to satisfy all its energy demand locally by 2050 280 acres of solar panels would be needed (assuming current PV panel efficiencies at 7 acres per MW).[1]

Hydro Power. There is no hydropower located in Norwich according to the Energy Dashboard. Small, run-of-the-river generators would be the only likely future hydro generation, given current state regulations with regard to damming waterways.

Biomass. While it is not known how much wood is harvested for fuel in Norwich on an annual basis, it is clear that there is potential for sustainable biomass production given that the town is more than 77% forested. Wood is a renewable source of thermal energy and technological improvements have greatly increased the efficiency and reduced the pollution associated with burning wood. A large percentage of homes in Norwich use wood as either a primary or secondary heating source. The State of Vermont is encouraging schools and municipal facilities to install high efficiency wood pellet or woodchip heating systems. Marion Cross??

Geothermal. There is one ground source heat pump installed at a residential property in Norwich according to the Energy Dashboard. The feasibility of installing geothermal systems needs to be assessed on a site-by-site basis.

Distributed Power Generation and Storage. Utilities will need to invest in infrastructure improvements and new technologies to achieve the state's renewable energy goal. As distributed net-metered and relatively small energy generation projects (as compared to conventional, centralized power plants) are connected to the existing grid, the infrastructure will need to be upgraded and modified to accept new loads. For example, the limited availability of three-phase power and absence of any substation is a significant factor in explaining why utility-scale renewable energy projects in Norwich are very unlikely. That network will need to be expanded and upgraded to supply the renewable electricity necessary to meet the state's energy goal by 2050.

Further, solar and wind are not a stable, constant source of energy. They will not be able to replace base loads and supply peak demand in the manner of conventional power plants without new energy storage technologies. Municipalities have no control over the rate of infrastructure improvements and technological innovation needed to meet the state's renewable energy goal.

[1] 228,370, 000, 000 BTU/3412 = 66,931,419kWH. If 1,000,000BTU = 293 kWh then 293 kWh =

There is no discussion or policymaking occurring at the state level that would suggest this issue is being rationally planned now. The New England region wholesale electricity market and grid is coordinated by ISO New England.to allow for shifting patterns of demand and generation and to work around planned outages or unscheduled break-downs Any regulatory action on the part of the state to alter the pattern of generation and distribution would need to conform to the binding agreements established under ISO New England.

Energy Conservation and Efficiency

Structures

The Energy Action Network's Community Energy Dashboard suggests just over 16 MMBTUs of energy were saved in 2016 (from the 2014 baseline) through energy efficiency and conservation. The scenario for meeting the state's renewable energy goal presented on the Dashboard shows that a total of 156.8 MMBTUs of energy will need to be saved by 2050 through efficiency and conservation measures. Under the US and VT constitution the town has no role in shaping or regulating the market provision of energy conservation or efficiency products and services. The town currently has no role in enforcing or inspecting for energy code compliance, as it does not administer building codes or issue certificates of occupancy. The rate of new construction or even substantial improvement is very slow. Norwich's building stock is relatively old, thus the rate of change is also likely to be very slow.

Transportation

Of note here is the assumption that by 2050 the total energy use for transportation will reduce from 195,162 MMBTUs to 56,348 MMBTUs (or a reduction of 28.8%). It is also expected that fully 90% of the 2050 transportation energy budget will be provided from renewable sources. If the assumption is that vehicles will be predominantly electric by 2050 then some significant increase in total electricity demand might be expected. Yet there only appears to be a minor increase in electricity demand predicted from 55,497 MMBTUs in 2016 to 57,572 MMBTUs in 2050 (or 3.6%). It is not clear that the electric load of transportation is factored in to this model. The paucity of meaningful data and the extremely limited role of municipal government in shaping transportation energy use means this cannot be a focus of the plan.

Available Resources

Efficiency Vermont offers homeowners and businesses various programs and incentives for efficiency (see www.efficiencyvermont.com). Opportunities for energy efficiency and conservation include:

- Weatherizing existing buildings.
- Replacing inefficient mechanical systems, equipment and vehicles with more efficient models.
- Siting and designing buildings to take advantage of passive solar.
- Constructing new buildings, additions and renovations to meet or exceed state residential or commercial energy code standards.

There are various state and regional programs to assist with weatherization and efficiency improvements:

- The Vermont Department of Families and Children offers a Weatherization Program that helps lower-income residents — particularly older Vermonters, people with disabilities, and families with children — to save fuel and money by improving the energy efficiency of their homes.
- Southeast Vermont Community Action's Weatherization Services include state-of-the-art energy audits, insulation and sealing, heating system improvements, and other energy-saving measures, all at no cost to residents who meet the income guidelines.

There are state and regional programs to encourage reduced Single Occupancy Vehicle (SOV) use including:

- GoVermont A suite of personal transportation services accessible via a phone app including: a rideshare matching service, vanpool program, guaranteed ride home program (reimbursement), a network of Park and Ride facilities serviced with EV charging stations and support for employers encouraging staff to share rides to and from work.
- Advance Transit operates regional bus routes that service Norwich and major points of employment, shopping and cultural activity

Municipal Facilities and Vehicle Fleet

Norwich is actively pursuing efficiency and conservation targets with municipal facilities and fleet. The newly opened Emergency Service building was designed as a net-zero building. In early 2019 the town received a grant to install an EV charging station at the Park and Ride at Huntley Meadow. Through a grant from the Womens Club it will be accompanied by a bicycle repair station. The Norwich Energy Committee is working with town staff and the Selectboard to meet the intent of (non-binding) Article 36 which passed at the 2019 Town Meeting:

> Shall the voters of Norwich direct all Town officials to take immediate and sustained efforts to gradually and continually reduce the Town's direct use of fossil fuels, beginning at a rate of no less than 5% per year starting in the 2019-20 fiscal year and continuing until they are eliminated entirely, and shall the Town Manager be charged with monitoring such efforts and reporting on them each year in the annual Town Report, and no capital expenditures shall be made that contradict or undermine this direction, absent a majority vote of the Selectboard?

To achieve this goal volunteers are working with staff to establish a baseline of current fossil fuel use to operate conditioned space in buildings and the municipal fleet. Volunteers are also working with town boards and commissions to develop a network of trails for bike and pedestrian use focusing on the village with the intention of reducing short in-town vehicle trips.

Future Generation, Use and Conservation

Energy Targets

Future targets for energy generation, use and conservation have been set for all Vermont municipalities as part of the state's enhanced energy planning under Act 174 (see "Norwich Energy Targets"). The planning scenario presented on the Energy Action Network's Community Energy Dashboard envisions that total energy consumption in Norwich will decrease to 228.4k MMBTUs by 2050 a 55.8% reduction over the 2016 consumption of 516.7k MMBTUs. Only 32.3k MMBTUs (or 14.1%) will be from fossil fuels.

This plan's land use, housing and transportation goals, objectives and policies call for new housing and economic development to be focused in and adjacent to the village where people can live close to employment, shopping and services, and where it is more feasible to provide public transit, in order to reduce energy used for transportation. Encouraging such a development pattern through the town's land use regulations and provision of public infrastructure are the most effective and direct measures Norwich as a municipality can take to move towards meeting the state's energy goals.

The 2017 TRORC Energy Plan recognizes that Norwich is currently generating 0.50 MW of electricity from solar and sets a target for an additional 19,167 to 23, 426 of MWh [inconsistent units] of renewable energy generation by 2050. This is calculated on the current percentage share of the Norwich population as compared to the total regional population (that is, no accounting for grid capacity, natural limitations etc). The portfolio of renewable energy generating sources includes both rooftop and ground-mounted solar, wind, and hydropower. The TRORC energy plan suggests that there is 81 times more 'suitable land' than is needed to host such renewable energy projects in Norwich.

Renewable Energy Project Siting Standards

This plan supports renewable energy production in Norwich. For this policy to continue with broad community support it must be balanced with this plan's policies related to:

- Protecting natural resources, environmental quality, scenic resources and rural character.
- Maintaining viable farms and the working lands needed to sustain them.
- Focusing development in those areas of town already served by existing public infrastructure.
- Preserving the cultural resources within Norwich village
- Preserving the recreational and natural value of those lands identified in the Ridgeline Protection Overlay Area, and Shoreline Protection Overlay Area

This plan calls upon the Public Utilities Commission to issue Certificates of Public Good for renewable energy projects in Norwich only when the following standards are met: [RF Note: *the policy statements below are intended to be illustrative of what is required/possible under Act 174 and I anticipate these will be replaced/edited as a result of the second phase of work on the plan*]

- For individual or group net metered renewable energy projects, the property owner must take reasonable measures to site and/or screen the installations to minimize any visual or noise impacts beyond the property line, particularly on sites where there are neighboring homes in close proximity.
- To the greatest extent feasible, solar projects larger than 150 kW must be located on roof-tops, within parking lots, and on previously developed land with other development limitations such as former gravel pits. These will be considered preferred sites. This plan identifies the following preferred sites based in existing uses and conditions:
    - Norwich Farmers Market site (stalls and parking lot)
    - King Arthur Flour (rooves and parking lot)
    - The Coop Service Station (roof and parking lot)
    - Marion Cross School (parking lot)
    - Dan and Whits Grocery (parking lot)
    - Huntley Meadow Playing Fields (parking lot)
- Projects larger than 150 kW must meet existing standards for setbacks, site design (landscaping, screening, lighting, stormwater, etc. as laid out in the Norwich Zoning and Subdivision Regulations
- Projects larger than 500 kW that are extensive (such as ground-mounted PV) must not be located on sites that have a higher use value such as land served (or planned to be served) by public infrastructure and suitable for compact residential, commercial or light industrial use.

- Projects larger than 500 kW must have a management and decommissioning plan that will ensure the land will be returned to its prior condition when no longer actively used for renewable energy generation. Wherever feasible, the energy generation use must be combined with continued agricultural use of the land.
- Projects larger than 500 kW must not clear land within a mapped forest block (see *Ecological Resources Map) unless there is a management and decommissioning plan that will ensure the land will be re-forested and managed in accordance with a forest management plan when no longer actively used for renewable energy generation.

Enhanced Energy Planning

This plan commits broadly to the goals laid out in the 2016 VT CEP and the 2017 TRORC Regional Energy Plan. In consideration of the limited existing grid infrastructure (i.e. no substation, lack of transmission lines, lack of 3 phase power) the extent of forest cover (77% forested) and unsuitable terrain for existing large scale wind turbine technology this plan is **not** seeking “enhanced status” under the provisions of Act 174.

Objectives

1. Reduce Single Occupancy Vehicle (SOV) among Norwich commuters (in and out).
2. Increase the amount of renewable energy being produced in Norwich in a manner that is consistent with the goals, objectives and policies of this plan.
3. Reduce overall energy use in Norwich through conservation and efficiency measures

Policies

1. Promote smart-growth development in a review of the Norwich Zoning and Subdivision Regulations, paying particular attention to the possibility of increasing the density of development immediately adjacent to the existing village area.
2. Promote non-vehicular transport modes (bike and pedestrian) using best practices for traffic engineering (sidewalks and bike lanes) and dedicated trails.
3. Advocate on behalf of non-vehicular road users before VTrans for improved accommodations on state highways
4. Encourage large-scale development or redevelopment projects to install solar collectors on rooftops and parking lots.
5. Support individual or residential renewable energy projects (including EV chargers) that are compatible with the goals, objectives and policies of this plan.
6. Consider life cycle costs (initial construction and ongoing operation) when planning to construct or upgrade municipal facilities.
7. Support programs that assist owners with weatherizing and improving the efficiency of existing buildings, and/or provide incentives for energy-efficient construction or renovation
8. Encourage owners to manage forestland for long-term, sustainable harvesting of wood as a renewable fuel source.
9. Support Advanced Transit to provide a range of commuter services to Norwich, connecting with locations where residents attend school, work and shop
10. Encourage climate-change and energy awareness in Norwich through the ongoing work of the Energy Committee

Actions

1. Participate in Section 248 process before the Public Utilities Commission to make decisions that further the goals, objectives and policies of this plan