2018 Chittenden County ECOS Plan

DRAFT ENERGY ELEMENT
10/31/2017

For a healthy, inclusive, and prosperous community

This plan is the Regional Plan, Metropolitan Transportation Plan, and Comprehensive Economic Development Strategy in one.

This plan can be found online at: www.ecosproject.com/plan

DRAFT Energy Element of the 2018 ECOS Plan Update – October 31, 2017

CCRPC, as well as other regional planning commissions, are working with the Vermont Department of Public Service (DPS) to develop Regional Energy Plans for their regions. These regional energy plans are intended to advance the State's Comprehensive Energy Plan's goals while being consistent with local and regional needs and concerns. The Chittenden County Regional Energy Plan will be a roadmap for Chittenden County to meet goals of energy consumption reduction, weatherization of homes and in-region renewable energy production.

Because Chittenden County's 2013 ECOS Plan is a comprehensive plan, energy is discussed throughout the Plan. **Therefore, amendments have been made in many sections of the Plan and only those sections are included herein to help focus your attention on the energy components.** Ultimately the economic development and transportation sections of the ECOS Plan will be amended as well, and a full 2018 ECOS Plan update will be compiled and released for public comment in January 2018 (adoption planned for June 2018).

This document contains EXCERPTS from the full ECOS Plan as updated for this purpose; as well as additional supplements at the end:

ECOS Plan Sections:

Section 2.5.1 – Land Use goal, key issues and indicators
Section 2.5.3 – Transportation goal, key issues and indicators
Section 2.5.5 – Energy goal, key issues and indicators
Section 3.2.2 – Smart Growth Strategy with the Future Land Use Map, including:
    4. Energy Action
    5. Transportation Action
Section 3.2.3 – Water Quality Strategy
Section 3.2.4 – Habitat Protection Strategy
Natural Systems Map with Development Constraints
Section 4.1.1 – Explanation of the maps and what development constraints are included on them
Section 4.1.2 – How CCRPC uses this Plan in development review
Section 4.1.3 – How CCRPC will use this Plan to review municipal plans

Supplements:

Multiple Energy Related Maps
Chittenden County Energy Data
Energy Data Methodology and Assumptions

2.5.1 LAND USE

Land Use Pattern Goal: Encourage future growth in the Center, Metro, Enterprise, Suburban, and Village Planning Areas to maintain Vermont's historic settlement pattern and respect working and natural landscapes.

Key Issues/Trends/Insights

[Data from this section drawn from Historic Development and Future Land Use/ Transportation Analysis Report]

- Over the past 60 years development trends, zoning regulations, and consumer preference have shifted growth away from the metropolitan areas around Burlington, to more suburban and rural locales. This shift has resulted in scattered development at low densities that consume large amounts of land, high infrastructure costs, with little opportunity for social interactions, and less ability to walk to services.
- Overall, Chittenden County is moving in the right direction of developing and implementing policies that encourage more growth in these areas. As of 2012, Chittenden County includes 10 Villages, 2 Downtowns, 2 Growth Centers, 2 New Town Centers, and 1 New Neighborhood that are part of the State Designation Program that promotes smart growth principles. Recent studies and surveys indicate that households are choosing to live in areas with shorter commute times, nearby shops and services, and more transit options. This growing demand indicates that the small lot and attached accessible housing stock may be in short supply.
- Forest and agricultural land fragmentation and increased parceling have meant that the number of parcels in rural areas has increased while their size has decreased, diminishing their economic viability, scenic, and the ecological services they provide.
- Future land-based opportunities for farming and forest-based products, recreation and tourism may become more limited as suitable open land becomes less available. This possibility has far reaching consequences for the future of Vermont's local and tourism economies.
- There are over 4,400 designated historic sites in Chittenden County (over 2,500 in Burlington alone) and over 80 designated historic districts (see historic resources map here: http://maps.ccrpcvt.org/ChittendenCountyVT/).
- A sustainable society operates without contributing new contaminants to the environment, but also cleans up old contaminants and returns those lands into productive use. Contamination impairs the environment, poses risks to human health, and discourages productive use or reuse of the property. Of 702 Chittenden County sites with reported contamination, 476 (68%) have completed corrective action (VT DEC Waste Management Identification Database).

Key Indicators

- **% of Acres in Major Land Use Categories, Chittenden County 2008**

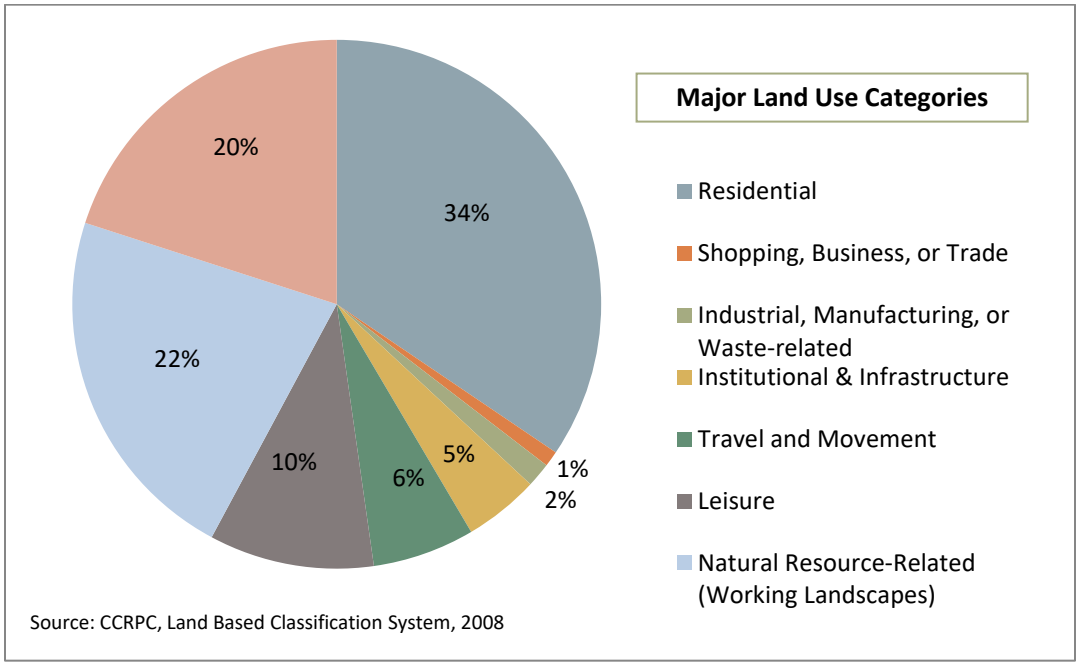


FIGURE 40 – LAND USE CATEGORIES BY PERCENTAGE

- **Percent of New Structures in Areas Planned for Growth: 1950 – 2010**

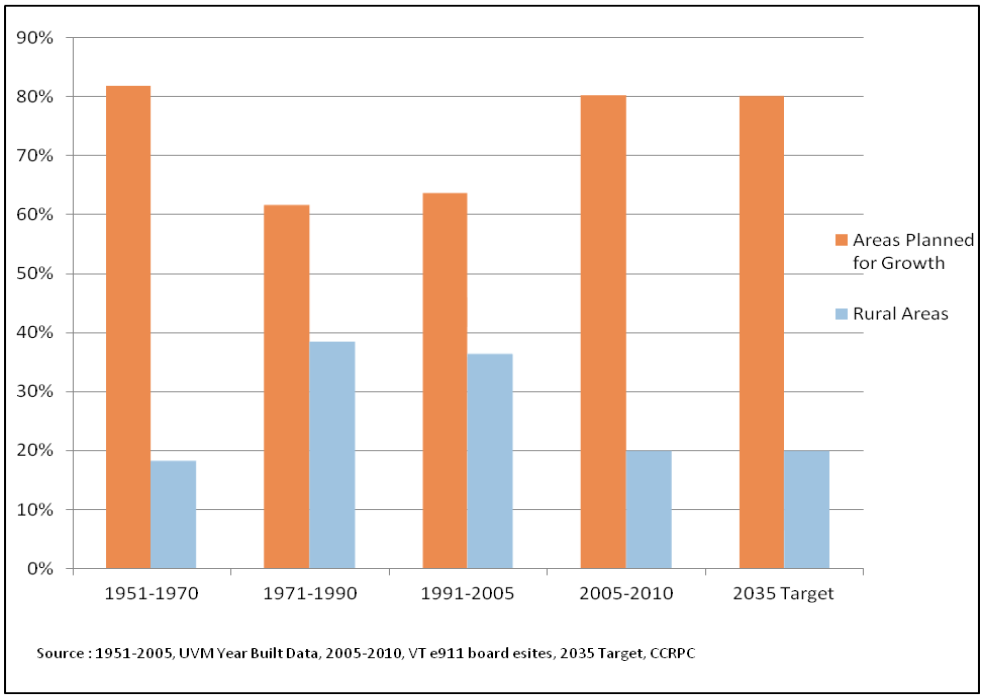


FIGURE 41 - PERCENT OF NEW STRUCTURES IN AREAS PLANNED FOR GROWTH, 1950 - 2010

Note regarding Figure 41: The best available data at the time of this report related to e911 structures. Going forward, CCRPC seeks to regularly track dwelling units and the non-residential square footage in the Areas Planned for Growth to better represent the development that is occurring in the County.

- **75% of private property investment is going into the Areas Planned for Growth and 25% in the Rural Planning Area** (Source: CCRPC from parcel and grand list data).

- **Development Density by Planning Area, 2010**

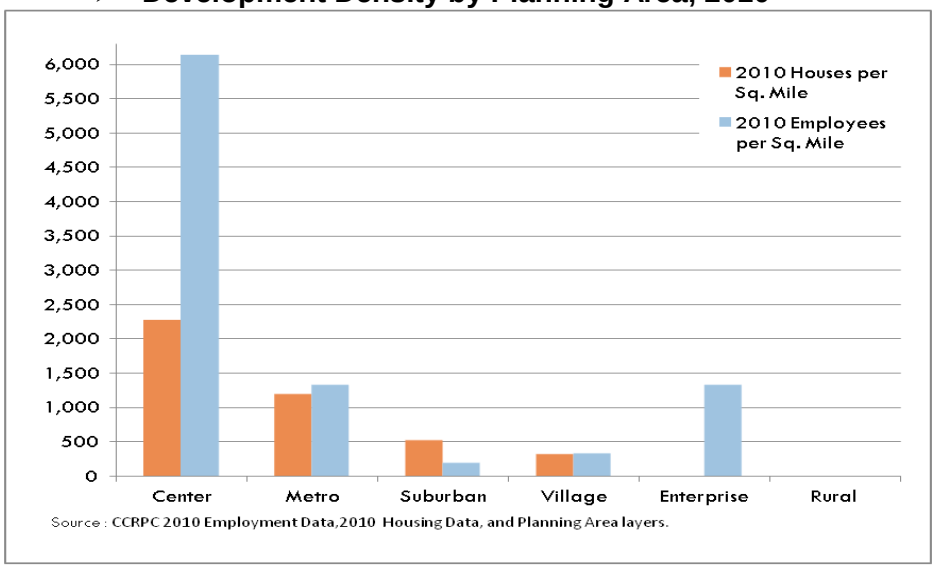


FIGURE 42 – DEVELOPMENT DENSITY BY PLANNING AREA, 2010

2.5.3 TRANSPORTATION

Transportation Goal: Provide accessible, safe, efficient, interconnected, secure, equitable and sustainable mobility choices for our region's businesses, residents and visitors.

Key Issues/Trends/Insights

[Data for this section drawn from Historic Development and Future Land Use/Transportation Analysis Report and MTP Supplemental Documents in Chapter 4]

- Congestion is worsening with potential negative consequences on economic development, the environment and human health.
- The 2008-2009 Scenario Planning Process undertaken by the Chittenden County Metropolitan Planning Organization resulted in a clear surveyed preference for future growth to be concentrated into higher density, mixed use centers – this preference is also demonstrated in the policy direction outlined in municipal plans and ordinances throughout the County. Directing transportation investments to serve mobility and accessibility in compact settlements will result in a more cost effective and efficient transportation system.
- Continued low-density development in rural areas will increase Vehicle Miles Traveled (VMT) and likely increase potentially harmful air pollutants and greenhouse gases.
- Higher fuel prices will lead to an increase in the percentage of household income needed to meet transportation expenses; rural residents are disproportionately impacted by household transportation costs.
- Some population segments – youth, the elderly, low-income and communities of color – lack access to viable public and private transportation options. The lack of safe, reliable, and complete connections within the transportation system and between transport modes reduces access to employment, social, economic, and recreation opportunities; and limits access to basic needs by means other than a personal vehicle.
- More robust investment in transportation options – transit, walking/biking, carsharing and ridesharing – could reduce transportation energy use, congestion, vehicle miles traveled, use of single occupancy vehicles, social exclusion, and could improve public health, and enhance the economic well-being of our residents, businesses and visitors.
- While access to public transit is widely available in the region's more urbanized areas, there are days and times when service is not available; some suburban and most rural populations lack access to transit.
- Roadway condition of over half of the arterial highway mileage in Chittenden County is rated poor or worse. Compounding our poor roadway conditions and inadequate investment, transportation funding in general is overly reliant on the state and federal gas taxes which are decreasing in value as inflation lowers purchasing power and revenues decline due to improving vehicle fuel efficiency, fewer VMT and a shift to electric vehicles.
- Transportation costs exceed our capacity to maintain, operate, and improve our current system. Nor do we have adequate funds needed to grow transit, walking/biking, and Transportation Demand Management (TDM) programs. The prospect of less funding in a time of increasing transportation investment need is a worrisome trend and needs to be addressed.
- The MTP must be fiscally constrained to the funding anticipated for investment in the planning horizon through 2035. The following chart outlines the funds anticipated to be available for the next 25 years. The chart highlights the fact that we will not be able to afford everything that may be needed and that investments will need to be selected which promote future sustainability.

Estimated Transportation Funding for Chittenden County: 2010 - 2035

	COSTS in Millions (2010$)
Estimate of future funds	$1,177
Cost to maintain/preserve the transportation system	$754
Committed projects (TIP and Circ Alternatives)	$113
Total available to address new transportation needs	$310
Estimated cost of anticipated new projects (the sum of all items on the MTP Project List - Transportation Need)	$849
Funding deficit (Transportation Need minus Total Available)	($540)

FIGURE 44 - ESTIMATED TRANSPORTATION FUNDING FOR CHITTENDEN COUNTY 2010 - 2035

- While our rate of driving alone to work increased by 36% between 1980 and 2000 (to 76% of all work trips), in more recent years this trend has shown improvement to 71% in 2010. We've also seen a nearly 60% increase in transit ridership the past decade. Vehicle Miles of Travel (VMT) per person is also on the decline, down 8% between 2000 and 2010. It is imperative that we maintain these positive recent trends in order to reduce congestion, reduce transportation energy use, decrease greenhouse gas emissions, and more efficiently utilize all of our transportation resources.
- Note: Aviation transportation is planned for by the Burlington International Airport (BIA) according to Federal Aviation Administration procedures. Air to ground transportation planning is coordinated between CCRPC, BIA, and the City of South Burlington and is considered in this Plan.
- The State of Vermont has a goal of obtaining 90% of energy across all sectors from renewable sources by 2050. This includes energy used for transportation. For this to occur state and federal policies will need to support the transition of light duty vehicles will switch entirely from gasoline and diesel to electric, and medium and heavy duty vehicles will switch entirely from diesel to biodiesel or renewable diesel. Although compressed natural gas (CNG) is not a renewable resource, it could serve as a bridge fuel for heavy duty vehicles as an alternative to gasoline. To be widely adopted, electric vehicles need to be appealing to consumers, and charging infrastructure must be affordable and easily accessible, which will require both financial and regulatory incentives and disincentives.

Key Indicators

- **Percent of workers commuting by non-Single Occupant Vehicle (SOV) mode (walk, bike, transit, carpool, telecommute).** Recent data suggests the reversal of a negative trend going back at least 30 years and probably longer.

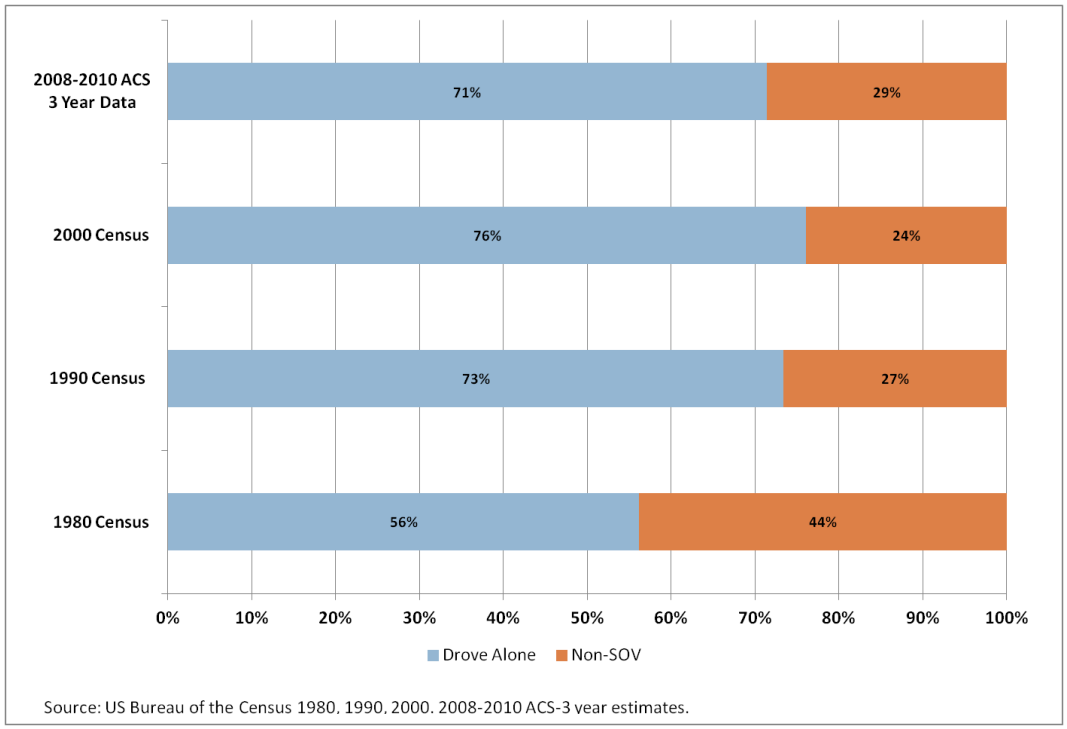


FIGURE 45 – PERCENT OF WORKERS COMMUNTING BY NON-SINGLE OCCUPANT VEHICLE (SOV)

- **VMT Per Capita.** Less driving per person can have positive environmental, transportation, economic, health and social impacts. Our most recent data may portend a positive trend.

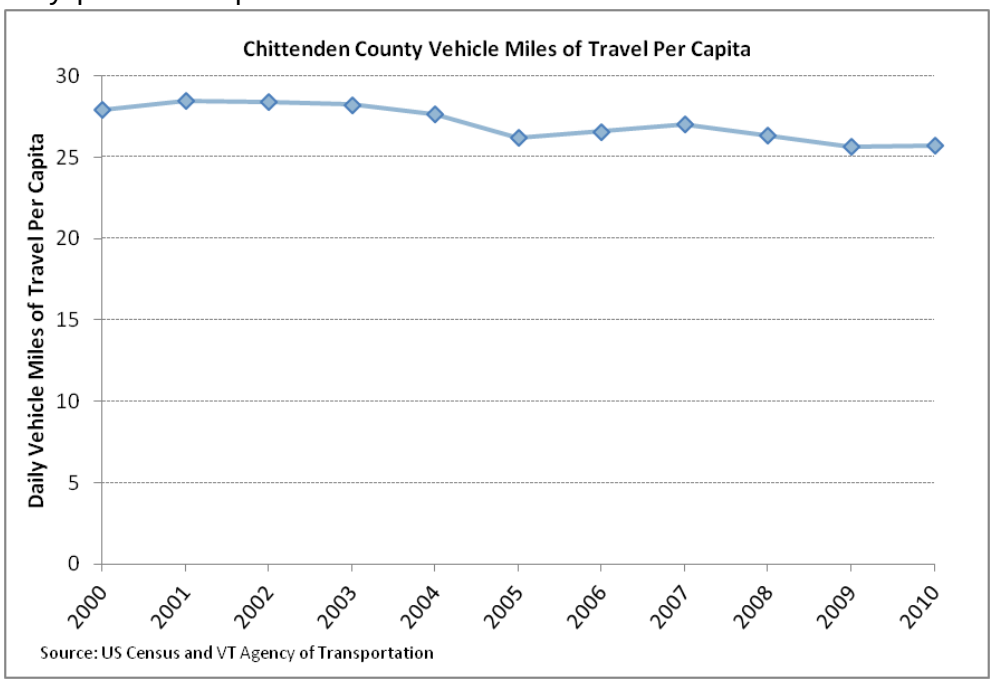


FIGURE 46 - VEHICLE MILES OF TRAVEL PER CAPITA

- **Number of electric vehicles registered.** Increasing the number of electric vehicles is key to reducing the use of fossil fuels for transportation and to reducing transportation energy use. There were 601 electric/plug-in hybrid vehicles registered in Chittenden County in July 2017, or 0.6% of all light duty vehicles.
- **Amount of fossil fuel used by heavy duty vehicles.** Decreasing fossil fuel use in heavy duty vehicles will depend on vehicles being able to run on fuels such as biodiesel. In 2017, heavy duty vehicles used XXXX gallons of fossil fuels.
- **Energy used for transportation.** By 2050, the LEAP model calls for a 79% decrease in energy used for light-duty transportation; a reduction of 5,953,000 MMBtus.

2.5.5 ENERGY

Energy Goal: Transform Chittenden County's energy system to a cleaner more efficient and renewable system that benefits health, economic development, and the local/global climate by working towards the State's Comprehensive Energy Plan goals.

The goals of the 2016 Vermont Comprehensive Energy Plan are to:

- Weatherize 80,000 Vermont homes by 2020
  - Intermediate goal of 60,000 homes by 2017
- Get 90% of Vermont's energy from renewable sources by 2050
  - Intermediate goal of 25% of energy from renewable sources by 2025, including 10% of transportation energy
  - Intermediate goal of 40% of energy from renewable sources by 2035
- Reduce total Vermont energy consumption by more than 1/3 by 2050
  - Intermediate goal of 15% reduction by 2025

Key Issues/Trends/Insights

[Data for this section drawn from: Energy Planning Methodology, Energy Analysis Report and Climate Change Trends and Impacts Report].

Efficiency and Conservation

- Chittenden County has a long history of electrical and natural gas energy efficiency programs, dating back to 1990, which have provided significant energy savings and economic benefits to the state and County. These programs along with improvements in federal standards have led to a reduction in per household and per employee energy consumption of electricity and natural gas. Reduction in energy consumption directly results in a reduction in energy bills. See Indicators for data on efficiency gains.
- The State of Vermont's goal to weatherize 80,000 Vermont homes by 2020 and 60,000 homes by 2017 is optimistic. Progress on weatherization has been low despite programs such as the State of Vermont's Heat Saver Loan Program. According to the LEAP analysis Chittenden County would need to weatherize 14% of homes by 2025 and 70% of homes by 2050.
- Electric efficiency programs have always worked to reduce electrical demand especially during peak periods but the development of the Smart Grid will provide a powerful tool to address this issue. Smart Grid coupled with education, behavior change, and load control technologies can help reduce peak demand and defer substation upgrades which can result in substantial cost saving.
- While efficiency programs targeting electricity and natural gas have been largely successful, there is an urgent need to fund and develop similar programs for non-regulated thermal fuels and for the transporation sector. The more widespread adoption of electric vehicles should reduce the total energy consumption in the County, due to better efficiency (an EV gets the equivalent of 100 miles/gallon). To prepare for widespread adoption of electric vehicles, charging infrastructure should be developed. In addition, policies and pricing structures to encourage off peak charging need to be considered to mitigate grid constraints.
- It is necessary to shift the heating sector away from fossil fuel use. Promoting cold climate heat pumps, in addition to wood, biogas and geothermal heating systems, will be key to meeting this goal.

- There is a need for focused study to determine solutions for vermiculite removal as it relates to weatherization, in particular low income weatherization. Vermiculite was used as an insulator for decades (1960-1990) and was mined with asbestos. Thus any home with vermiculite is assumed to be contaminated.

Transition to Renewable Energy

- In analyzing Chittenden County's ability to meet the 90% renewable energy by 2050 goal the Long-Range Energy Alternatives (LEAP) model was utilized to understand the type and amount of fuel needed to meet the State's energy goals. It is important to note that Chittenden County's LEAP scenario reflects 85% renewable by 2050. Although the level of renewability is not 90%, the ECOS Plan is deemed to be consistent with the State energy goals because the policy statements within this plan are aligned with the framework for advancing state energy goals and Chittenden County is well suited to move in the right direction. See the methodology report for more information on LEAP.
- The LEAP model shows a significant reduction in natural gas as one scenario to achieve the ambitious 90% renewable energy by 2050 goal in Chittenden County. This scenario will be challenging because of the region's current reliance on natural gas for heating in significant portions of Chittenden County, recent and planned service area expansions, and the relatively low cost of the fuel source. The natural gas infrastructure in Chittenden County also represents a significant investment on the part of utility companies, and much of the County's dense residential and commercial growth is dependent on this fuel. Therefore, fulfillment of this scenario requires aggressive weatherization of the region's building stock, switching to heat pumps and other renewable heating technologies. The shift to renewable energy sources for heating will also require the involvement of private-sector energy developers, regional and state-wide utilities, and individual energy users; as well as changes to state energy policy implementation. Despite challenges related to natural gas, CCRPC will work to the best of our ability to meet the 90x2050 goal via the actions discussed in Strategy 3.2.2.
- A transition to renewable energy will require electrifying the heating and transportation sectors and by generating more electricity from renewable sources to power these sectors. Chittenden County, perhaps more so than other regions of the State, can achieve great benefits from its density and infill development goals. For example, this land use pattern can lay the ground work for a switch to electric vehicles, carpooling, transit ridership, walking/biking and a smaller energy footprint per household. Dense population centers make distributed generation easier, because energy can be produced near significant numbers of customers. Finally, the county's dense land use pattern may allow for innovative energy solutions, such as district heating and microgrids. Switching home heating away from fossil fuels is a key strategy for meeting our energy goals. Cold climate heat pumps, which use heat from the outside air to heat a home, and biomass systems, such as pellet stoves, are home heating alternatives that do not use fossil fuels.
- Chittenden County citizens, businesses, and industries spent about $617 million on energy in 2009 (25% of Vermont's total). Much of this money leaves the County and state immediately. This outflow of energy dollars acts as a drain on the local economy (data need to be updated).
- The price of energy is forecasted to continue increasing in the future, which will result in an additional burden on the County's residents and businesses, unless energy consumption can be reduced.
- Fossil fuel combustion increases the atmospheric concentration of carbon dioxide and other greenhouse gases, which are the causes of global climate change. Climate change will have profound impacts on the environment, public health, infrastructure, and economy of Chittenden County.
- Vermont, and the County, relies heavily on gasoline and diesel for transportation. Gasoline consumption has increased as more residents drive to and from work, and run errands.

- Chittenden County is home to an international airport and a National Guard base, therefore the transportation fuel consumption in the County not only includes gasoline, diesel, and compressed natural gas, but also aviation gasoline and jet fuel. It is important to note fuel use in the aviation sector was removed from CCRPC's LEAP analysis and modeling of future energy use, as this is a sector the region will have little influence over.

Renewable Energy Generation

- Chittenden County has many non-fossil fuel based, renewable energy production sites owned by utilities, private parties, and municipalities. Reliable, cost effective, and environmentally sustainable energy availability is critical to support the economy and natural resources of Chittenden County.
- Vermont's rural nature offers challenges for the transmission and distribution of energy. It is important to maintain and develop an energy production, transmission, and distribution infrastructure in Chittenden County that is efficient, reliable, cost-effective, and environmentally responsible. Current energy distribution projects include: Extension of 3-phase power in south Hinesburg along VT116 by Green Mountain Power; Extension of natural gas service in Hinesburg up Richmond Road by VT Gas; and Extension of natural gas service to St. George village center. In addition, Burlington's plan to capture "waste heat" from the McNeil power plant and distribute it to the Old North End of Burlington and heat greenhouses at the Intervale is a thermal energy project with a more efficient distribution of a previously wasted energy source. See the CEDS Project list in Section 4.2.6 for cost estimates, funding sources and proposed timelines for these projects. (This will be updated to reflect the completion of some projects)
- The cost of electricity is related to the distance it travels. When electricity is transmitted over long distances, a significant amount of electricity is lost. Improving line efficiency or encouraging distributed generation (such as locally sited small scale renewable projects) reduces losses and could result in more cost-effective rates.
- Every three years, Vermont Systems Planning Committee (VSPC) launches a process to update and identify constrained areas and reliability needs for the electric transmission grid. Chittenden County has areas identified as needing improvement. An adequate distribution grid that is able to accommodate the planned increase in electricity use and reduces energy loss is necessary to meet the goals of this section.
- CCRPC has undergone a process to look at areas suitable for solar and wind energy generation to determine our ability to meet the 90% renewable by 2050 goal. See the key indicators below for an analysis of existing generation and future generation possibilities.
- In 2016, the Vermont Legislature enacted Act 174 to improve energy planning and give town and regional plans greater weight or "substantial deference" in Public Service Board proceedings. The effects of "substantial deference" have yet to be tested in PSB proceedings.

Key Indicators

- **Current energy consumption in the transportation sector, and 2025, 2035 and 2050 targets for consumption.** The table below shows current energy consumption for transportation and sets targets for future consumption in line with the goals of a greater than 1/3 reduction by 2050 and 90% renewable energy by 2050.

Current Transportation Energy Use

Metric	County Data
Fossil Fuel Burning Cars, 2015	106,936
Fossil Fuel Energy Used for Transportation in 2015 (MMBtu)	4,971,503
Electric Vehicles in 2015 (#)	546
Electricity Used for Transportation in 2015 (MMBtu)	4,347
Sources: VTrans, American Community Survey, Drive Electric Vermont, DMV	

Transportation Energy Use, 2015-2050

	2015	2025	2035	2050
Total Light Duty Transportation Energy Use (MMBtu)	7,552,000	6,061,000	3,744,000	1,599,000
Electricity Used for Transportation (MMBtu)	6,000	81,000	543,000	1,124,000
Electric Vehicles (% of Vehicle Fleet)	0%	6%	41%	89%
Biofuel Blended* Energy Used for Transportation (MMBtu)	7,546,000	5,980,000	3,201,000	475,000
Biofuel Blend* Vehicles (% of Vehicle Fleet)	100%	94%	59%	11%
**This measures biofuels blended with fossil fuels. A common example is gasoline with ethanol mixed in.*				
Sources: VTrans, LEAP Model				

- **Current energy Consumption in the heating sector, and 2025, 2035 and 2050 targets for consumption.** The graph below shows current energy consumption for heating (delivered fuels to be added) and sets targets for future consumption in line with the goals of a greater than 1/3 reduction by 2050 and 90% renewable energy by 2050.

Current Thermal Energy Use from Natural Gas, 2015

Total Residential Natural Gas Consumption (Mcf)	3,331,770
Percentage of Municipal Natural Gas Consumption	45%
Total Commercial/Industrial Natural Gas Consumption (Mcf)	4,120,470
Percentage of Municipal Natural Gas Consumption	55%
Total Municipal Natural Gas Consumption	7,452,239
Sources: Vermont Gas	

Commercial and Industrial Thermal Energy Use, 2015-2050

	2015	2025	2035	2050
Total Commercial and Industrial Thermal Energy Use (MMBtu)	3,574,500	3,219,900	2,776,400	2,112,000
Percent of Commercial and Industrial Establishments Weatherized by Target Year	11%	20%	22%	39%
Energy Saved by Weatherization by Target Year (MMBtu)	86,500	189,006	259,783	629,830
Commercial and Industrial Establishments Using Heat Pumps (%)	1%	22%	35%	39%
Commercial and Industrial Thermal Energy Use by Heat Pumps (MMBtu)	6,590	284,318	562,046	839,773
Commercial and Industrial Establishments Using Wood Heating (%)	7%	9%	10%	11%
Commercial and Industrial Thermal Energy Use Attributable to Wood Heating (MMBtu)	266,300	424,000	583,700	854,500
Sources: LEAP Model, Department of Public Service, Department of Labor				

Residential Thermal Energy Use, 2015-2050

	2015	2025	2035	2050
Total Residential Thermal Energy Use (MMBtu)	6,281,000	5,597,000	4,772,000	3,382,000
Percent of Residences Weatherized by Target Year	2%	14%	23%	70%
Energy Saved by Weatherization by Target Year (MMBtu)	41,800	250,800	455,400	1,518,000
Percent of Residences Using Heat Pumps	3%	18%	35%	55%
Residential Thermal Energy Use from Heat Pumps (MMBtu)	62,000	362,000	750,000	1,126,000
Residences Using Wood Heating (%)	14%	14%	14%	13%
Residential Thermal Energy Use from Wood Heating (MMBtu)	982,000	1,029,000	1,035,000	931,000
Sources: LEAP Model, Department of Public Service				

- **Current energy consumption in the electric Sector, and 2025, 2035 and 2050 targets for consumption.** The graph below shows current energy consumption for electricity and sets targets for future consumption in line with the goals of a greater than 1/3 reduction by 2050 and 90% renewable energy by 2050.

Current Electrical Energy Use

Residential Electric Energy Use (kWh)	425,335,425
Commercial and Industrial Electric Energy Use (kWh)	1,483,005,818
Total Electric Energy Use (kWh)	1,908,341,243

Sources: Efficiency Vermont, Burlington Electric Department, 2016

Electrical Energy Use, 2015-2050

	2015	2025	2035	2050
Total Electric Energy Saved (kWh)	9,000,000	107,000,000	216,000,000	404,000,000
Residences that have increased their Electric Efficiency	3%	31%	58%	98%
Commercial and Industrial Establishments that have Increased Their Electric Efficiency	3%	31%	58%	98%

Sources: LEAP Model and Efficiency Vermont, 2013

- **Number of home weatherization projects completed.** To meet the State weatherization target, 70% of Chittenden County homes need to be weatherized by 2050 (47,967 homes out of 68,525). As of 2016, 3,690 homes have completed weatherization through the Home Performance with ENERGY STAR® program.

- **Current Renewable Energy Generation in Chittenden County.** The table below shows solar, wind, hydro, and biomass generation in Chittenden County.

Existing Renewable Electricity Generation

	Sites	Power (kW)	Energy (kWh)
Solar	2,785	40,080	49,806,017
Wind	23	10,460	31,136,031
Hydroelectric	6	35,800	164,136,000
Biomass	14	50,578	266,163,840
Other	0	0	0
Total	2,785	136,918	511,241,888*

Source: Community Energy Dashboard, October 2017
**The total existing renewable energy generation varies from the existing renewable energy generation reported in the Energy Overview due to variations in the way the data is counted.*

- **Renewable Electricity Generation Potential.** The table below shows renewable energy generation potential for rooftop solar, ground mounted solar, and wind. See Map 5-7 and Map 9 for more details on appropriate locations for renewable energy generation development.

Land Available for Wind and Solar Generation

	Prime (acres)	Base (acres)
Solar	9,600	71,706
Wind	4,555	46,142

Renewable Electricity Generation Potential

	Power (MW)	Energy (MWh)
Rooftop Solar	103	126,328
Ground-Mounted Solar	1,168	1,432,176
Wind		N/A
Hydro	See Hydro Map	
Biomass	See Biomass Map	
Methane	Unknown	Unknown
Other	Unknown/District Heat?	Unknown/District Heat?
Source: CCRPC and the Department of Public Service		

- **Renewable Electricity Generation Targets.** The table below shows renewable energy generation targets for ground mounted solar and wind. These targets are set by CCRPC and are aligned with state energy policy and are intended to set trajectories and pace of change needed toward a path of meeting the goal of obtaining 90% of energy from renewable sources. The target for the region assumes that 50% of renewable energy will be generated in-state. The low and high targets are achievable as the County has 9,600 acres of prime solar and 4,555 acres of prime wind. See Map 5-7 and Map 9 for more details on appropriate locations for renewable energy generation development.

Renewable Energy Generation Target	MWh
State Projected Electricity Demand (2050)	10,000,000
In-State Generation Target (2050)	5,000,000
State Imported Generation (2050)	50%
Low Target for Renewable Energy Generation in Chittenden County -15% of State	
Total Target	756,250
Existing Renewable Energy Generation	500,590
New Generation Needed	255,660
High Target for Renewable Energy Generation un Chittenden County -25% of State	
Total Target	1,265,134
Existing Renewable Energy Generation	500,590
New Generation Needed	764,544

Possible Scenario for Achieving the Targets			
	MWh	MW	Acres Needed
Low Target: New Generation by 2050			
75% of Renewable Energy is Land-based Solar	191,745	156	1,251
25% of Renewable Energy is Wind	63,915	21	521
Total	255,660	177	1,772
High Target: New Generation by 2050			
75% of Renewable Energy is Land-based Solar	573,408	468	3,740
25% of Renewable Energy is Wind	191,136	62	1,559
Total	764,544	530	5,299

3.2.2 STRIVE FOR 80% OF NEW DEVELOPMENT IN AREAS PLANNED FOR GROWTH, WHICH AMOUNTS TO 15% OF OUR LAND AREA.

The areas planned for growth are defined as the Center, Metro, Suburban, Village, and Enterprise Planning Areas (all but Rural) as displayed on the Future Land Use Map. CCRPC is committed to annually monitoring the quantity and location of development to measure our progress on concentrating 80% of new growth in these Planning Areas at a regional scale (not each municipality). This goal mimics the development patterns we've seen in the recent past (see Section 2.5.1 Indicators for more detail). CCRPC will monitor this through annual updates of its housing, employment, and commercial/industrial square footage databases and also by the State of Vermont's e911 locational database. The databases identify when a structure was built, number of dwelling units, employees, and square footage at a specific location. The major source of information for updating these databases will be gathered from CCRPC's member municipalities.

Increasing investment in denser, mixed use growth areas will improve economic opportunities, housing options, transportation options and improve community health. Focusing growth in the appropriate planning areas is also a cost-effective approach to increasing the supply of affordable housing and using existing infrastructure efficiently. Also, this pattern of growth reduces energy consumption for transportation. Homes are in closer proximity to jobs and other services, making trips shorter and making travel by walking, biking, transit and carsharing more feasible.

Actions

1. **Invest in Areas Planned for Growth** -

    a. Establish wastewater, water infrastructure and public transit in areas currently developed and/or planned for growth.
    b. Target reuse, rehabilitation, redevelopment, infill, and brownfield investments to the non-rural Planning Areas.
    c. Retrofit existing buildings to reduce energy use and greenhouse gas emissions.
    d. Improve design quality of high density areas, and allow flexibility for creative solutions.

2. **Municipal Planning and Zoning** - Strengthen and direct development toward areas planned for growth through infill development and adaptive reuse of existing buildings through municipal plan and bylaw revisions and state designation programs.

    a. Municipal Development Review Regulations should be revised to improve the mix of uses, shared parking, support for transit, access to a variety of services (for example restaurants, grocery stores, parks, entertainment) via active transportation, energy efficiency, renewable energy and the affordability of housing. A particular emphasis is needed on providing for affordable rental housing.
    b. Integrate capital planning and budgeting in planning efforts to provide the right mix of infrastructure over time. Official maps can also be a useful tool to drive infrastructure improvements in the areas planned for growth.
    c. Health Impact Assessments (HIA) provide a tool to use at the regional, municipal, agency, and organizational level to assure that planning decisions maintain or improve the public health. Access can be improved by co-locating public facilities, in particular, medical and mental health facilities in areas with easy access via active transportation

and public transit. Town health officers should be encouraged to participate in community planning efforts.

d. Empower local officials through trainings and education on strategies to achieve the above plan and bylaw amendments, and implementation of them during development review. This could include how to effectively analyze development costs and benefits, and select appropriate multi-modal congestion mitigation measures.

3. **Affordable Housing** – Producing more affordable housing helps meet basic needs, creates jobs and 50-year hard assets. This is a critical part of the infrastructure of the community and the economy.

    a. Implement incentives that encourage more housing construction that is lower cost including, but not limited to, affordable and supportive housing. This housing should be integrated within our communities throughout the County to provide a mix of housing for different incomes and access to jobs and services. These actions include:
        i. Chittenden County Regional Planning Commission and its partners should study the current and projected shortage of affordable housing units by type (rental, owner, multi-family, single family).
        ii. Increase density in areas planned for growth considering community character and design.
        iii. Revise infrastructure requirements with a goal of reducing costs for developers.
        iv. Consider fee waivers or other development review process incentives.
        v. Continue to work with the University of Vermont, Champlain College and Burlington College to develop specific plans to increase the percentage of students who reside in dedicated student housing.
    b. Maintain or increase local and state resources that fund additional affordable housing, make housing more affordable, and/or maintain existing affordable housing. These actions include:
        i. The state should fully fund the Vermont Housing and Conservation Board with 50% of property transfer tax revenues. This funding should be used to increase the stock of permanently affordable housing in Chittenden County.
        ii. Review and amend (if necessary) local ordinances impacting the maintenance and use of existing buildings to ensure they're encouraging maintenance and retrofits of existing housing stock without adding undue cost.
        iii. Advocate for more Tax Increment Financing (TIF) districts to help fund infrastructure improvements. Encourage the use of municipal housing trust funds to assist in the financing of affordable housing.
        iv. Take steps to preserve existing affordable housing (including protecting subsidized housing and ensuring perpetual affordability through shared equity programs) from being converted to market rate housing; and continue to encourage shared equity for new owner homes.
    c. Engagement and education efforts should continue and be improved. These actions include:
        i. Increase fair housing education and outreach for landlords, property managers, real estate professionals, and anyone involved in the sale, rental or finance of housing. Work with the Vermont Refugee Resettlement Program, The Association of Africans Living in Vermont, Opportunities Credit Union, and other organizations to develop strategies for new Americans to quickly develop credit history. Create educational materials that encourage landlords to use alternative

criteria for new Americans that don't penalize them for a lack of credit or rental history.

ii. Provide fair housing and land use planning training for land use professionals and municipal officials throughout the County.

iii. Train municipal officials and staff, the public, and developers to promote better development practices that achieve a higher level of density with quality design.

d. Increase efforts to comply with fair housing requirements. These actions include:

i. Identify gaps in municipal implementation of State Fair Housing laws and ADA compliance (including but not limited to municipal bylaws should include language that explicitly permits officials to make reasonable accommodations to accommodate the needs of people with disabilities without delay or public input).

ii. The Vermont legislature should enact legislation that limits security deposits to no more than one month's rent with no more than one-half month's rent and no more than $200 for pet deposits (excluding assistance animals for persons with disabilities). For tenants with rent subsidized through public programs, security deposit amounts should be based on the tenant's share of the rent before the application of any utility allowance. These limits do not apply to service deposits for residential care/assisted living settings.

iii. Implement the recommendations (as best as possible within current resource capacities) of the 2010 Burlington Analysis of Impediments and the 2012 State Analysis of Impediments. This includes tracking zoning variances, local permit applications, adjusted residential permit application and denials to identify disparities and trends.

e. Increase enforcement and testing capacity of fair housing organizations such as Vermont Legal Aid. Currently, Vermont Legal Aid is only funded to test the protected classes included in federal fair housing law. Seek funding sources that would allow Vermont Legal Aid to test and enforce state protected classes (Age, marital status, sexual orientation, gender identity, receipt of public assistance).

4. Energy – Transform the Region's energy system to meet the goals of Vermont's energy and greenhouse gas reduction goals.

a. Reduce energy consumption and decrease greenhouse gas emissions, to support the State's goals:

- Reduce greenhouse gas emissions 50% from 1990 levels by 2028,
- Reduce greenhouse gas emissions 75% from 1990 levels by 2050,
- Reduce per capita energy use across all sectors (electricity, transportation and heating) 15% by 2025,
- Reduce per capital energy use across all sectors (electricity, transportation and heating) by more than 1/3 by 2050, and
- Weatherize 25% of all homes by 2020.

i. Continue partnerships with Vermont Gas, Burlington Electric Department, Efficiency Vermont and the State Weatherization Assistance Program to facilitate the weatherization and increased energy efficiency of housing stock and other buildings.

ii. Decrease fossil fuel heating by working with partners such as Efficiency Vermont to educate developers and homeowners on the benefits of technology such as cold climate heat pumps, wood heating and geothermal systems. Examples include district heating (for example, using waste heat from the McNeil Plant to heat buildings in Burlington) and biogas generation (capturing the methane produced by landfills or farms and using it instead of natural gas).
iii. Work with local municipalities and the State to encourage all municipalities to participate in the State's stretch energy code to avoid disincentives for infill development in areas planned for growth.
iv. Reduce fossil fuel consumption in the transportation sector, through the Transportation Demand Management and electric vehicle promotion strategies outlined in Part 6c of this section and in the Metropolitan Transportation Plan (MTP) included in this plan.
v. Collaborate with the State of Vermont and utilities to ensure that state energy policy implementation (i.e. permits for non-renewable fuels) reflect state energy goals and our policies in Section b.
vi. Encourage renewable energy generation to reduce energy costs for publicly owned buildings.
vii. Provide assistance to municipalities to enhance town plans to be consistent with Act 174 standards for the purpose of enabling municipalities the ability to gain substantial deference in the Certificate of Public Good Section 248 process. This assistance will include working with municipalities to identify natural, cultural, historic, or scenic resources to be protected from all development types and identify preferred locations for renewable energy generation facilities.
viii. Use the Energy Action Network (EAN) Community Energy Dashboard to educate residents and municipalities about opportunities to reduce energy use and switch to renewable energy sources.
ix. Support a wide variety of renewable energy generation types, including sustainable uses of biomass for heating, bio-digesters for electricity generation, and optimizing the energy potential for existing hydro-electric dams.
x. Work with the utilities on long-range infrastructure capacity planning.
xi. Support in-place upgrades of existing facilities, including existing renewable energy generation, storage, transmission lines, distribution lines and substations as needed to reliably serve municipalities and the region.
xii. Support changes in federal, state, and local policies to achieve the state of Vermont Comprehensive Energy Plan goals.

b. CCRPC supports the generation of new renewable energy in the County to meet the Vermont Comprehensive Energy Plan's goal of using 90% renewable energy by 2050, in a manner that is cost effective and respects the natural environment. Specifically, Chittenden County needs to generate 756,250 Mwh (Megawatt hours) of energy to meet the low target, or a 51% increase -- and 1,265,134 Mwh to meet the high target, or a 153% increase. The low and high ranges represent two pathways toward meeting the State's 90% renewable goal. The following statements are CCRPC's renewable energy generation facility siting policies and will inform CCRPC's preferred sites policy.

Constraint Policies: Ground mounted renewable energy generation is constrained in certain areas due to state and local restrictions on development.

i. Site renewable energy generation to avoid state and local known constraints and to minimize impacts to state and local possible constraints, as defined in strategies 3.2.3.1.f, 3.2.4.1.e, 3.2.4.2.e.
ii. Site ground-mounted solar development in accordance with setback standards as defined in 30 V.S.A. §248(s) and municipal screening requirements adopted in accordance with 30 V.S.A. §248(b)(B).

Suitability Policies: After considering the constraints referenced above and found in section 4.1.1, different levels of suitability exist for different scales and types of renewable energy generation depending on location within the County. To determine an appropriate location for a facility, first review the constraints above and then look at the polices below to determine how and where CCRPC encourages renewable energy generation facilities. CCRPC encourages the location of renewable energy generation facilities in accordance with the relevant guidelines below. Inability to meet these guidelines does not preclude the ability to develop renewable energy generation development.

i. Locate energy generation proximate to existing distribution and transmission infrastructure with adequate capacity and near areas with high electric load.
ii. Locate renewable energy generation in areas designated by a municipality in an adopted plan for such use, including specific preferred sites for solar (state preferred sites are mapped on Map 5).
iii. Locate solar generation (including but not limited to net metering) on previously impacted areas (such as, parking lots, previously developed sites, brownfields, landfills, gravel pits/quarries, or on or near existing structures).
iv. Locate ground-mounted solar larger than 15 kW AC and wind turbines with a hub height larger than 30 meters outside of state designated village centers, growth centers, downtowns, new town centers, neighborhood development areas, and historic districts on the State or National Register.
v. Locate ground-mounted solar generation, and small-scale wind (1 or 2 turbines, up to 50 meters in Chittenden County's areas planned for growth, while allowing infill development wherever reasonably practical.
vi. Locate wind generation in areas with high wind potential, such as the prime and base wind potential areas shown on Map 7.

4. State/Local Permitting Coordination & Improvement

a. Support changes to the local and state permitting process to make the two more coordinated and effective. Participate in the Agency of Commerce and Community Development's (ACCD) process to improve the State's designation programs designed to encourage development in appropriately planned places and discourage development outside of those areas. This program could be improved with regulatory and/or fiscal incentives. These could include expedited permitting processes for projects in areas that are: a) designated for growth; and, b) where a community has a robust plan, regulations and staff capacity; and reduction of redundancies such as delegation of permitting for certain local and state reviews (such as exemption from Act 250). In conjunction with delegation it may be appropriate to develop more stringent standards and thresholds for development review in rural areas.

b. Collaborate with stakeholders to ensure local and state regulations, bylaws and plans encourage transparency, predictability and timely review of sustainable and environmentally sound development applications.
c. Develop a transportation assessment process that supports existing and planned land use densities and patterns in Center, Metro, Suburban, Village, and Enterprise Planning Areas to allow for more congestion and greater mode choice than allowed by current standards. The CCRPC will collaborate with the Vermont Agency of Transportation (VTrans), the Natural Resources Board, and other state and local stakeholders to develop a process that evaluates the transportation impact from a multi-modal perspective rather than just a traffic flow standpoint.
    - Policies and planning studies that are adopted as part of this ECOS Plan and subsequent amendments will guide CCRPC's position in permit proceedings.

5. Metropolitan Transportation Plan Investments

a. Adequately fund the maintenance and preservation of our existing transportation assets including roads, bridges, rail, transit, walking/biking, park & ride facilities, and transportation demand management (TDM) programs.
b. New transportation system investment should focus on the highest priority transportation projects as detailed in the ECOS/Metropolitan Transportation Plan (MTP) Project List. In the next five years, these projects will primarily be those that are included in the Transportation Improvement Program (TIP), as may be amended.
c. Future transportation investments will support a shift away from single-occupancy vehicle (SOV) trips by focusing on the following areas and programs:
    i. Encourage increased use of public transit by:
        1. Increasing investment in GMT transit services in the county to achieve 20-minute headways for all urban routes (excluding the Link Express) and increase the frequency of weekend services.
        2. Working in cooperation with GMT on their NextGEN Transit and Transit Development Plans to identify new and future opportunities for transit expansion. Integrate park and rides with transit routes; including access to the Montpelier Link at the future Exit 12 Park and Ride.
        3. Invest in transit signal priority technology in partnership with GMT, VTrans and municipalities.
        4. Maximize ridership for public school busses and minimize use of private vehicles for student transport.
    ii. Expand walking and biking infrastructure to support active transportation and to provide interconnection with the region's transit system by:
        1. Implementing the strategies, projects and priorities identified in the 2017 Chittenden County Active Transportation Plan to provide safe and efficient facilities to connect common trip origins and destinations.
        2. Working with municipalities to ensure implementation of complete streets principles through Act 34 of 2011, which requires that the needs of all transportation users, regardless of their age, ability, or preferred mode of transportation be considered, regardless of the project's funding source in state and municipal transportation projects and project phases including but not limited to: planning, design, construction, and maintenance.
        3. Reviewing state transportation projects to ensure that complete streets are implemented.

4. Ensuring that site plans include adequate bike and pedestrian infrastructure and safety measures, through participation in the Act 250 hearing process.
5. Assisting municipalities with scoping of future bike and pedestrian facilities to improve safety, accessibility, efficiency and continuity of the system. Municipalities could use the outcomes of the scoping studies to apply for various VTrans implementation grants.

iii. Expand the deployment of Intelligent Transportation Systems (ITS) to facilitate efficient flow of traffic on the roadway system which will improve safety, reduce delays and congestion, and decrease transportation energy use by improving traffic flows.

iv. Promote Transportation Demand Management and Car Sharing programs:
1. Promote and support the Go! Vermont program that links travelers to a variety of transportation resources and choices and the TravelSmarterVT initiative.
2. Support the continued development and expansion of Chittenden County Park and Ride facilities as recommended in the 2011 Regional Park and Ride Plan.
3. Identify structural barriers to telecommuting such as internet connectivity and speed. STAFF NOTE: Perhaps relocate.
4. Work with the Chittenden Area Transportation Management Association (CATMA) to support employer programs to encourage telecommuting, carpooling, vanpooling, walking, and biking for employee commute trips.
5. Support CarShare Vermont's initiatives.

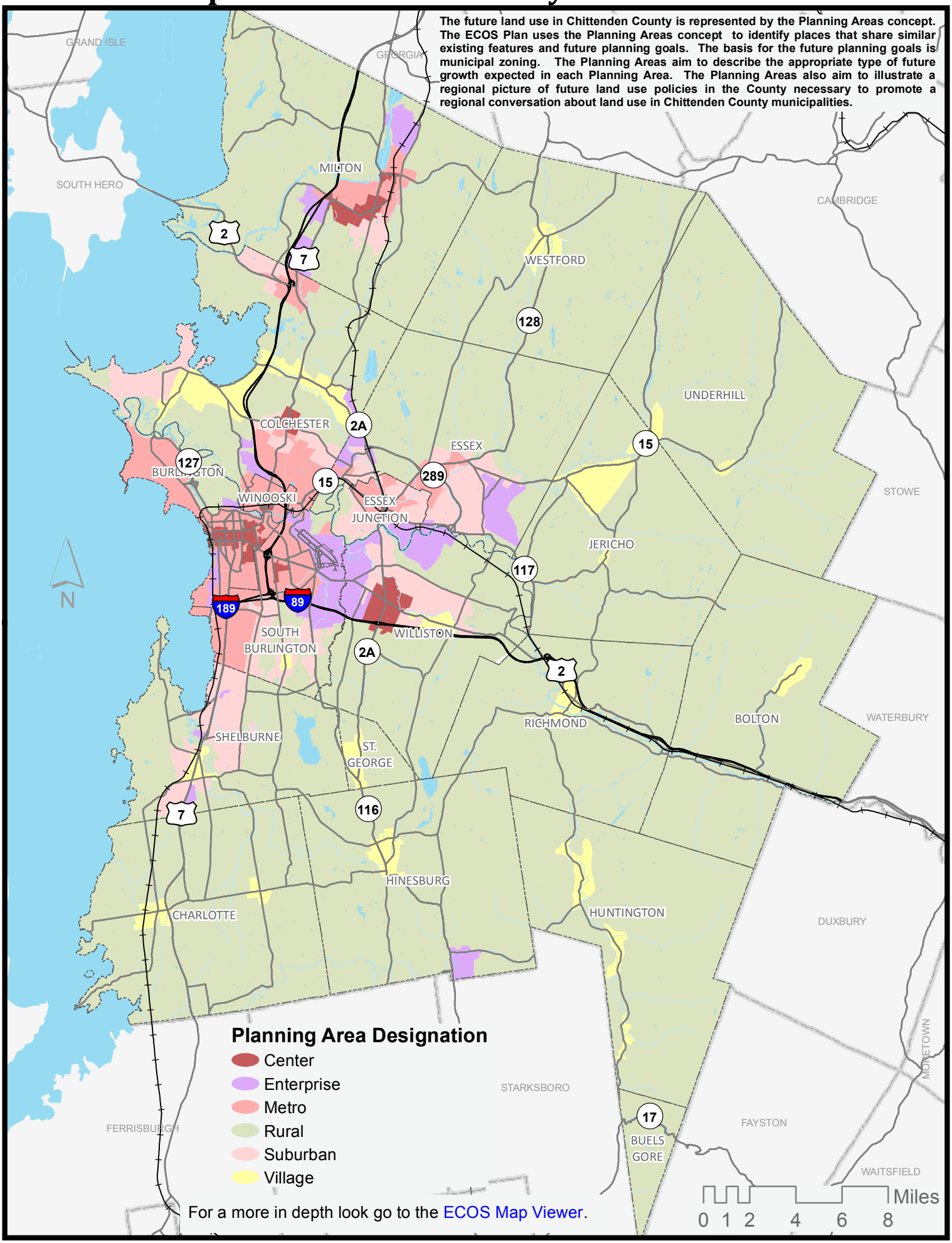
v. Promote a shift away from gas/diesel vehicles to electric or other non-fossil fuel transportation options through the following actions:
1. Work with the Clean Cities Coalition to encourage municipal fleets to switch to biodiesel for heavy-duty vehicles.
2. Work with local employers and nonprofit partners such as the Vermont Energy and Climate Action Network and Vermont League of Cities and Towns to encourage broader implementation of EV incentives, such as free or reduced parking costs for EV and fuel-efficient vehicle owners and preferential access to parking spaces limited in supply.
3. Promote the Drive Electric Vermont webpage, which connects users to financial incentives dealers, and recharging stations for EVs.
4. In partnership with Drive Electric Vermont, Vermont Clean Cities Coalitions and other entities, increase awareness of the benefits of and access to EVs and alternative-fuel vehicles by:
   - Organizing high-visibility events where people can see and test drive EVs, such as county fairs, energy fairs, and summer festivals. Events should also leverage local newspaper and public access coverage to showcase local residents and organizations that are helping to propel the transition to EVs.
   - Encouraging municipalities and other entities that operate fleets to switch a portion of their vehicles to electric or biodiesel-fueled vehicles.
   - Providing technical assistance and support to communities interested in accessing VW diesel settlement funds for EV charging and/or

heavy-duty vehicle replacements according to VT ANR's mitigation plan that will detail eligible activities.

- Assisting with deploying EV Infrastructure at workplaces and key public locations.
- Assessing current access to public and workplace charging (to the extent known) in the community or region and identify strategic locations in busy areas (large employers or areas of high visitation in downtowns) where charging stations should be added or expanded.
- Encouraging electric utilities to invest in charging infrastructure, offer incentives to increase EV ownership, and build awareness of charging opportunities as part of their strategy for complying with the state's Renewable Energy Portfolio Standard.
- Seeking grants to fund the installation of DC fast-charging infrastructure at strategic locations along major travel corridors and in transit hubs such as park and-ride locations and along the Interstate 89 Alternative Fuels Corridor.
- Educating municipalities and providing technical assistance on amending zoning regulations to include electric vehicle charging infrastructure.

d. Support Amtrak and intercity rail travel with our investments in Amtrak stations and the Essex Junction to Burlington line.

Map 2 - Chittenden County Future Land Use



3.2.3 IMPROVE THE SAFETY, WATER QUALITY, AND HABITAT OF OUR RIVERS, STREAMS, WETLANDS AND LAKES IN EACH WATERSHED.

While striving toward all of these ECOS strategies, and particularly Strategy #2 – 80% of growth in 15% of our land area, it is essential to do so in such a way that we do not impair our essential water resources (including potable water) and that we prepare ourselves for the impacts of a changing climate.

1. **River Hazard Protection** – Develop and implement adaptation strategies to reduce flooding and fluvial erosion hazards. While supporting planned growth, ensure that growth is evaluated in terms of preparedness for a changing climate. Chittenden County will continue its efforts, along with the municipalities, to avoid development in particularly vulnerable areas such as floodplains, river corridors, wetlands, lakeshore and steep slopes; protect people, buildings and facilities where development already exists in vulnerable areas to reduce future flooding risk; plan for and encourage new development in areas that are less vulnerable to future flood events (see Section 3.2.2); and implement stormwater management techniques to slow, spread and sink floodwater (see the Non-Point Source Pollution section below).
    a. Identify problem locations - Conduct on the ground inventories and map flow and sediment attenuation locations and problematic infrastructure (undersized culverts, eroding roadways, "vulnerable infrastructure" - infrastructure subject to repeat damage and replacement, etc.).
    b. Revise bridge/culvert designs - Revise public works and zoning ordinances with culvert and bridge design specifications that allow for wildlife passage and movement of floodwater and debris during high intensity events. Implement culvert and bridge designs that produce stable structure in river channels (i.e. fluvial geomorphology).
    c. Protect river corridors– Existing bylaws protect the majority of Fluvial Erosion Hazard (FEH) areas with stream setbacks and floodplain regulations. Work with ANR to get the FEH data incorporated into the River Corridor Protection Area maps. Work with municipalities and ANR to improve bylaws to protect the River Corridor Protection Areas or River Corridors not currently protected and enforce these bylaws. Continue protection of river corridors including non-regulatory protection measures such as stream re-buffering, river corridor easements on agricultural lands, river corridor restoration and culvert and bridge adaptation.
    d. Support non-regulatory conservation and/or preservation of vulnerable areas through public and land trust investments, including identification of repetitively damaged structures and provide assistance to elevate, relocate or buy out structures, and identify where flood storage capacity may be restored and conserved.
    e. Participate in the development and implementation of the Lamoille, Winooski and Direct to Lake Tactical Basin Plans. CCRPC will work with the State, municipalities and other partners to address river hazard protection, flood resiliency and water quality through these Plans – including prioritizing projects for funding.
    f. To protect water quality, development should be located to avoid state and local known constraints that have been field verified, and to minimize impacts to state and local possible constraints that have been field verified.
        i. State and Local Known Constraints, as protected by municipalities and State agencies, are shown on Map 9 and include the following: DEC River Corridors,

FEMA Floodways, and Municipal Water Quality Setbacks, Local Known Constraints – see table in Section 4.1.1.

ii. State and Local Possible Constraints are shown on Map 9 and include the following: FEMA Special Flood Hazard Areas and hydric soils, Local Possible Constraints – see table in Section 4.1.1.

2. **Non-point Source Pollution** - While we have addressed point sources of pollution, non-point sources are still contributing pollutants to our water bodies.
    a. Assemble data – Work from existing data collected and further identify the locations that are contributing to water quality pollution such as flow, sediment, pathogen and nutrient. Where needed, conduct on-the-ground inventories of water quality and biological assessments (in-stream), wetlands, sub-watersheds, river corridors (buffered or not) and geomorphology. Map the existing and new data on one regional map.
    b. Revise Plans and Bylaws and Ensure Enforcement -- Incorporate the above data into municipal plans; establish specific statements that protect these resources; develop clear standards for how to protect these resources within zoning regulations; and initiate on-going enforcement of the regulations. Encourage low impact development techniques, and shared storm water control programs to maximize land development in areas planned for growth. Incentivize best management practices for agricultural uses; and encourage the Agency of Agriculture to better enforce their required agricultural practices. In addition, EPA's DRAFT Lake Champlain Total Maximum Daily Load (TMDL) for phosphorus, Vermont's Phase 1 TMDL Implementation Plan, and the Vermont Clean Water Act (2015 Act 64) have established a variety of regulatory programs to address phosphorus reduction. CCRPC will work with the municipalities and other partners to implement these programs: Municipal Roads General Permit, Phosphorus reduction integration into the existing MS4 permit, and Developed Lands (3 or more acres of impervious). See Chittenden County's Work Plan and the 2016 All Hazard Mitigation Plan (in development) for more detail on these actions.
    c. Implement Non-regulatory approaches - Identify and implement non-regulatory approaches to nutrient, pathogen and sediment pollution management. Under new MS4 permit requirements, municipalities will be developing flow restoration plans to achieve the total maximum daily load requirements for impaired streams, rivers, and Lake Champlain. These plans may require additional public investment in storm water facilities or investments or actions by individual property owners. Support watershed organizations.

3. **Wastewater Treatment Plant Upgrades** – The non-point sources have been identified as the largest contributors of phosphorus to Lake Champlain, and therefore Vermont's August 2015 *Draft* Lake Champlain Phosphorus TMDL Phase I Implementation Plan, does not allocate any additional phosphorus reductions to wastewater treatment plants in the Lake Champlain basin. However, EPA's *Draft* Phosphorus TMDLs for Vermont Segments of Lake Champlain, dated August 14, 2015, does include reductions at some of the County's wastewater treatment plants as identified in Table 9 of that document. These treatment plants are listed in the ECOS Project List (see Section 4.2.6). To provide further context to the treatment plants on this list, here is further information from EPA's Phosphorus TMDL:

"*The currently permitted WWTF [wastewater treatment facility] contributions in [the Main Lake, Shelburne Bay and Burlington Bay] segments ranges from 16 to 97% of the total segment base load and should be reduced. EPA has made WWTF waste load allocations [WLA] equivalent to setting the phosphorus limit at 0.2 mg/l at design flow for the 17 facilities with flows greater than 0.20 MGD. Those facilities [in Chittenden County] are: Burlington East, Burlington Main, Burlington North, Essex Junction, Hinesburg, Global Foundries, Shelburne #1 and #2, Richmond, South Burlington Airport Parkway, South Burlington Bartletts Bay, and Winooski. [Some] of these facilities have recently made upgrades or have the ability to make process improvements that would enable them to meet permit limits consistent with the new allocations without major construction upgrades. [Within Chittenden County] these include, Essex Junction, South Burlington Airport Parkway, Shelburne #1 and #2, and South Burlington Bartlett Bay….There are two exceptions to this general approach. The 2002 WLAs for Weed Fish Culture Station and Burlington Electric were lower than a limit equivalent to 0.2 mg/l at design flow. The more stringent 2002 allocations have been retained and are already reflected in the permit limits for these facilities.*" EPA's Phosphorus TMDLs for Vermont Segments of Lake Champlain August 14, 2015, page 31.

4. Support and promote the use of more holistic, less chemical dependent and less energy intensive effluent management efforts whenever possible (for example, composting toilets, localized grey water systems, passive grey water and black water septic systems, rain water harvesting and storage, etc.)

3.2.4 INCREASE INVESTMENT IN AND DECREASE SUBDIVISION OF WORKING LANDS AND SIGNIFICANT HABITATS, AND SUPPORT LOCAL FOOD SYSTEMS.

1. **Habitat Preservation** - Protect forests, wetlands and agricultural lands from development, and promote vegetative landscaping in urban areas in order to maintain natural habitats, natural storm water management and carbon sequestration. This will keep people and infrastructure out of harm's way and allow for natural flood attenuation areas.
    a. Inventory - Conduct on the ground surveys and inventories of significant habitats (include wetlands), connectivity corridors, scenic resources and locations of invasive species and map this information. Incorporate this data into municipal and regional plan text and maps and establish specific policies that address and protect these resources.
    b. Municipal Development Review Regulations - Develop clear definitions of the resources to be protected and establish standards to describe how to protect these resources within zoning and subdivision regulations.
    c. Education - Educate engineers, developers, real estate professionals, planners and the public regarding resources and methods for restoration and protection.
    d. Non-regulatory Protection - Support non-regulatory conservation and/or preservation through public and land trust investments. Establish invasive plant removal management plans, implement the plans and include long-term monitoring.
    e. To protect significant habitats, development should be located to avoid state and local known constraints that have been field verified, and to minimize impacts to state and local possible constraints that have been field verified.
        - State and Local Known Constraints, as protected by municipalities and State agencies, are shown on Map 9 and include the following: State - significant natural communities and rare threatened and endangered species, vernal pools (unconfirmed and confirmed), and Class 1 and Class 2 Wetlands, Local Known Constraints – see table in Section 4.1.1.
        - Possible State and Local Constraints, as protected by municipalities and State agencies, are shown on Map 9 and include the following: Protected Lands (state lands in fee simple ownership and privately conserved land), deer wintering areas, the Agency of Natural Resources Vermont Conservation Design Highest Priority Forest Blocks, Local Possible Constraints: – see table in Section 4.1.1.

2. **Working Lands Implementation** – To preserve the soul of Vermont, as well as move forward into the future with resiliency, Vermont needs to protect the farmland and forestland we have and support existing and new operations (including, but not limited to, un-intensive urban and suburban home gardens and mini-homesteads). Support implementation of the Farm to Plate Strategic Plan and the VT Working Landscape Partnership Action Plan.
    a. Municipal Development Review Regulations - Develop clear definitions of working lands to be protected and establish zoning and subdivision standards to describe how to protect these areas from development so that they may be retained and

accessible as “working” lands. Maintain access and scale of working lands to ensure viability after subdivision in the rural landscape (including but not limited to protection of log landings of previously logged forested parcels, zoning techniques such as fixed area ratio zoning to separate lot size from density, conservation zoning and homeowners association bylaws that allow for farming on the open space lots, etc.); while promoting urban agriculture in areas planned for growth. While farming is generally exempt from municipal zoning, some structures such as farm houses, processing facilities, the generation of energy for on-farm use, and on-farm retail and related enterprises may be regulated. The economic viability of farm enterprises can often depend on these facilities so municipal regulation should not impede reasonable farm related improvements.

b. Infrastructure & Systems – support establishment of food processing industries, value-added product markets, workforce training, etc to help support the viability of these industries.
c. Support non-regulatory conservation and/or preservation through public and land trust investments (including but not limited to municipal land conservation funds).
d. Work with farmers and the Farm to Plate Initiative to balance this plan’s goals of a strong local food system and increased production of renewable energy.
e. To preserve working lands, development should be located to avoid state and local known constraints that have been field-verified, and to minimize impacts to state and local possible constraints that have been field-verified.

- Possible State or Local Constraints, as protected by municipalities and State agencies, are shown on Map 9 and include the following: Agricultural soils and Act 250 agricultural soil mitigation areas, and local constraints listed in Section 4.1.1.

3. **Earth Resources Extraction -** Mineral extraction and processing facilities, including smaller private extraction operations existing to support agricultural operations, should be planned, constructed, and managed, in conjunction with State and local regulations, to:

a. Not place an excessive or uneconomic burden on local and state highways and bridges – including but not limited to a burden to the function and safety of existing roads and bridges serving the project site, strain from heavy loads on roadbeds and bridges, conflicts with pedestrians or bicyclists and increased heavy traffic in dense residential areas; and
b. Minimize any adverse effects on water quality, fish and wildlife habitats, and adjacent land uses; and
c. Plan for their eventual rehabilitation so that slopes are stable and the surface is revegetated with a variety of native species to support a wide range of biodiversity. To that end, topsoil should not be removed from sites and excavations should stop early enough so that stable slopes can be established on the property; and
d. Extraction sites should be screened to the extent practical if topography and vegetation allow.

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

These maps do not take the place of site-specific investigation for a proposed facility and should not be used as "siting maps". This map does not take all regulations into account and automatically prohibit or allow renewable energy generation and replace the detailed process a developer must go through to propose a site for a renewable energy facility. This map shall not be used without the accompanying policies contained within the Chittenden County ECOS Plan.

Milton
Westford
Underhill
Colchester
Essex
Burlington
Winooski
Essex Junction
Jericho
South Burlington
Williston
Shelburne
St. George
Richmond
Bolton
Hinesburg
Charlotte
Huntington
Buels Gore

2 7 127 2A 15 289 128 117 89 116 17

State and Local Development Constraints

Legend

- State Known Constraints
- State Possible Constraints
- Local Known Constraints
- Local Possible Constraints

ECOS Plan Policy:Development should be located so as to avoid state and local known constraints that have been field verified and to minimize impacts to state and local possible constraints which have also been field verified.

0 1.25 2.5 5 7.5 10 Miles

N

State Known Constraints
Vernal Pools; VCGI, 2017
DEC River Corridors;VCGI, 2017
FEMA DFIRM Floodways;VCGI,2017
RTE + Sig.Natural Comm;VCGI,2017
Wetlands;VSWI Wetlands Class Layer,

State Possible Constraints
Agricultural Soils; VCGI, 2017
FEMA Special Flood Hazard Areas; VCGI, 2017
Protected Land; VCGI
Act 250 Mitigation Areas; VCGI, 2017
Deer Wintering Areas; VCGI, 2017
Priority Forest Blocks,Vermont Conservation Design
Hydric Soils; VCGI, 2017
Local Known and Possible Constraints, CCRPC and Municipalities

Document Path: D:\Projects17\Act174\Maps\County\Act174EnergyMap_Constraints_20171030.mxd

DRAFT

Map 9: Natural System Areas

4.1.1 ECOS PLAN POLICIES & MAPS

For the purposes of complying with VT Statute (24 VSA 4348a), the ECOS Plan's goals in Chapter 2 serve as the policy statements, and the maps are located throughout this document and online (more detail about the maps can be found below). These goals were influenced by analysis reports, data, sub-committee expertise and public participation efforts. The strategies and actions described in Chapter 3 will help CCRPC, member municipalities and partners reach the desired goals. CCRPC deliberately chose to make the 2013 ECOS Plan a strategic plan that is intended to provide **general advisory guidance** and intentionally chose to use "should", rather than shall, in the Plan's goal statements.

ECOS Plan Maps

The following ECOS Plan maps can be found within the Plan itself:

- Map 1 - Economic Infrastructure (located in Section 3.2.1)
- Map 2 - Future Land Use (located in Section 3.2.2)
- Map 3 - Utility and Facilities (located in Section 3.2.2)
- Map 4 – Future Transportation Improvements (located in Section 3.2.2)
- Map 5 – State Preferred Sites for Solar Generation
- Map 6 – Solar Generation Potential
- Map 7 – Wind Generation Potential
- Map 8 - Water Quality and Safety (located in Section 3.2.3)
- Map 9 - Natural Systems/Development Constraints (located in Section 3.2.4)
- Map 10 - Opportunity and Race (located in Section 3.2.8)

Don't change these yet, because these will all change in the MTP I'm sure. And we don't need them for tomorrow.

- Map 8 – 2013 Metropolitan Transportation Systems Map (located in Section 4.3.1)
- Map 9 – 2006-2010 High Crash Locations-Intersections (located in Section 4.3.2
- Map 10- 2006-2010 High Crash Location –Segments (located in Section 4.3.2)
- Map 11 – Transportation Corridors (located in Section 4.3.5)

The maps included in the ECOS Plan are limited illustrations of the underlying datasets that reside in CCRPC's Geographic Information System (GIS) and are intended to provide a general overview of future and existing conditions. The accuracy of information presented in the maps is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. These maps are not sufficient for delineation of features on-the-ground. These maps identify the presence of features, and may indicate relationships between features, but are not a replacement for surveyed information or engineering studies. More detail of the mapped data can be accessed through the ECOS Online Map (http://maps.ccrpcvt.org/ChittendenCountyVT/). Map updates will be incorporated into the online map as data is available and time allows. Once a year, a thorough examination of available data will be conducted. The ECOS Online Map contains data which helped to inform the regional analysis and is presented in four categories: Built Environment, Social Community, Economic Infrastructure, and Natural Systems. The ECOS Online map is a data viewer that allows a user to locate their area of

interest and control the display of various layers. A user can see data at the County level as well as at the address level. The ECOS Online Map essentially enables unique creation and printing of individual maps through the Internet.

Map 1- Economic Infrastructure Map

The Economic Infrastructure Map identifies areas within the County that are appropriate for commercial and industrial uses, per municipal zoning regulations. These uses exist throughout the County and include warehouses, manufacturing, office buildings, hotels, retail stores, medical buildings, and auto sales. This map also shows whether the areas zoned for commercial and industrial uses are within the sewer service area.

Map 2 - Future Land Use Map

The future land use map identifies the location and boundaries of the Chittenden County Regional Planning Areas as described below.

Planning Areas

The ECOS Plan uses the Planning Areas concept to identify places that share similar existing features and future planning goals. The Planning Areas reflect current municipal zoning. In addition, the scenario exercise described in Section 3.1 showed public support for growth in line with these Planning Areas. The Planning Areas aim to describe the appropriate type of future growth expected in each Planning Area; however the exact uses and densities allowable are determined by local ordinances. The Planning Areas also aim to illustrate a regional picture of future land use policies in the County necessary to promote a regional conversation about land use in Chittenden County municipalities. The six Planning Areas are depicted on the Future Land Use Plan Map. They are Center, Metro, Suburban, Village, Rural, and Enterprise.

Center Planning Areas are intended to be regional centers or traditional downtowns that serve the County and beyond and contain a mix of jobs, housing, and community facilities. Center Planning Areas also contain the County's highest density and largest-scale developments with residential densities generally ranging from 7 to more than 60 dwelling units per acre. Center Planning Areas may contain a state designated New Town Center, Growth Center, Tax Increment Financing District, or high density Village Center. Development in downtown centers primarily happens through infill development of underutilized vacant land and adaptive reuse of older structures whereas, development in municipal growth centers occurs in targeted areas that will accommodate future anticipated growth. These land uses are locally planned and managed to coexist successfully with neighborhoods and natural areas. Places within Center Planning Areas are served by wastewater facilities, other infrastructure, and offer a variety of transportation options, including non-motorized modes

Metro Planning Areas are areas where local zoning authorizes places to accommodate jobs and housing in a compact development pattern that supports transit service and encourages pedestrian activity and are within the sewer service area. Commercial land uses found in the Metro Planning Area are intended to serve the nearby residential area. Existing densities within Metro Planning Areas are typically higher than those found in the Suburban, Rural, Village, and Enterprise Planning Areas and generally range between 4 and 20 dwelling units per acre. Future development in the metro area should be encouraged to occur at the higher end of this range to ensure that there are adequate housing and jobs in these areas.

Suburban Planning Areas are areas near a Center Planning Area, Metro Planning Area, Village Planning Area, or Enterprise Planning Area where local zoning authorizes future development to occur at scales, densities, and uses compatible with existing development and with general residential densities greater than 1 and less than 4.5 dwelling units per acre. Many parts of the Suburban Planning Area already have been developed, often in suburban styles of development and are predominantly within the sewer service area. Future development and redevelopment in this Planning Area should be publicly sewered, minimize adverse impacts on natural resources, and protect strategic open space.

Enterprise Planning Areas are areas where local zoning authorizes a future concentration of employment uses that attract workers from the County and multi-county region. Development in these Planning Areas should have adequate wastewater capacity and access to transit or be near these services. Typically, this area encompasses major employers or a cluster of single employers and has current or planned transit service.

Village Planning Areas are areas where local zoning authorizes a variety of future residential and nonresidential development at densities and scales in keeping with the character of a Vermont village, generally between 2 and 12 dwelling units per acre if sewered and between 0.2 and 4 units per acre if not sewered. Village Planning Areas are compact areas of mixed-use activities that maintain the character of a Vermont village. This type of Planning Area is intended to serve its local surroundings as a place where people can live, work, shop and recreate.

Rural Planning Areas are areas where regional and town plans promote the preservation of Vermont's traditional working landscape and natural area features. The Rural Planning Area also provides for low density commercial, industrial, and residential development (generally 1 dwelling unit per acre or less) that is compatible with working lands and natural areas so that these places may continue to highlight the rural character and self-sustaining natural area systems. Development in the rural planning areas is typically outside the sewer service area.

Map 3 – Existing Utilities and Facilities

The Utilities and Facilities Map shows the existing sewer service area, the water supply district, solid waste facilities, natural gas service area, and cellular towers.

Map 4 - Future Transportation Improvements

The Future Transportation Improvements Map gives an overview of the projects that fit within the funding constraints identified in the ECOS project list in Section 4.3.6 of the ECOS Plan. These future improvement projects create a multimodal strategy to address the efficient and long term movement of people and goods, while respecting ECOS goals. For a complete overview of proposed transit investments refer to the 2010 CCTA Transit Development Plan.

Map 5 – Preferred Sites for Solar Generation

This map will show the location of legislatively-identified preferred sites:

Preferred sites as defined by the State of Vermont include:

- Rooftops and other structures
- Parking lots
- Previously developed sites
- Brownfields

- Gravel pits
- Quarries
- Superfund sites

Map 6 and Map 7 – Solar Generation Potential and Wind Generation Potential

These maps combine GIS analysis of either solar generation potential, or wind generation potential, respectively, with state and local identified *known* and *possible* constraints. The maps and corresponding data are intended to be used to inform energy planning efforts by municipalities and regions, and provided a basis for CCRPC to estimate solar and wind generation potential and municipal and regional ability to meet the generation targets. For more information on the methodology used to determine solar generation potential, please visit http://www.vtenergyatlas-info.com/solar/methodology; and for wind generation potential please visit http://www.vtenergyatlas-info.com/wind/methodology. For more information on the constraints, see the discussion of Map 6.

Areas with state and local identified constraints are removed from the Generation Potential maps completely, leaving:

1. Prime Solar or Wind Areas: areas with generation potential and no local or state constraints, and
2. Base Solar or Wind Areas: areas with generation potential and possible local or state constraints.

The accuracy of information presented in this map is limited due to scale and the accuracy of the original data source. Errors and omissions may exist, including in the analysis of whether a site has generation potential to begin with.

Map 8 - Water Quality and Safety Map

The Water Quality and Safety Map illustrates the level of impairment for streams and lakes based on the Vermont Department of Environmental Conservation 303d List and the 2012 List of Priority Surface Waters. Additionally, it shows the location of wetlands, fluvial erosion hazard areas, special flood ways, and the 500 year flood hazard area.

Map 9 - Natural Systems Map

The Natural Systems Map depicts sensitive and protected areas in the County. The resources included on the map are described within two categories: known constraints, and possible constraints. Development should be located so as to avoid state and local known constraints, and to minimize impacts to state and local possible constraints. Constraints are based on statewide or local policies that are currently adopted or in effect. As with all maps included in the ECOS Plan, the map of constraints is intended to provide a general overview of existing conditions. The accuracy of information presented in the maps is limited due to scale. Errors and omissions may exist. These maps are not sufficient for delineation of features on-the-ground. To determine whether a site has constraints, surveyed information, engineering studies or other site-specific information will likely be necessary.

Local Known and Possible Constraints (as of 10/29/2017)

Bolton	Burlington	Charlotte	Colchester
Known Constraints: • Surface Water Buffers • Wetland Buffers **Possible Constraints:** • Conservation District • Slopes 15% or more • Forest District • Town Owned Land • Flood Hazard Overlay II	**Known Constraints:** none identified **Possible Constraints:** • Historic Districts, Historic Neighborhoods (Eligible for Listing) • Mixed Use, Institutional Core Campus and Enterprise Zoning Districts • Designated Downtown and Neighborhood Development Area 5. Official Map Features • View Corridors Burlington Country Club property • City-owned parks and Centennial Woods	**Known Constraints:** none identified **Possible Constraints:** • Shoreland Setback and Buffer Area • Surface Waters, Wetlands, and Buffer areas • Flood Hazard Areas • Special Natural Areas • Wildlife habitat • Historic Districts, Site, and Structures • Slopes greater than 15% • Land in Active Agriculture • Water Supply Protection • Scenic Views 11. • Significant Wildlife Habitat	**Known Constraints:** • Slopes 20% or greater • Wetlands and Surface Water Buffers **Possible Constraints:** • Shoreland Overlay District
Essex	**Hinesburg**	**Jericho**	**Milton**

Known Constraints: • Slopes Higher than 20% **Possible Constraints:** • Scenic Resource Protection Overlay District • Resource Protection District • Slopes 15%-20% • Core Habitat • Habitat Blocks	**Known Constraints:** • Slopes Higher than 25% **Possible Constraints:** • Slopes (15-25%) • Core Habitat • Village Growth • Area • Industrial Zoning District	**Known Constraints:** • Well Protection Area • Overlay District • Natural Areas • Natural Communities • Primary Conservation Areas **Possible Constraints:** • Secondary Conservation Areas • Village Centers	**Known Constraints:** None identified **Possible Constraints**: • Town Forest and Municipal Natural and Rec Areas w/Management Plans • Habitat Blocks 8-10 • Encumbered Open Space

Shelburne	South Burlington	Underhill	Westford
Known Constraints: None identified **Possible Constraints:** • Significant View Areas • Lakeshore Buffer • Archeologically Sensitive Areas (not mapped)	**Known Constraints:** Wetlands and buffer **Possible Constraints:** • Source Protection Area • Zone 1 • Habitat Blocks • Riparian Connectivity • Slopes 20% or greater • SEQ Natural Resource Protection Area	**Known Constraints:** • Above 1,500 ft. Elevation **Possible Constraints:** • Slopes 15% or greater • Mt. Mansfield Scenic Preservation District • Wetlands and associated buffers, Surface Waters and buffers • Above 1,500 ft. Elevation	**Known Constraints:** • Slopes 25% or greater • Deer Wintering Areas • Ledge Outcropping • Flood Hazard Overlay • Water Resources Overlay **Possible Constraints:** None identified

Williston	State	State
Known Constraints: • Water Protection Buffers • Primary Viewshed Areas **Possible Constraints:** • Slopes 15% or more • Conservation Areas/Natural Communities	**Known Constraints** • FEMA Floodways • DEC River Corridors • National Wilderness Areas • State-significant Natural Communities and Rare, Threatened, and Endangered Species • Vernal Pools (confirmed and unconfirmed) • Class 1 and 2 wetlands (VSWI and advisory layers)	**Possible Constraints** • Agricultural Soils + Hydric Soils • Act 250 Ag. Soil Mitigation Areas • FEMA Special Flood Hazard Areas • VT Conservation Design Highest Priority Forest Blocks • Protected Lands (State fee lands and private conservation lands) • Deer Wintering Areas

Map 10 - Opportunity and Race Map

The Opportunity and Race Map combines an opportunity index, developed by the U.S. Department of Housing and Urban Development, with U.S. Census data on race. The purpose of this map is to show levels of opportunity in areas where there are the highest concentrations of racial minorities. HUD has developed a process for analyzing opportunity at the Census Tract level. The opportunity index includes data on poverty rate, school proficiency, homeownership rate, unemployment, and job access. Each tract is ranked relative to the others in the county. Tracts that are low opportunity typically have a higher proportion of rental housing, people receiving public assistance, lower school scores, and more unemployment in comparison to other areas. Opportunity mapping is a way to see where to target investments to address disparities in the County.

Map 11 - 2013 Metropolitan Transportation Systems Map

The Metropolitan Transportation Systems Map represents the present transportation network. The Metropolitan Transportation System is the multimodal network of highways, arterial and major collector roadways, transit services, rail lines, bicycle paths, sidewalks, Burlington International Airport, and other inter-modal facilities critical to the movement of people and goods in the region.

Map 12 - 2006-2010 High Crash Locations-Intersections

The High Crash Locations at Intersections Map depicts where the rate of crashes exceeds a threshold known as the critical rate. Locations are ranked by calculating a ratio between the critical rate and actual rate.

Map 13 - 2006-2010 Crash Locations-Segments

The High Crash Locations of Segments Map depicts where the rate of crashes exceeds a threshold known as the critical rate. Locations are ranked by calculating a ratio between the critical rate and actual rate.

Map 14 - Transportation Corridors

The Transportation Corridors Map represents the locations of the corridors where projects, programs, and strategies are implemented within Chittenden County's transportation system.

4.1.2 ACT 250, SECTION 248 & SUBSTANTIAL REGIONAL IMPACT

In accordance with 24 VSA § 4345a(17) a regional planning commission shall, as part of its regional plan, define a substantial regional impact, as the term may be used with respect to its region. This definition shall be given due consideration, where relevant, in state regulatory proceedings. Those proceedings are:

1. Act 250 – Certain proposed developments are required to obtain a permit from one of Vermont's nine District Environmental Commissions in order to establish that the proposed development will satisfy 10 criteria defined by Act 250 (10 VSA §6086). One of these 10 criteria is that the proposed development be "in conformance with any duly adopted local or regional plan or capital program."

2. Section 248 – Certain proposed utility facilities are required to obtain a permit from Vermont's Public Service Board to establish that the proposed facility will satisfy criteria defined by Section 248 (30 VSA §248). One of the Section 248 criteria is that the proposed facility will "not unduly

interfere with the orderly development of the region with due consideration having been given to the recommendations of the municipal and regional planning commissions."

3. In addition, the Secretary of the Agency of Natural Resources may not issue a new Solid Waste Management Facility Certification (10 VSA §6605(c)) unless the facility is "in conformance with any municipal or regional plan adopted in accordance with 24 VSA Chapter 117."

In accordance with 24 VSA §4348 (h), in the above three proceedings, in which the provisions of a regional plan or a municipal plan are relevant to the determination of any issue in those proceedings, the provisions of the regional plan shall be given effect to the extent that they are not in conflict with the provisions of a duly adopted municipal plan. To the extent that such a conflict exists, the regional plan shall be given effect it if is demonstrated that the project under consideration in the proceedings would have a "substantial regional impact." **That is, the issue of whether a proposed development has a "substantial regional impact" is important only when there is a conflict between the regional plan and municipal plan.** CCRPC will attempt to reduce the potential for such conflicts through its municipal plan review and approval process.

The following is the required definition of "substantial regional impact," as this term is to be used with respect to Chittenden County:

A proposed development has a substantial regional impact if it is not consistent with the Future Land Use Policy (Strategy 3.2.2) and associated Map 2 of this Regional Plan.

This definition puts the emphasis on the Planning Areas – and stipulates that if a development proposal is not consistent with the Planning Areas, then the Regional Plan will take effect in the State proceedings (as described above) if there is a conflict between the regional plan and the municipal plan. The Planning Areas form the basis for the appropriate areas for growth in the next 20 years as shown in the Future Land Use Plan.

The Planning Areas are consistent with current municipal plans and zoning, so only developments that are NOT consistent with municipal zoning and the planning area definitions would likely prompt the SRI definition. Further, developments that push beyond these defined areas are more likely to have a significant impact on our region, than developments within the defined areas for growth. Upon request by a municipality to make a change to the Planning Areas as a result of a municipal plan, zoning and/or infrastructure service area change, CCRPC will review the request for consistency with the Planning Area definitions prior to any action.

The CCRPC has a role in development review outside of the very limited circumstances in which the substantial regional impact definition will come into play. RPCs "shall appear before district environmental commissions to aid them in making a determination as to the conformance of developments and subdivisions with the criteria of 10 VSA § 6086" (24 VSA § 4345a(13)). Both Act 250 and Section 248 require the permit applicant for a project that is proposed to be located in Chittenden County to submit a copy of the application to CCRPC. CCRPC is a party in any such application for an Act 250 permit and may apply to be a party in any such application for a Section 248 permit.

CCRPC's current policy, Guidelines and Standards for Reviewing Act 250 and Section 248 Applications, guidesits participation in the permit review procedures of Act 250 and Section 248. Currently under this interim policy:

- CCRPC's Executive Committee considers whether an applicant's proposal is in conformance with the Regional Plan, with specific attention given to the Planning Areas of this Plan (for the same reasons described above for the SRI definition), and the criteria dealing with traffic and other criteria within CCRPC's expertise.

- Staff initially reviews each Act 250 application (with specific attention given to those applications going to a hearing as the FY13 CCRPC contract with the Agency of Commerce and Community Development requires that the CCRPC review and comment on Act 250 and Section 248 applications if a hearing is held).
- CCRPC staff will discuss potential Act 250 and Section 248 projects with Planning and Zoning staff and members of the Planning Advisory Committee to identify emerging development proposals to assess their conformance with the Regional Plan. The intent is that this proactive, collaborative approach attempts to work out any concerns about Act 250 and Section 248 applications prior to their submission.

The Planning Advisory Committee may recommend to the CCRPC revised procedures for participation in Act 250 and Section 248 proceedings in order to better achieve the goals of this Chittenden County 2013 ECOS Plan. These revisions will be established through formal amendments to the *Guidelines and Standards for Reviewing Act 250 and Section 248 Applications*, and if appropriate, as amendments to this Plan as well. Changes in the review of transportation impacts and CCRPC policies will be coordinated with VTrans and the District Environmental Commission as appropriate to seek consistency in Act 250 reviews.

Subsequent to Plan adoption, the CCRPC anticipates three potential changes to the *Guidelines and Standards for Reviewing Act 250 and Section 248 Applications*:

- **Measures and thresholds used to evaluate allowable congestion in Planning Areas Designated for Growth** - Currently, Level of Service (LOS) is the predominant measure used to quantify traffic congestion of the transportation system and often determines whether or not mitigation is required for specific development proposals LOS measures quality of service of a transportation facility from a driver's perspective. Alternatively, LOS will not be used as the predominant measure of congestion when reviewing overall intersection performance in traffic impact studies as part of Act 250 applications. For Planning Areas Designated for Growth (excludes Rural Planning Areas), the CCRPC will use both LOS and volume-to-capacity (*v/c*) measures to evaluate congestion. Rather than focusing on incremental and often inconsequential changes between different levels of service, the *v/c* measure provides information on whether capacity of an intersection is being fully utilized. Applying both LOS and *v/c* measures will more effectively assist in reaching the land use and transportation goals of the region. The CCRPC will work with VTrans and other stakeholders to develop LOS and *v/c* thresholds that will allow for higher levels of congestion within non-Rural CCRPC defined Planning Areas than currently defined in the VTrans LOS Policy.
- **Development Constraints** – Resources have been identified in Strategies 3 & 4, and illustrated on Map 9 as development constraints. Development should be located to avoid state and local known constraints, and to minimize impacts to state and local possible constraints. Constraints are based on statewide or local policies that are currently adopted or in effect. CCRPC will amend their policy to include a review of these development constraints within their Act 250 and Section 248 development proposal review. Because these constraints are protected at the state and local level already, CCRPC will defer to the relevant municipal or agency review of the constraint unless a review or permit has not been issued by those authorities.
- **Preferred Sites for Solar Generation Facilities** – Net metering projects in Vermont are capped at 150 kW, unless they are located on a preferred site. Vermont's net metering rules (5.100 Rule Pertaining to Construction and Operation of Net-Metering Systems) allows for net metering projects to be up to 500 kW if they are located on a structure, a parking lot canopy, a previously developed site, a brownfield, a landfill, the disturbed portion of a gravel pit, a specific

location designated in a duly adopted town plan, or a specific location identified in a joint letter of support from the municipal legislative body and the municipal and regional planning commission. Upon request, CCRPC will review both the development constraints in Strategies 3 & 4, and the suitability statements in Strategy 2 to determine what sites qualify as a preferred site.

4.1.3 STATEMENT OF COMPATIBILITY AND CONSISTENCY

Pursuant to 24 *VSA* 4302 (f), 4345a (5), 4348a (a), and 4348a (a)(8), CCRPC has reviewed the approved plans of its member municipalities and of its adjoining regional planning commissions and concluded that this *ECOS Plan* is compatible with those plans (that is, this *ECOS Plan*, as implemented, will not significantly reduce the desired effect of the implementation of the other plans).

Chittenden County is bordered to the north by Grand Isle and Franklin Counties, which are served by the Northwest Regional Planning Commission. The ECOS Plan is compatible with the NRPC 2015 Regional Plan. Most bordering areas are designated as Rural in the ECOS Plan and as Agricultural Resource, Rural or Conservation and Forest Resource in the NRPC 2015 Regional Plan. There are two areas near the border with Franklin County that should be monitored in the future. Any development near around Exit 17 on Route 2 in Colchester may have an impact on Grand Isle County. Additionally, there is an area in Milton planned for Enterprise in the ECOS Plan near, but not bordering, an area planed for Conservation in Georgia in Franklin County. Development in the future should be monitored to ensure no adverse effects.

Chittenden County is bordered to the east by Lamoille County (served by the Lamoille County Regional Planning Commission) and Washington County (served by the Central Vermont Regional Planning Commission). The ECOS Plan is compatible with the Lamoille County Regional Plan: 2014-2022. The Lamoille County Regional Planning Commission's Future Land Use Map designates the areas bordering Chittenden County as Rural Residential, Forest Conservation or Agricultural Conservation. This is compatible with the ECOS Plan's designation of adjoining municipalities as Rural Planning Areas. The ECOS Plan is also compatible with the 2015 Amendment to the Central Vermont Regional Plan. The Plan's future land use map designates areas bordering Chittenden County as Resource and Rural areas. This is compatible with the ECOS Plan's designation of adjoining municipalities as Rural Planning Areas.

Chittenden County is bordered to the south by Addison County (served by the Addison County Regional Planning Commission). The ECOS Plan is compatible with the Addison County 2011 Regional Plan. The Addison County 2011 Regional Plan designates areas bordering Chittenden County to the south as Rural and Agricultural or Forestland and Conservation/Floodplain areas, which is generally compatible with the designation of bordering areas in the ECOS Plan as Rural Planning Areas. There are two possible points of conflicts between future land uses. In Hinesburg, a designated Enterprise Zone is Hinesburg borders a Rural and Agricultural area in Starksboro. In Ferrisburgh, a designated Village and Commercial/Industrial area borders a Rural Planning Area in Charlotte. Development in the future should be monitored to ensure no adverse effects.

Beyond the abutting land designations as described above, it is likely that there is housing pressure on the surrounding regions based on a lack of housing within Chittenden County. This is evidenced by a low vacancy rate in Chittenden County, and the number of commuters from outside of the region.

County	Percent of Primary Jobs held by County Residents located in Chittenden County (2013)	Number of Primary Jobs held by County Residents located in Chittenden County (2013)
Grand Isle County	57.50%	2,009
Franklin County	42.30%	9,538
Lamoille County	19.80%	2,279
Washington County	16.20%	4,105
Addison County	26.90%	4,160

Source: http://onthemap.ces.census.gov/

While some of these commuters may prefer to live outside of Chittenden County for reasons other than the housing expense within the County, continued efforts to increase the housing stock within the areas planned for growth in the County will hopefully minimize this pressure on the surrounding regions.

Due to the amount of commuting traffic from the surrounding regions into Chittenden County, there is a demand for transportation services and infrastructure to get residents to their places of work and home again. All four regional plans include a similar sentiment as this one from the Northwest Regional Plan: "As this demand increases, efforts to combine infrastructure capacity improvements with increased public transportation services should be examined at every possible opportunity." A recent example of this type of improvement, selected by the Circ Alternatives Task Force, is the CCTA Jeffersonville Commuter bus route on Route 15. The Plans are consistent in calling for access management, and concentrated development to maintain these arterial corridors for mobility and preservation of character. Concentrated development of jobs and housing that is affordable in the areas planned for growth is a major tenant of the ECOS Plan and a critical component in addressing some of the cross regional pressures on transportation networks. Particular roadway improvements and corridor plan recommendations identified in the surrounding regional plans are consistent with the ECOS Plan.

Also, hazard mitigation and emergency services are regional issues as responders cross municipal and county boundaries. All four regional plans include a similar sentiment as this one from the Addison County Regional Plan: "To maintain a strong and effective response system that is built on the concept of cooperation and mutual aid."

CCRPC has also reviewed the goals of 24 *VSA* 4302 and concluded that this *ECOS Plan* is consistent with those goals (that is, implementation of this *ECOS Plan* will result in substantial progress toward attainment of the goals established in 24 *VSA* 4302).

Municipal Plan Review & Compatibility

In determining whether the Municipal Plans are compatible with this Regional Plan (upon request by the Municipality and in accordance with VT Statute 24 VSA 4350b), the CCRPC will refer to the Planning Areas depicted on the Future Land Use Map, the goals in Chapter 2 and the strategies in Chapter 3. In conducting these reviews and determining compatibility CCRPC's Planning Advisory Committee will use the *Guidelines and Standards for Confirmation of Municipal Planning Processes and Approval of Municipal Plans* and when needed seek guidance from community partners with expertise in subject areas outside of CCRPC's realm.

Decisions for how we create denser mixed use communities are made at the local municipal level of government. Therefore, municipalities are encouraged to apply ECOS strategies in their development

decision making process. Specific implementation of the ECOS strategies will vary throughout the County as municipalities consider their own unique needs and relationship to the region as a whole.

Upon receipt of a Certification of Energy Compliance from the Department of Public Service for this energy enhanced ECOS Plan, CCRPC will have the authority to grant Certificates of Energy Compliance to our municipalities as they amend their municipal plans to meet the enhanced energy standards of Act 174. CCRPC will amend the *Guidelines and Standards for Confirmation of Municipal Planning Processes and Approval of Municipal Plans* to add this procedure. Local development constraints are folded into this ECOS Plan based on current adopted municipal policies or ordinances, and we anticipate those may change as local municipalities work on their individual enhanced energy plans. To ensure consistency with the Regional Plan, CCRPC will review those local constraints in light of the energy generation targets before approval of the local Certificate of Energy Compliance.

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

These maps do not take the place of site-specific investigation for a proposed facility and should not be used as "siting maps". This map does not take all regulations into account and automatically prohibit or allow renewable energy generation and replace the detailed process a developer must go through to propose a site for a renewable energy facility. This map shall not be used without the accompanying policies contained within the Chittenden County ECOS Plan.

Milton
Westford
Underhill
Colchester
Essex
Burlington
Winooski
Essex Junction
Jericho
South Burlington
Williston
Shelburne
St George
Richmond
Bolton
Hinesburg
Huntington
Charlotte
Buels Gore
2
7
127
2A
15
289
117
89
128
116
17

Preferred Sites

Legend

- Closed Landfill
- Sand or Gravel Pit
- Brownfield
- Parking Lots
- 3 Phase Power Lines

DRAFT

0 1.25 2.5 5 7.5 10 Miles

Sources:
Closed Landfill-ANR
Sand or Gravel Pit-ANR
Brownfields-ANR
Parking Lots-CCRPC
3-phase power-VCGI, Burlington Electric Dept.

Disclaimer:
The accuracy of information presented is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. This map is not sufficient for delineation of features on-the-ground. This map identifies the presence of features, and may indicate relationships between features, but is not a replacement for surveyed information or engineering studies.

Document Path: D:\Projects17\Act174\Maps\County\DraftECOSPlanMaps\Map5_StatePreferredSite_20171030.mxd

CHITTENDEN COUNTY RPC

Map 5: State Preferred Sites for Solar Energy Generation

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

These maps do not take the place of site-specific investigation for a proposed facility and should not be used as "siting maps". This map does not take all regulations into account and automatically prohibit or allow renewable energy generation and replace the detailed process a developer must go through to propose a site for a renewable energy facility. This map shall not be used without the accompanying policies contained within the Chittenden County ECOS Plan.

Milton
Westford
Underhill
Colchester
Essex
Burlington
Winooski
Essex Junction
Jericho
South Burlington
Williston
Shelburne
St George
Richmond
Bolton
Hinesburg
Charlotte
Huntington
Buels Gore
2
7
127
128
2A
15
289
117
89
116
17

Prime and Base Solar Energy Areas

Legend

- 3 Phase Power Lines
- Prime Solar: Areas with high solar potential and no state/local known + possible constraints
- Base Solar: Areas with high solar potential and a presence of state/local possible constraints

N

0 1.25 2.5 5 7.5 10 Miles

Sources:
Solar Energy Resource Areas;VCGI,2017
3-phase power-VCGI, Burlington Electric Dept.
Disclaimer:
The accuracy of information presented is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. This map is not sufficient for delineation of features on-the-ground. This map identifies the presence of features, and may indicate relationships between features, but is not a replacement for surveyed information or engineering studies.

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CHITTENDEN COUNTY RPC

DRAFT

Map 6: Solar Energy Generation Potential

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

These maps do not take the place of site-specific investigation for a proposed facility and should not be used as "siting maps". This map does not take all regulations into account and automatically prohibit or allow renewable energy generation and replace the detailed process a developer must go through to propose a site for a renewable energy facility. This map shall not be used without the accompanying policies contained within the Chittenden County ECOS Plan.

Milton
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Colchester
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Winooski
Essex Junction
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Williston
South Burlington
Shelburne
St George
Richmond
Bolton
Hinesburg
Huntington
Charlotte
Buels Gore
2
7
128
127
2A
15
289
117
89
116
17

Prime and Base Wind Energy Areas

Legend

- 3 Phase Power Lines
- Prime Wind: Areas with high wind potential and no state/local known +possible constraints
- Base Wind: Areas with high wind potential and a presence of state/local possible constraints

N

0 1.25 2.5 5 7.5 10 Miles

Sources:
Wind Energy Resource Areas;VCGI,2017
3-phase power-VCGI, Burlington Electric Dept.
Disclaimer:
The accuracy of information presented is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. This map is not sufficient for delineation of features on-the-ground. This map identifies the presence of features, and may indicate relationships between features, but is not a replacement for surveyed information or engineering studies.

Document Path: D:\Projects17\Act174\Maps\County\DraftECOSPlanMaps\Map7_WindGenerationPotential_20171030.mxd

CHITTENDEN COUNTY RPC

DRAFT

Map 7: Wind Energy Generation Potential

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

These maps do not take the place of site-specific investigation for a proposed facility and should not be used as "siting maps". This map does not take all regulations into account and automatically prohibit or allow renewable energy generation and replace the detailed process a developer must go through to propose a site for a renewable energy facility. This map shall not be used without the accompanying policies contained within the Chittenden County ECOS Plan.

Milton
Westford
Colchester
Essex
Underhill
Burlington
Winooski
Essex Junction
Jericho
South Burlington
Williston
Shelburne
St George
Richmond
Bolton
Hinesburg
Charlotte
Huntington
Buels Gore

2 7 128 127 2A 15 289 117 89 116 17

Woody Biomass Resource Areas

Legend

Woody Biomass Resource Areas

Sources:
Wood Biomass Resource Areas-VCGI, 2017
Disclaimer:
The accuracy of information presented is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. This map is not sufficient for delineation of features on-the-ground. This map identifies the presence of features, and may indicate relationships between features, but is not a replacement for surveyed information or engineering studies.

0 1.25 2.5 5 7.5 10 Miles

N

Document Path: D:\Projects17\Act174\Maps\County\DraftECOSPlanMaps\MapX_Biomass_20171031.mxd

CHITTENDEN COUNTY RPC

DRAFT

Map X: Biomass Resource Areas

Note: This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. This map may also be used for conceptual planning by those interested in developing renewable energy infrastructure.

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St George
Hinesburg
Charlotte
Huntington
Buels Gore
2
7
127
2A
15
289
117
89
128
116
17

Energy Generation of Existing Hydro Facilities

Legend

- Current Operating Hydroelectric Dams
- Unknown Capacity
- > 50kW Capacity
- < 10kW Capacity
- Low Hazard with >50 kW
- Low Hazard with <10KW
- Significant Hazard with <10KW
- 3 Phase Power Lines

0 1.25 2.5 5 7.5 10 Miles

Sources:
Hydro Dams;VCGI,2017
3-phase power-VCGI, Burlington Electric Dept.
Disclaimer:
The accuracy of information presented is determined by its sources. Errors and omissions may exist. The Chittenden County Regional Planning Commission is not responsible for these. Questions of on-the-ground location can be resolved by site inspections and/or surveys by registered surveyor. This map is not sufficient for delineation of features on-the-ground. This map identifies the presence of features, and may indicate relationships between features, but is not a replacement for surveyed information or engineering studies.

N

Document Path: D:\Projects17\Act174\Maps\County\DraftECOSPlanMaps\MapX_Hydro_20171031.mxd

CHITTENDEN COUNTY RPC

DRAFT

Map X: Hydroelectricity Generation Potential

MUNICIPAL ENERGY DATA AND MAPS: CHITTENDEN COUNTY

This document incudes all data required for Chittenden County to plan for these goals at a municipal level. The tables contain data that estimate current energy use and provide targets for future energy use across all sectors (transportation, heating, and electricity). The tables also show the region's targets for renewable energy generation. Please note that these data are a starting point for Chittenden County to consider its energy future. This information should provide the framework for a discussion about changes that will need to occur within Chittenden County to ensure that state energy goals are met.

Estimates of current energy use consist primarily of data available from the American Community Survey (ACS), the Vermont Agency of Transportation (VTrans), the Vermont Department of Labor (DOL), Vermont Gas and the Vermont Department of Public Service (DPS). Where available, real consumption data obtained from utilities are used.

Targets for future energy use are drawn from the Long-range Energy Alternatives Planning (LEAP) analysis for Chittenden County, completed the Vermont Energy Investment Corporation (VEIC). The LEAP model is an accounting framework that shows one possible path for Chittenden County to meet the goals above.

Assumptions used to create the LEAP analysis are slightly different than assumptions used to calculate current regional energy use. Regardless, the targets established here show the direction in which change needs to occur to meet regional and state energy goals. It is also important to remember that the targets established by LEAP represent only one way to achieve Chittenden County's energy goals. Other strategies may allow the region to meet its goals.

Over the next few months, the CCRPC Board will choose a Metropolitan Transportation Plan scenario, which will describe CCRPC's expectations of transportation use between now and 2050. Once that scenario is chosen, the LEAP model will be re-run to ensure that these energy use data correspond with the LEAP model.

For more explanation on the data included here, please see the Methodology Document.

PLEASE NOTE THAT THIS IS A DRAFT AND SUBJECT TO CHANGE.

TRANSPORTATION ENERGY USE

Current Transportation Energy Use

Metric	County Data
Fossil Fuel Burning Cars, 2015	106,936
Fossil Fuel Energy Used for Transportation in 2015 (MMBtu)	4,971,503
Electric Vehicles in 2015 (#)	546
Electricity Used for Transportation in 2015 (MMBtu)	4,347

Sources: VTrans, American Community Survey, Drive Electric Vermont, DMV

Transportation Energy Use, 2015-2050

	2015	2025	2035	2050
Total Light Duty Transportation Energy Use (MMBtu)	7,552,000	6,061,000	3,744,000	1,599,000
Electricity Used for Transportation (MMBtu)	6,000	81,000	543,000	1,124,000
Electric Vehicles (% of Vehicle Fleet)	0%	6%	41%	89%
Biofuel Blended* Energy Used for Transportation (MMBtu)	7,546,000	5,980,000	3,201,000	475,000
Biofuel Blend* Vehicles (% of Vehicle Fleet)	100%	94%	59%	11%

**This measures biofuels blended with fossil fuels. A common example is gasoline with ethanol mixed in.*

Sources: VTrans, LEAP Model

THERMAL ENERGY USE

Current Thermal Energy Use

Current Thermal Energy Use from Natural Gas, 2015

Total Residential Natural Gas Consumption (Mcf)	3,331,770
Percentage of Municipal Natural Gas Consumption	45%
Total Commercial/Industrial Natural Gas Consumption (Mcf)	4,120,470
Percentage of Municipal Natural Gas Consumption	55%
Total Municipal Natural Gas Consumption	7,452,239
Sources: Vermont Gas	

Commercial and Industrial Thermal Energy Use, 2015-2050

	2015	2025	2035	2050
Total Commercial and Industrial Thermal Energy Use (MMBtu)	3,574,500	3,219,900	2,776,400	2,112,000
Percent of Commercial and Industrial Establishments Weatherized by Target Year	11%	20%	22%	39%
Energy Saved by Weatherization by Target Year (MMBtu)	86,500	189,006	259,783	629,830
Commercial and Industrial Establishments Using Heat Pumps (%)	1%	22%	35%	39%
Commercial and Industrial Thermal Energy Use by Heat Pumps (MMBtu)	6,590	284,318	562,046	839,773
Commercial and Industrial Establishments Using Wood Heating (%)	7%	9%	10%	11%
Commercial and Industrial Thermal Energy Use Attributable to Wood Heating (MMBtu)	266,300	424,000	583,700	854,500
Sources: LEAP Model, Department of Public Service, Department of Labor				

Residential Thermal Energy Use, 2015-2050

	2015	2025	2035	2050
Total Residential Thermal Energy Use (MMBtu)	6,281,000	5,597,000	4,772,000	3,382,000
Percent of Residences Weatherized by Target Year	2%	14%	23%	70%
Energy Saved by Weatherization by Target Year (MMBtu)	41,800	250,800	455,400	1,518,000
Percent of Residences Using Heat Pumps	3%	18%	35%	55%
Residential Thermal Energy Use from Heat Pumps (MMBtu)	62,000	362,000	750,000	1,126,000
Residences Using Wood Heating (%)	14%	14%	14%	13%
Residential Thermal Energy Use from Wood Heating (MMBtu)	982,000	1,029,000	1,035,000	931,000
Sources: LEAP Model, Department of Public Service				

ELECTRIC ENERGY USE

Current Electrical Energy Use

Residential Electric Energy Use (kWh)	425,335,425
Commercial and Industrial Electric Energy Use (kWh)	1,483,005,818
Total Electric Energy Use (kWh)	1,908,341,243
Sources: Efficiency Vermont, Burlington Electric Department, 2016	

Electrical Energy Use, 2015-2050

	2015	2025	2035	2050
Total Electric Energy Saved (kWh)	9,000,000	107,000,000	216,000,000	404,000,000
Residences that have increased their Electric Efficiency	3%	31%	58%	98%
Commercial and Industrial Establishments that have Increased Their Electric Efficiency	3%	31%	58%	98%
Sources: LEAP Model and Efficiency Vermont, 2013				

ELECTRIC ENERGY GENERATION

Existing Renewable Electricity Generation

	Sites	Power (kW)	Energy (kWh)
Solar	2,785	40,080	49,806,017
Wind	23	10,460	31,136,031
Hydroelectric	6	35,800	164,136,000
Biomass	14	50,578	266,163,840
Other	0	0	0
Total	2,785	136,918	511,241,888*

Source: Community Energy Dashboard, October 2017

**The total existing renewable energy generation varies from the existing renewable energy generation reported in the Energy Overview due to variations in the way the data is counted.*

Renewable Electricity Generation Potential

	Power (MW)	Energy (MWh)
Rooftop Solar	103	126,328
Ground-Mounted Solar	1,168	1,432,176
Wind		N/A
Hydro	See Hydro Map	
Biomass	See Biomass Map	
Methane	Unknown	Unknown
Other	Unknown/District Heat?	Unknown/District Heat?

Source: CCRPC and the Department of Public Service

Land Available for Wind and Solar Generation

	Prime (acres)	Base (acres)
Solar	9,600	71,706
Wind	4,555	46,142

Note: Prime areas are areas of high energy potential and an absence of state/local known and possible constraints. Base areas are areas with high energy potential and a presence of state/local possible constraints.

Renewable Electricity Generation Targets

Renewable Energy Generation Target	MWh
State Projected Electricity Demand (2050)	10,000,000
In-State Generation Target (2050)	5,000,000
State Imported Generation (2050)	50%
Low Target for Renewable Energy Generation in Chittenden County -15% of State	
Total Target	756,250
Existing Renewable Energy Generation	500,590
New Generation Needed	255,660
High Target for Renewable Energy Generation un Chittenden County -25% of State	
Total Target	1,265,134
Existing Renewable Energy Generation	500,590
New Generation Needed	764,544

Possible Scenario for Achieving the Targets			
	MWh	MW	Acres Needed
Low Target: New Generation by 2050			
75% of Renewable Energy is Land-based Solar	191,745	156	1,251
25% of Renewable Energy is Wind	63,915	21	521
Total	255,660	177	1,772
High Target: New Generation by 2050			
75% of Renewable Energy is Land-based Solar	573,408	468	3,740
25% of Renewable Energy is Wind	191,136	62	1,559
Total	764,544	530	5,299

Figure 1 Total Energy Consumption by Scenario, (aviation excluded)

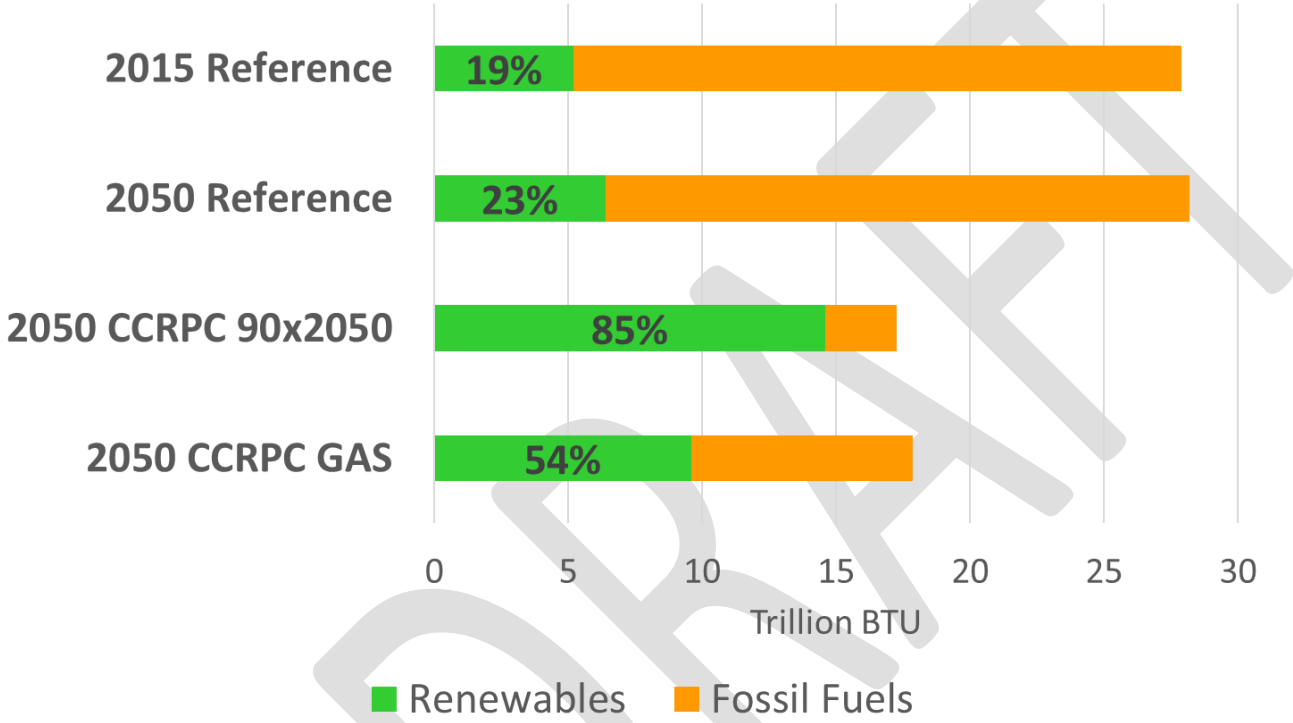


Figure 2 90X2050 Scenario by Sector

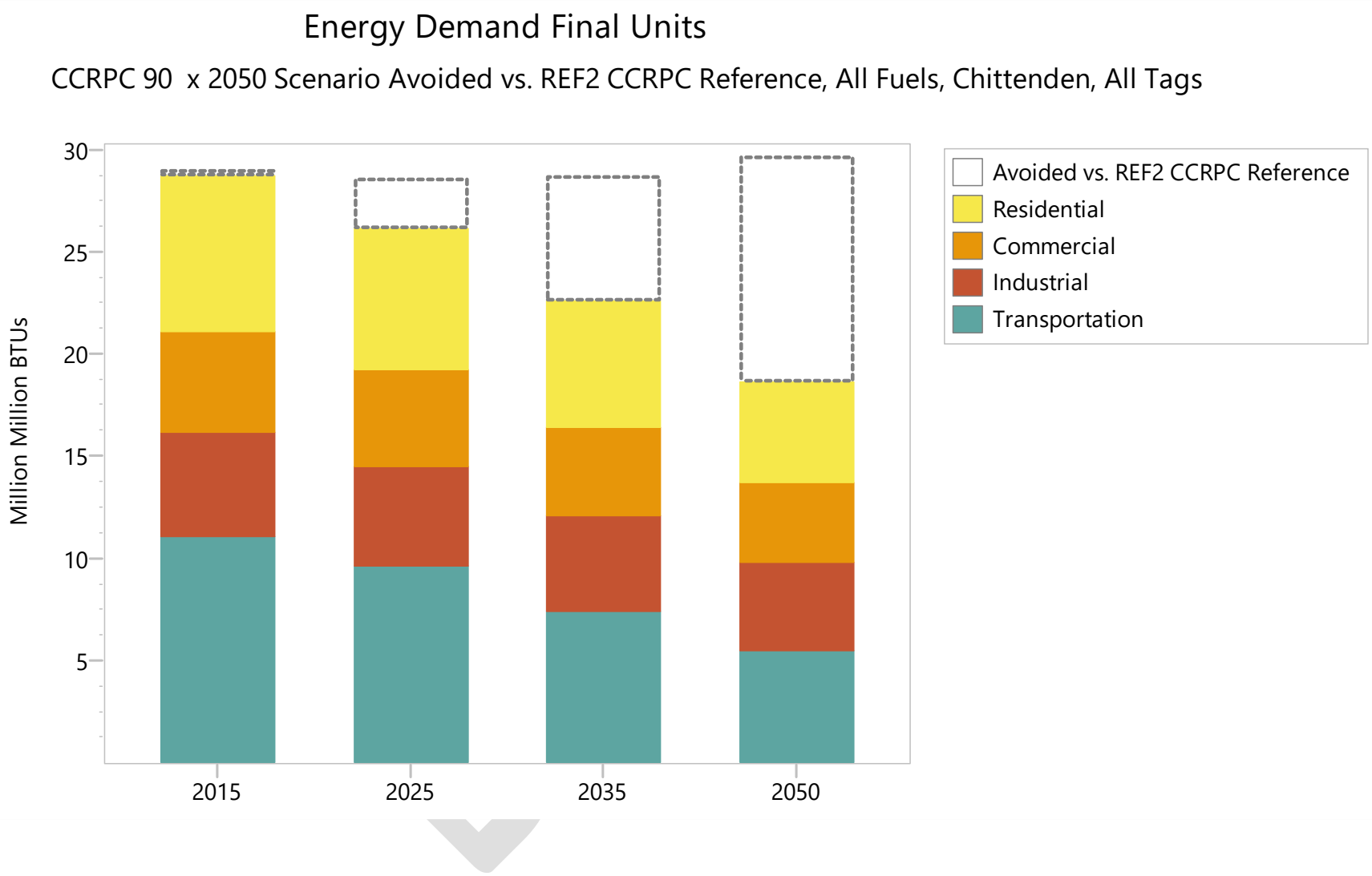
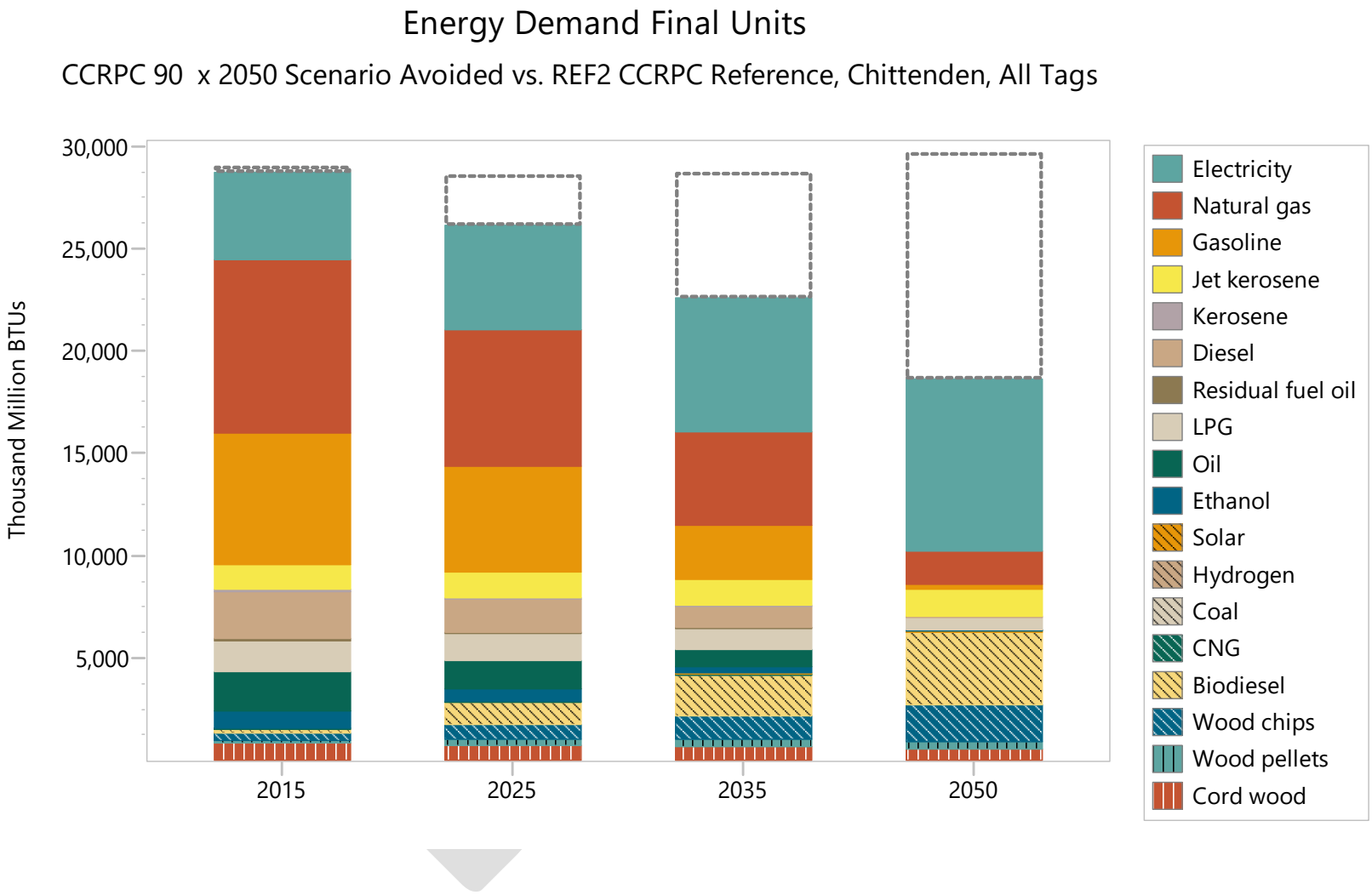


Figure 3 90X2050 Energy by Fuel



Energy Data Methodology and Assumptions

LEAP Model

The LEAP Model shows one pathway that would result in Chittenden County using 1/3 less energy by 2050, and obtaining 90% of energy from renewable sources across all sectors in 2050. The modeling was completed by the Vermont Energy Investment Company (VEIC). VEIC also produced the documentation below.

Over the next few months, the CCRPC Board will choose a Metropolitan Transportation Plan scenario, which will describe CCRPC's expectations of transportation use between now and 2050. Once that scenario is chosen, the LEAP model will be re-run to ensure that these energy use data correspond with the LEAP model.

Introduction

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

Statewide Approach

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

Demand Drivers

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

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

RPC	Annual Growth
Addison	0.00%
Bennington	0.02%
Central VT	0.12%

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

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

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

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

Chittenden	0.48%
Lamoille	1.46%
Northwest	0.87%
NVDA	0.21%
Rutland	-0.27%
Southern Windsor	0.24%
Two Rivers	0.29%
Windham	0.34%

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

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

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

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

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

Regionalization Approach

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

The industrial sector was assumed to be more diverse in its energy consumption. In the industrial sector, natural gas was allocated among the regions currently served by natural gas based on the number of industrial employees

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

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

Results

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

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

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

Statewide Total Energy Consumption

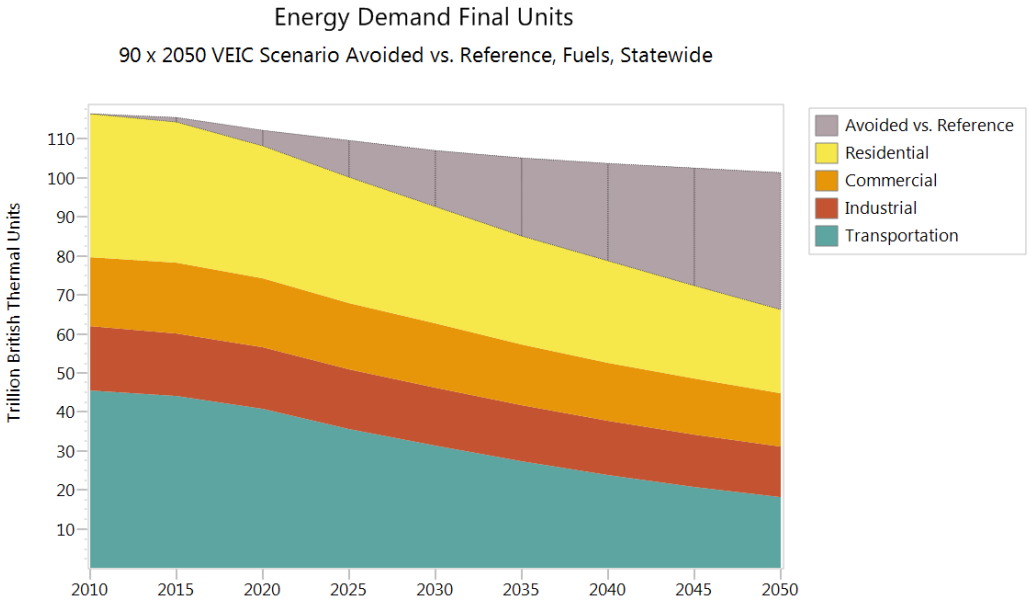


FIGURE 1 - STATEWIDE ENERGY CONSUMPTION BY SECTOR, 90% X 2050 VEIC SCENARIO COMPARED TO THE REFERENCE SCENARIO

REGIONAL TOTAL ENERGY CONSUMPTION

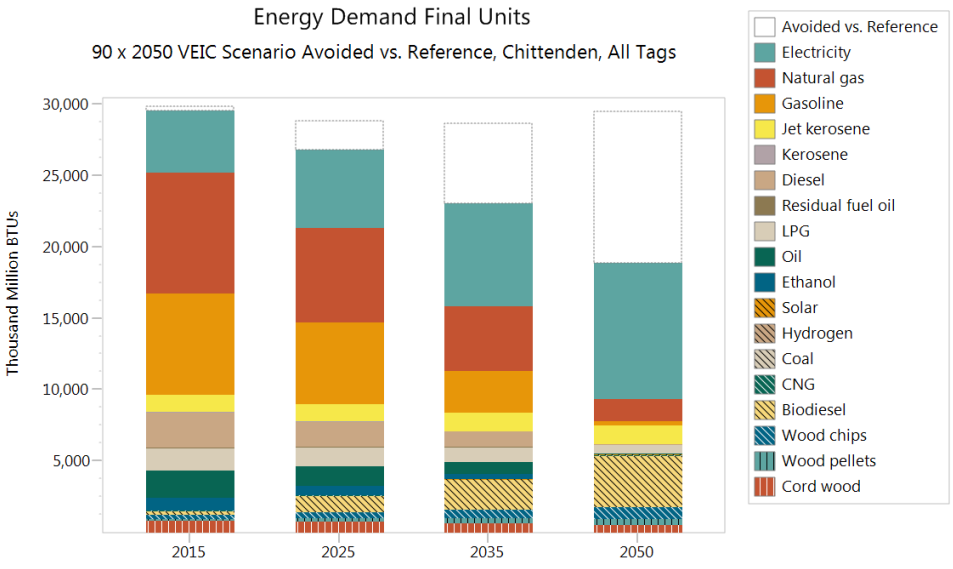


FIGURE 2: REGIONAL ENERGY CONSUMPTION BY FUEL

Regional Energy Consumption by Sector

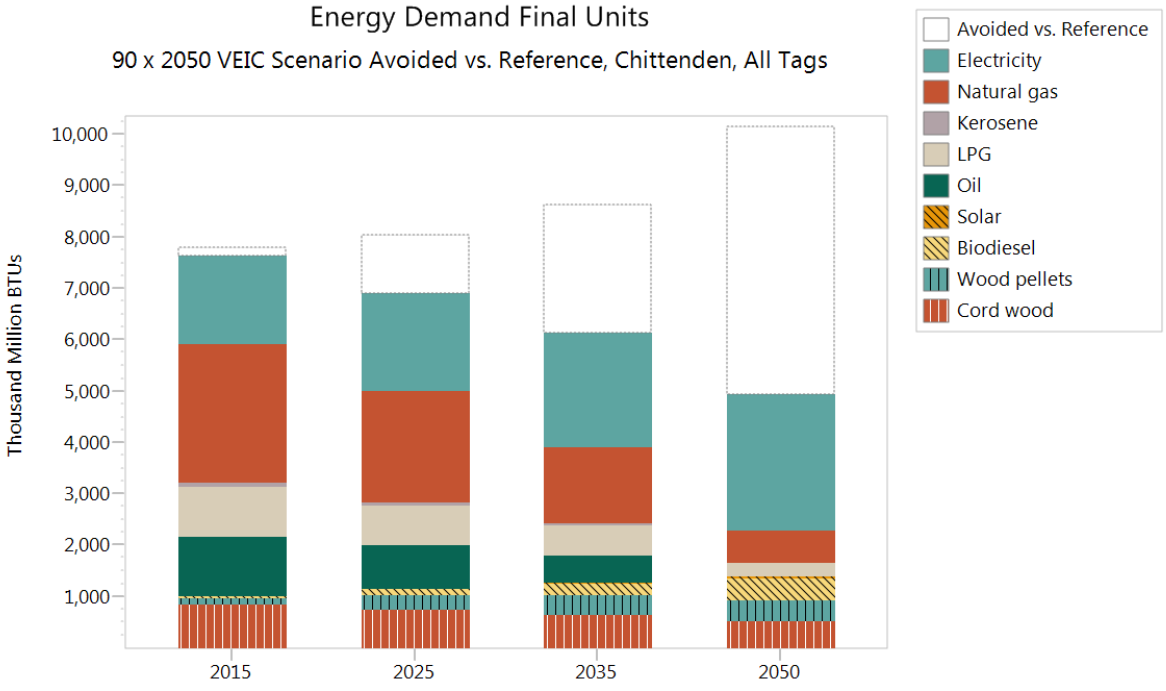


FIGURE 3: REGIONAL RESIDENTIAL ENERGY CONSUMPTION BY FUEL

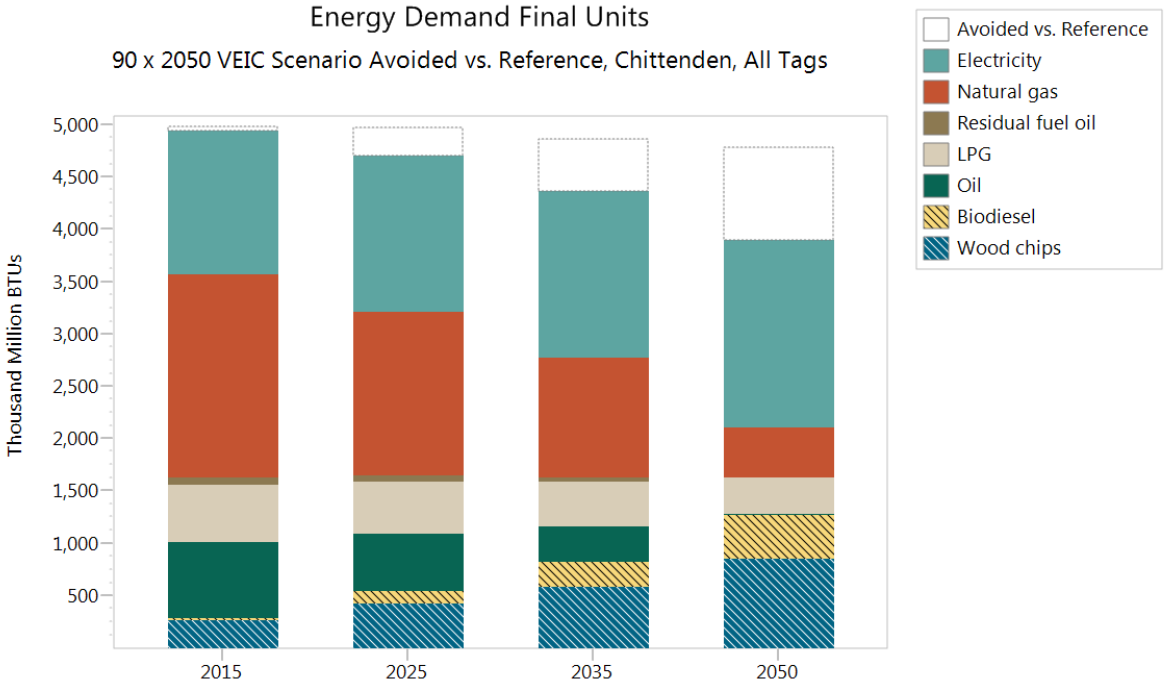


FIGURE 4: REGIONAL COMMERCIAL ENERGY CONSUMPTION BY FUEL

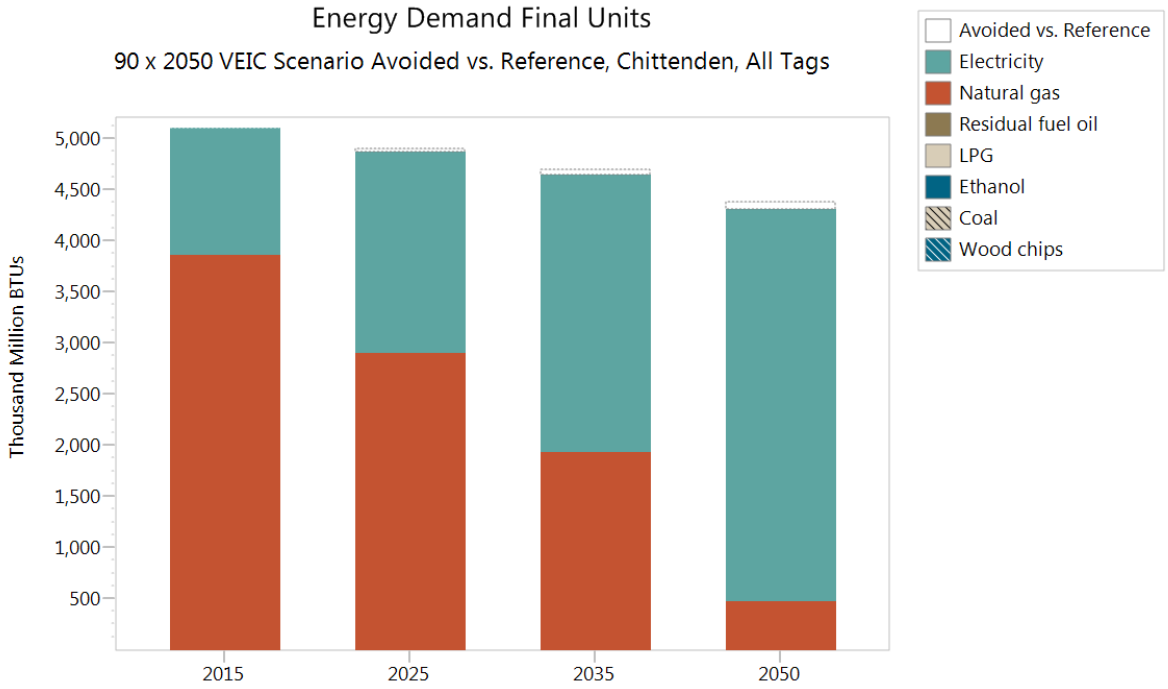


FIGURE 5: REGIONAL INDUSTRIAL ENERGY CONSUMPTION BY FUEL

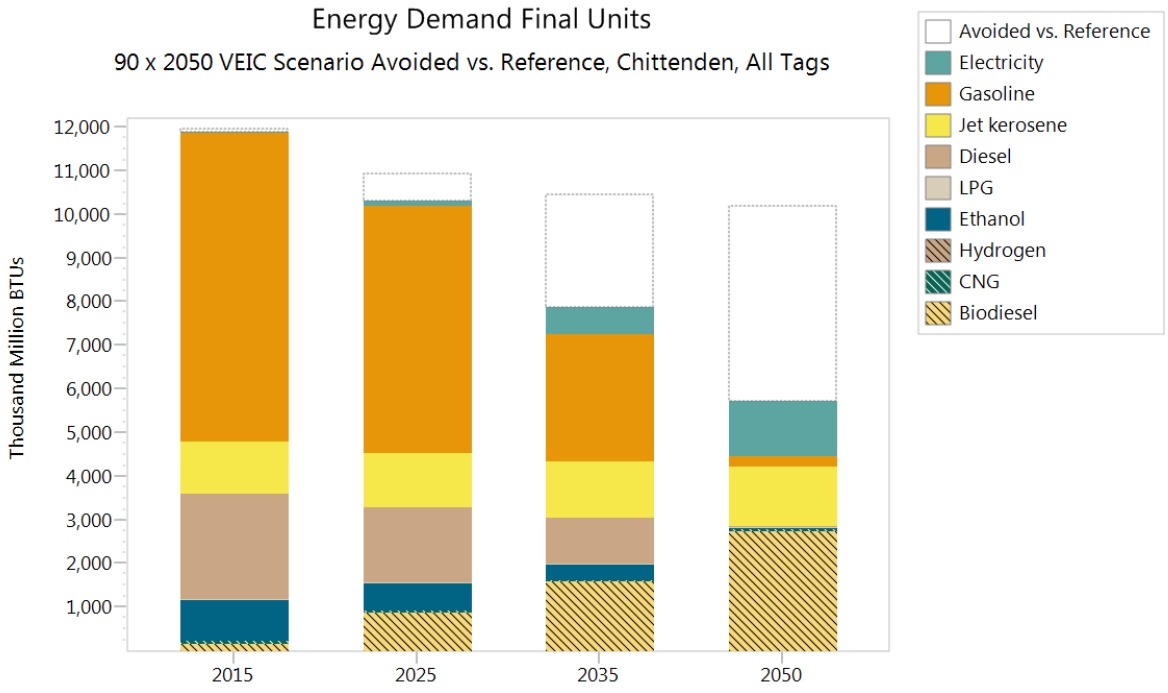


FIGURE 6: REGIONAL TRANSPORTATION ENERGY CONSUMPTION BY FUEL

Detailed Sources and Assumptions

Residential

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

Space Heating

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

Additional information came from the following data sources:

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

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

- Multi-family units use 60% of the heating fuel used by single family homes, on average, due to assumed reduced size of multi-family units compared to single-family units. Additionally, where natural gas is available, the team assumed a slightly higher percentage of multi-family homes use natural gas as compared to single family homes, given the high number of multi-family units located in the Burlington area, which is served by the natural gas pipeline. The team also assumed that few multi-family homes rely on cordwood as a primary heating source.
- Unoccupied/Seasonal Units: On average, seasonal or unoccupied homes were expected to use 10% of the heating fuel used by single family homes. For cord wood, we expected unoccupied or seasonal homes to use 5% of heating fuel, assuming any seasonal or unoccupied home dependent on cord wood are small in number and may typically be homes unoccupied for most of the winter months (deer camps, summer camps, etc.)
- Mobile homes—we had great mobile home data from 2009 RECS. As heat pumps were not widely deployed in mobile homes in 2009 and did not appear in the RECs data, we applied the ratio of oil

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

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

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

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

consumed between single family homes and mobile homes to estimated single family heat pump use to estimate mobile home heat pump use.

- The reference scenario heating demand projections were developed in line with the TES reference scenario. This included the following: assumed an increase in the number of homes using natural gas, increase in the number of homes using heat pumps as a primary heating source (up to 37% in some home types), an increase in home heated with wood pellets, and drastic decline in homes heating with heating oil. Heating system efficiency and shell efficiency were modeled together and, together, were estimated to increase 5-10% depending on the fuel type. However, heat pumps are expected to continue to rapidly increase in efficiency (becoming 45% more efficient, when combined with shell upgrades, by 2050). We also reflect some trends increasing home sizes.
- In the 90% x 2050 VEIC scenario, scenario heating demand projections were developed in line with the TES TREES Local scenarios, a hybrid of the high and low biofuel cost scenarios. This included the following: assumed increase in the number of homes using heat pumps as a primary heating source (up to 70% in some home types), an increase in home heated with wood pellets, a drastic decline in homes heating with heating oil and propane, and moderate decline in home heating with natural gas. Heating system efficiency and shell efficiency were modeled together and were estimated to increase 10%-20% depending on the fuel type. However, heat pumps are expected to continue to rapidly increase in efficiency (becoming 50% more efficient, when combined with shell upgrades by 2050). We also reflect some trends increasing home sizes.

Lighting

Lighting efficiency predictions were estimated by Efficiency Vermont products experts.

Water Heating

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

Appliances and Other Household Energy Use:

EnergyStar appliance estimates and the Efficiency Vermont Electric Usage Chart[13] provided estimates for appliance and other extraneous household energy uses.

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

Commercial

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

Industrial

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

Transportation

The transportation branch focused on aligning with values from the Total Energy Study (TES) Framework for Analysis of Climate-Energy-Technology Systems (FACETS) data in the transportation sector in the Business as Usual

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

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

(BAU) scenario. The VEIC 90% x 2050 scenario was predominantly aligned with a blend of the Total Renewable Energy and Efficiency Standard (TREES) Local High and Low Bio scenarios in the transportation sector of FACETS data. There were slight deviations from the FACETS data, which are discussed in further detail below.

Light Duty Vehicles

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

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

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

Heavy Duty Vehicles

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

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

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

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

[17] Jonathan Dowds et al., "Vermont Transportation Energy Profile."

[18] Ibid.

[19] "Natural Gas Fuel Basics," *Alternative Fuels Data Center*, accessed August 19, 2016, http://www.afdc.energy.gov/fuels/natural_gas_basics.html.

[20] U.S. Environmental Protection Agency: Office of Transportation & Air Quality, "Biodiesel."

[21] US Energy Information Administration (EIA), "Freight Transportation Energy Use, Reference Case," *Annual Energy Outlook 2015*, 2015, http://www.eia.gov/forecasts/aeo/data/browser/#/?id=58-AEO2015&region=0-0&cases=ref2015&start=2012&end=2040&f=A&linechart=ref2015-d021915a.6-58-AEO2015&sourcekey=0.

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

Although there has been some progress toward electrifying HDVs, the VEIC 90% x 2050 scenario does not include electric HDVs. An electric transit bus toured the area and gave employees of BED, GMTA, and VEIC a nearly silent ride around Burlington. The bus is able to fast charge using an immense amount of power that few places on the grid can currently support. The California Air Resources Board indicated a very limited number of electric HDVs are in use within the state.[23] Anecdotally, Tesla communicated it is working on developing an electric semi-tractor that will reduce the costs of freight transport.[24]

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

Rail

The rail sector of the transportation branch consists of two types: freight and passenger. Currently in Vermont, freight and passenger rail use diesel fuel.[28,29] The energy intensity (Btu/short ton-mile) of freight rail was obtained from the U.S Department of Transportation Bureau of Transportation Statistics.[30] A 10-year average energy intensity of passenger rail (Btu/passenger mile) was also obtained from the U.S Department of Transportation Bureau of Transportation Statistics.[31] Passenger miles were calculated using two sets of information. First, distance between Vermont Amtrak stations and the appropriate Vermont border location were estimated using Google

[22] Oregon Department of Transportation and U.S. Department of Transportation Federal Highway Administration, "Primer on Renewable Diesel," accessed August 29, 2016, http://altfueltoolkit.org/wp-content/uploads/2004/05/Renewable-Diesel-Fact-Sheet.pdf.

[23] California Environmental Protection Agency Air Resources Board, "Draft Technology Assessment: Medium- and Heavy-Duty Battery Electric Trucks and Buses," October 2015, https://www.arb.ca.gov/msprog/tech/techreport/bev_tech_report.pdf.

[24] Elon Musk, "Master Plan, Part Deux," *Tesla*, July 20, 2016, https://www.tesla.com/blog/master-plan-part-deux.

[25] Jonathan Dowds et al., "Vermont Transportation Energy Profile."

[26] "Transportation Energy Data Book: Edition 33" (Oak Ridge National Laboratory, n.d.), accessed August 18, 2016.

[27] U. S. Census Bureau, "Total Population, Universe: Total Population, 2012 American Community Survey 1-Year Estimates," *American Fact Finder*, 2012, http://factfinder.census.gov/bkmk/table/1.0/en/ACS/12_1YR/B01003/0100000US.

[28] US Energy Information Administration (EIA), "Freight Transportation Energy Use, Reference Case."

[29] Vermont Agency of Transportation Operations Division - Rail Section, "Passenger Rail Equipment Options for the Amtrak Vermonter and Ethan Allen Express: A Report to the Vermont Legislature," January 2010, http://www.leg.state.vt.us/reports/2010ExternalReports/253921.pdf.

[30] U.S. Department of Transportation: Office of the Assistant Secretary for Research and Technology Bureau of Transportation Statistics, "Table 4-25: Energy Intensity of Class I Railroad Freight Service," accessed August 26, 2016, http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_25.html.

[31] U.S. Department of Transportation: Office of the Assistant Secretary for Research and Technology Bureau of Transportation Statistics, "Table 4-26: Energy Intensity of Amtrak Services," accessed August 26, 2016, http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_26.html.

Maps data. Second, 2013 passenger data was obtained from the National Association of Railroad Passengers.[32] Combined, these two components created total Vermont passenger miles. We used a compound growth rate of 3% for forecast future passenger rail demand in the 90% x 2050 $_{VEIC}$ scenario, consistent with the historical growth rates of rail passenger miles in Vermont.[33] Passenger rail is assumed to completely transform to electric locomotion. Freight rail is assumed to transform to biodiesel or renewable diesel.

Air

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

[32] National Association of Railroad Passengers, "Fact Sheet: Amtrak in Vermont," 2016, https://www.narprail.org/site/assets/files/1038/states_2015.pdf.
[33] Joseph Barr, AICP et al., "Vermont State Rail Plan: Regional Passenger Rail Forecasts."

Municipal and County Data

CCRPC's Municipal and County Data Guides use a methodology created by the Vermont Department of Public Service to describe LEAP Model results in a more understandable format—for example, reporting a number of electric cars instead of the raw amount of electricity used for transportation.

Transportation Energy Use

Transportation energy use from the LEAP model is divided between each municipality based on that municipality's share of regional vehicle registrations in 2015. See below for more details on the LEAP model.

- Fossil fuel and electric vehicles in 2015: Vermont Department of Motor Vehicles, sorted by zip codes on vehicle registrations and fuel type
    - Williston and St. George share a zip code, and DMV data were broken down proportionately. St. George has 7% of the combined population of the two municipalities, and Williston has 93%.
    - Essex and Essex Junction share a zip code, and DMV data were reported together (data from several other sources, including the Department of Labor, were only available for Essex and Essex Junction combined).
    - For Jericho, Richmond and Bolton, ACS data on vehicles available per household were used, as zip code boundaries cannot be easily broken down to correspond with town boundaries.
- Average annual number of miles travelled by a fossil fuel LDV in the region: 9,269
- Average fuel economy of fossil fuel burning LDV fleet in the region: 22
- Percentage of ethanol blended into area fuel supplies "at the pump" in the region: 9%
- Btu in a gallon of fossil fuel, computed as a weighted average of the individual heat contents of gasoline (95) and diesel (5%): 121,259
- Btu in a gallon of ethanol: 84,710
- Average annual number of miles travelled by EVs in the region: 7,000
- Average fuel economy of electric vehicles today, in miles per kWh: 3
- The number of Btu in a kWh of electricity at the point of use, aka site energy. (Note that all electricity numbers in the LEAP scenario are reported as site energy): 3,412
- Growth rate of vehicle ownership, 2015-2050: 0.4%
    - This was the growth rate of vehicle registrations in Chittenden County between 2011-2015.

Example Calculation: Electric Vehicles

	2015	2025	2035	2050
Electricity Used for Transportation (from LEAP Model)	57.0 MMBtu	767.5 MMBtu	5,158.5 MMBtu	10,678.0 MMBtu
	= County Total * Municipal Share			
Energy Use of Average Electric Vehicle (Increases over time due to predicted technology improvement)	10.54 MMBtu	9.66 MMBtu	8.78 MMBtu	7.91 MMBtu
Municipal Electric Vehicles	5	80	587	1,355
	= Total Electricity Used for Transportation / Electricity Use per Electric Vehicle			

Thermal Energy Use

Thermal residential energy use from the LEAP model is divided between each municipality based on that municipality's share of regional households in 2015. Thermal commercial/industrial energy use from the LEAP model is divided between each municipality based on that municipality's share of total regional commercial/industrial thermal energy use in 2015. See below for more details on the LEAP model.

- Current number of residential buildings: CCRPC ECOS Plan Population and Household Forecasts, EPR
    - Growth rate between 2015 and 2050: 0.63%
- Current number of commercial and industrial establishments: Vermont Department of Labor
    - Data were reported for each municipality, with the exception of Essex and Essex Junction, which are combined in the DOL database. Data were reported for the two municipalities combined.
- Growth rate of commercial and industrial establishments, 2015-2050: 2.23%
    - This was the rate of commercial and industrial establishment growth between 2010-2015
- Average annual heating load of area residences: 110 MMBtu
    - Department estimate of the average square footage of conditioned residential space in the state. All else equal, higher average residence sizes than this will be associated with higher average area heat loads (and vice versa): 1,600-1,900
    - Percent of residences in the state that were built before 1930. All else equal, a higher percentage than this in your area will likely be associated with higher average area heating loads (and vice versa): 26%
    - Percentage of residences in the State with 6 rooms or more. All else equal, a higher percentage than this in your area will likely be associated with higher average area heating loads (and vice versa): 50%
    - Approximate percentage of residences in the State with 4 bedrooms or more. All else equal, a higher percentage than this in your area will likely be associated with higher average area heating loads (and vice versa): 20%
    - Number of people per household in State. All else equal, a higher number than this will likely be associated with higher average area heating loads (and vice versa): 2.30
    - Public Service Department estimate of the percentage of residences in the State that have been weatherized throughout the 2000s. All else equal, a higher percentage than this in your area will likely be associated with lower average area heating loads (and vice versa): 10%

- Average annual heating load of commercial establishments in area: 695
- Current Natural Gas Consumption: Reported by Vermont Gas
- The number of homes using wood heat is calculated by breaking down the projected energy used by wood heat in the LEAP model, based on the average area residential heating load. The number of homes using heat pumps is calculated by breaking down the projected energy used by heat pumps in the LEAP model, based on the average area residential heating load.
    - Average area residential heating load changes over time to account for increasing home weatherization.

2015	2025	2035	2050
110 MMBtu	105 MMBtu	100 MMBtu	83 MMBtu

- The number of businesses using wood heat is calculated by breaking down the projected energy used by wood heat in the LEAP model, based on the average area business heating load. The number of

businesses using heat pumps is calculated by breaking down the projected energy used by heat pumps in the LEAP model, based on the average area business heating load.

- Average area business heating load changes over time to account for increasing business weatherization.

2015	2025	2035	2050
695 MMBtu	665 MMBtu	662 MMBtu	637 MMBtu

- Percent residences weatherized is calculated by dividing the LEAP model's projections of total heat energy saved by the weatherization of homes by the amount of energy projected to be saved by a typical home weatherization
  - The typical amount of heat energy that will be saved through future Residential weatherization investments: 28 MMBtu
- Percent businesses weatherized is calculated by dividing the LEAP model's projections of total heat energy saved by the weatherization of businesses by the amount of energy projected to be saved by a typical business weatherization
  - The typical amount of heat energy that will be saved through future business weatherization investments: 139 MMBtu

Example Calculation: Wood Heat

	2015	2025	2035	2050
Total Heat Energy from Wood (LEAP Model)	8150.6 MMBtu	8540.7 MMBtu	8590.5 MMBtu	7727.3 MMBtu
	= County Total * Municipal Share			
Average Household Heating Load (Decreases over time due to predicted increases in efficiency and weatherization)	110 MMBtu	105.28 MMBtu	99.72 MMBtu	82.75 MMBtu
Total Homes Using Wood Heat	74	84	86	93
	= Total Heat Energy from Wood / Average Household Heating Load			

Electric Energy Use

- Current electrical usage: 2013 consumption data from Efficiency Vermont, except for Burlington (see below), reported by town
  - In Burlington, actual 2013 consumption data were reported by Burlington Electric Department
- Total electric energy saved by municipality is determined by multiplying the total amount of electric energy saved projected by the LEAP model by the municipality's percentage of total county-wide electric energy use

- The percentage of residences that have increased their electric efficiency is determined by dividing the total electric energy saved in the municipality by the average electric savings from an electrical efficiency upgrade.
    - Average electric savings from an electrical efficiency upgrade: 400 kWh
- Current number of residential buildings: American Community Survey data
    - Growth rate between 2015 and 2050: 0.63%
- The percentage of businesses that have increased their electric efficiency: assumed to be the same as residences, per Department of Public Service guidance.

Example Calculation: Electric Efficiency Upgrades

	2015	2025	2035	2050
Total Electricity Saved via Efficiency Upgrades	74,700 kWh	888,100 kWh	1,792,800 kWh	3,353,200 kWh
	= County Total * Municipal Share			
Average Electricity Savings from Efficiency Upgrade	400 kWh	400 kWh	400 kWh	400 kWh
Total Homes Upgrading Electric Efficiency	14	171	245	645
	= Total Electricity Saved / Average Savings per Household			

Existing Electric Energy Generation

- Data on generation sites, power and energy generation are available from the Vermont Energy Atlas. The Atlas reports sites and capacity (power) from Certificates of Public Good filed in each municipality. Some large facilities report actual energy generation to the Department of Public Service, which is included in the Energy Atlas. For all other facilities, energy generation is estimated with the following formula:
    - Solar MWh of energy = (number of MW) * (8760 hours per year) * (0.14 capacity factor)
    - Wind MWh of energy = (number of MW) * (8760 hours per year) * (0.35 capacity factor)
    - Hydro MWh of energy = (number of MW) * (8760 hours per year) * (0.40 capacity factor)

Methodology for Renewable Energy Generation Targets

Regional Solar and Wind Targets

To determine how much renewable energy generation Chittenden County should aim for by 2050, we have developed a low and high target. Chittenden County has a large proportion of the State's population and a small proportion of the state's prime wind and solar generation areas. Because of this, the low target uses the average of Chittenden County's proportion of the population and its proportion of the state's prime wind and solar areas, and the high target uses just the County's proportion of the population. Then, the existing renewable energy generation was subtracted out of each of the total low and total high target to estimate the amount of new generation needed for each range. The final target, therefore, reflects the total capacity that the LEAP System suggests is needed by 2050, allocated based on resource availability, demand, and existing capacity.

The targets are technology neutral, meaning that they can be met with any mix of technologies. These targets reflect Chittenden County's share of the renewable energy production that will be needed to meet the goal of 90% renewable energy by 2050.

The existing renewable energy generation for the County is summarized up from each municipalities' total existing renewable energy generation sited within a particular municipalities' borders. For example, Milton includes half of Georgia Mountain Community Wind because two turbines are within the town of Milton. Note that this total does not match exactly the renewable energy generation reported for Chittenden County by the Department of Public Service.

Municipal Generation Targets

To better understand how the region can achieve its 2050 target, the CCRPC used a methodology to determine new generation targets for each municipality in its region. The formula used for these calculations is simple and similar to that used for the regional projections just discussed. In order to calculate town-level targets, the CCRPC first considered a municipality's share of the region's population and averaged that with the municipality's share of the region's electricity consumption. These averaged proportions approximate each municipality's responsibility to develop new generation based on existing conditions and demand. The municipal targets are technology neutral, meaning that they can be met with any mix of technology. These targets break down the regional generation targets to the municipal level, based on population and electricity consumption and account for existing generation within a municipality's borders.

Town-Level Targets

To be added for next version

Constraints and Suitability Methodology

Constraints Methodology

State Constraints

The Department of Public Service has distributed energy planning standards, which establish known and possible constraints at the state level. Regions and municipalities can make constraints more restrictive (i.e. turn a possible constraint into a known constraint) but not less restrictive (i.e. turn a known constraint into a possible constraint). CCRPC has not made any changes to state constraints.

Local and Regional Constraints

Because one of the purposes of Act 174 is to give local land use policies greater weight in the Public Utilities Commission process, CCRPC's ECOS Plan includes local constraints in the energy siting maps and policies. In late 2016, CCRPC staff discussed the possibility of substantial deference for municipal land use policies with planning commissions and municipal staff, and asked municipalities to provide a list of "constraints" that they would like to see given substantial deference. The CCRPC Long Range Planning Committee Energy Subcommittee (the Subcommittee) asked staff to map the constraints provided by the municipalities. Municipalities requested known constraints (areas in which they wanted no renewable energy development), possible constraints (areas on which they wanted renewable energy development to be limited or impacts to be mitigated or minimized). All requested constraints were mapped in early 2017 and reviewed by the Subcommittee.

Based on feedback from the Department of Public Service, it was determined that for constraints on energy to be consistent with the Act 174 energy planning standards, the constraints had to be restrictive of all development, not just renewable energy development. With this in mind, CCRPC staff screened the constraints originally requested by municipalities and determined that a number of them originally requested as known constraints were not equally restrictive of all development. These constraints were considered possible constraints, based on the description below. If no supporting policies or regulations could be located to support a request for a possible constraint, the constraint was not included at all.

Please note that this is an ongoing process and CCRPC staff will work with municipalities to ensure that constraints are adequately characterized.

These local constraints are included in the ECOS Plan due to their importance at the local level. The ECOS Plan classified local constraints based on the following methodology. However, the description of constraints below is for classification only, and these descriptions are not the definitions of known and possible constraints as discussed in the policies of the ECOS Plan.

> **Known Constraints**: Zoning districts or resource areas where development is prohibited with no exceptions. Typically, phrases such as "development *shall not* take place" are used to denote these areas.
>
> **Possible Constraints**: Zoning districts or resource areas such as those in which:
>
> - Development is not completely prohibited, but impacts of development should be "minimized", "avoided," "limited," "avoided *where possible,*" mitigated or similar;
> - Development is allowed only following conditional use review;
> - The goals of the zoning district are such that large-scale energy development may not be appropriate, such as scenic overlay districts;

These constraints are identified in an adopted municipal plan or municipal land use regulation such as zoning regulations or subdivision regulations, in effect as of December 1, 2017.[34] Over the next few years CCRPC will be working with municipalities to complete energy planning, and will continue to review municipal plans through CCRPC's *Guidelines and Standards for Confirmation of Municipal Planning Processes and Approval of Municipal Plans*. CCRPC will check to ensure that any local policies don't preclude municipalities from meeting their energy generation targets and complying with the state energy goals. CCRPC will determine on a case by case basis if an edit is needed to the *ECOS Plan*.

CCRPC staff evaluated constraints based on the requests of the municipality. Not every development constraint in Chittenden County is reflected in the regional energy planning process, because some municipalities did not request any known or possible constraints (no requests from Buel's Gore, Huntington or St. George), or only requested that some of their resource protections considered.

While there was some overlap between the constraints requested by each municipality, no constraints emerged as being universal restrictions to development across the county. Therefore, no region-wide constraints were added.

Constraints are discussed in Strategies 3 and 4 of the ECOS Plan, which address the protection of natural resources.

Suitability Methodology

Constraints represent areas in which development, including energy generation, is restricted. However, areas in which development is generally appropriate still have different levels of *suitability* for different types and scales of renewable energy generation. This may be due to conflicts between energy generation and other types of planned development, or infrastructure capacity issues. Therefore, we have incorporated considerations of scale into our siting policy statements in Chapter 3 to address suitability.

[34] Subject to change based on ECOS hearing and adoption schedule.