CHITTENDEN COUNTY RPC
Communities Planning Together

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MEMORANDUM

To: Andrew Strniste, Planning Director, Town of Underhill; Underhill Planning Commission; Underhill Energy Committee
From: Chittenden County Regional Planning Commission
Date: February 12, 2018
Re: Analysis, Targets, and Maps for Enhanced Energy Planning

The purpose of this memo is to share CCRPC's updated *Municipal Energy Data Guide* for your municipality. This replaces the guide issued in April 2017. The guide can be accessed on the CCRPC website here: https://www.ccrpcvt.org/our-work/our-plans/regional-energy-plan/#energy-data-guides. The guide is intended to support municipal "Enhanced Energy Planning," which is needed to advance the State's energy goals. The State's energy goals are:

- To obtain 90% of all energy across all sectors (transportation, heating and electricity) from renewable sources by 2050, with the interim goals of 25% renewable by 2025 and 40% renewable by 2035;
- To reduce total energy consumption per capita by 15% by 2025, and by more than one third by 2050;
- To weatherize 25% of homes by 2020; and
- To reduce greenhouse gases by 50% from 1990 levels by 2028; and 75% by 2050.

The data in this guide provide an overview of current energy use and set targets for advancing the State's 2050 goals for energy use from heating, transportation, electricity, as well as the State's 2050 goals for renewable energy generation. Intermediate targets for 2025 and 2035 provide each municipality with checkpoints towards meeting these goals. This document incudes all data required to plan for these goals at a municipal level. Consistency with the goals above is measured through the Vermont Department of Public Service's "Energy Planning Standards for Municipal Plans." For the full standards, visit the Department of Public Service's website: http://publicservice.vermont.gov/content/act-174-recommendations-and-determination-standards. The data in this document meet the *Analysis and Targets* section of the Standards (Standards 4 and 5).

The projections in this guide are consistent with the ECOS Plan's Metropolitan Transportation Plan scenario. This Municipal Energy Data Guide replaces the one distributed to you in April 2017. The data in the Guide are subject to change until the ECOS Plan is adopted, likely in June 2018. The guide is meant to be only a starting point for discussions on how towns and the regions can begin to plan for meeting the Act 174 standards. It is a representation of possible conditions and should be used for planning purposes only. These data will not be used to assess whether energy generation projects, utilities or municipalities are meeting energy goals. More in-depth analysis or evaluation should be done to verify or confirm actual conditions for each scenario represented, as errors or omissions may exist in the data.

A. Current Energy Use and Generation

The data below are from various sources and represent actual current consumption and generation, rather than estimates from the Long-Range Energy Alternatives (LEAP) model. Estimates from the LEAP model are shown in Section B.

Table A1. Current Municipal Transportation Energy Use

Fossil Fuel Burning Light Duty Vehicles, 2015	2,404
Electric Light Duty Vehicles, July 2017	14
Sources: Drive Electric Vermont, DMV	

Table A2. Number of Homes Heating with Delivered Fuels, 2015

Number of homes heating with Fuel oil, Kerosene	530 homes (46% of homes)
Number of homes heating with Propane	214 homes (18% of homes)
Percentage of Households Heating with Delivered Fuels	64% of homes
Sources: American Community Survey 2011-2015 5-Year Estimate	

Table A3. Current Thermal Energy Use from Natural Gas, 2015

Total Residential Natural Gas Consumption (MMBtu)	11,323
Percentage of Municipal Natural Gas Consumption	92%
Total Commercial/Industrial Natural Gas Consumption (MMBtu)	924
Percentage of Municipal Natural Gas Consumption	8%
Total Municipal Natural Gas Consumption	12,247
Sources: Vermont Gas	

Table A4. Recent Residential Energy Efficiency Projects

	2014	2015	2016
Home Performance with ENERGY STAR® Leads	13	13	15
Home Performance with ENERGY STAR® Projects	5	1	6
Total Residential Projects (includes Home Performance with ENERGY STAR® projects)	30	65	68
Source: Efficiency Vermont, October 2017			

Table A5. Electrical Energy Use, 2015

Residential Electric Energy Use (MWh)	9,453
Commercial and Industrial Electric Energy Use (MWh)	1,362
Total Electric Energy Use (MWh)	10,815
Sources: Efficiency Vermont, October 2017	

Table A6. Existing Renewable Electricity Generation

	Sites	Power (MW)	Energy (MWh)
Solar	95	.68	765
Wind	0	0	0
Hydroelectric	0	0	0
Biomass (Wood)	0	0	0
Other	0	0	0
Total	95	.68	765

Source: Community Energy Dashboard, July 2017

B. Projected Energy Use

Projected future energy use targets are drawn from the Long-range Energy Alternatives Planning (LEAP) analysis for Chittenden County, completed by the Vermont Energy Investment Corporation (VEIC). LEAP is an accounting framework that shows one possible path for Chittenden County and its municipalities to meet the State's energy goals required for enhanced energy plans. LEAP aggregates existing energy use data and forecasts the demand for energy and sources of energy over time, based on a set of anticipated economic and policy changes. For example, demographic projections are one component of projecting future energy use. LEAP is well suited for examining how energy systems might evolve over time to meet certain goals (in this case, Vermont's goal to gain 90% of energy from renewable sources by 2050). These targets show the direction and magnitude of change needed meet local, regional and state energy goals

It is also important to remember that the targets established by LEAP represent only one way to achieve each municipality's energy goals. Other strategies may allow the municipality to meet its goals (for example, switching some wood heating systems to heat pump systems). If desired, CCRPC will provide the spreadsheets and source materials used to calculate these data, and a municipality can revise their targets. Many of these targets are associated with concrete implementation actions. The Department of Public Service's Guidance on implementation actions can be found here: http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Act_174/Municipal%20Guidance_Final.pdf

For more information on the LEAP model, including its underlying assumptions, please see Draft 2018 ECOS Plan Supplement 6 – Energy Analysis, Targets, & Methodology, available here: http://www.ecosproject.com/2018-ecos-plan/

Table B1. Projected Transportation Energy Use, 2025-2050

	2025	2035	2050
Total Light Duty Transportation Energy Use (MMBtu)	141,728	89,775	39,128
Electricity Used for Light Duty Transportation (MMBtu)	1,890	13,028	27,495
Light Duty Electric Vehicles (% of Vehicle Fleet)	6%	41%	89%
Biofuel Blended* Energy Used for Light Duty Transportation (MMBtu)	139,838	76,748	11,633
Biofuel Blend*Light Duty Vehicles (% of Vehicle Fleet)	94%	59%	11%
Heavy-Duty Transportation Energy Use from Biodiesel (Percent of Total)	33%	58%	96%
Heavy-Duty Transportation Energy Use from Fossil Fuels (Percent of Total)	67%	42%	4%

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

Sources: VTrans, LEAP Model

Table B2. Projected Commercial and Industrial Thermal Energy Use, 2025-2050

	2025	2035	2050
Total Commercial and Industrial Thermal Energy Use (MMBtu)	30,136	28,704	25,389
Percent of Commercial and Industrial Establishments Weatherized by Target Year	25%	27%	47%
Energy Saved by Weatherization by Target Year (MMBtu)	1,620	2,246	5,413
Commercial and Industrial Establishments Using Heat Pumps (%)	27%	44%	49%
Commercial and Industrial Thermal Energy Use by Heat Pumps (MMBtu)	2,444	4,831	7,217
Commercial and Industrial Establishments Using Wood Heating (%)	12%	13%	14%
Commercial and Industrial Thermal Energy Use Attributable to Wood Heating (MMBtu)	3,646	5,022	7,353
Sources: LEAP Model, Department of Public Service, Department of Labor			

Table B3. Projected Residential Thermal Energy Use, 2025-2050

	2025	2035	2050
Total Residential Thermal Energy Use (MMBtu)	103,340	87,620	60,665
Percent of Residences Weatherized by Target Year	14%	36%	100%
Energy Saved by Weatherization by Target Year (MMBtu)	4,824	13,176	41,241
Percent of Residences Using Heat Pumps	18%	37%	60%
Residential Thermal Energy Use from Heat Pumps (MMBtu)	6,698	13,780	20,203
Residences Using Wood Heating (%)	14%	14%	14%
Residential Thermal Energy Use from Wood Heating (MMBtu)	18,977	18,995	16,690
Sources: LEAP Model, Department of Public Service			

Table B4. Projected Electrical Energy Use, 2025-2050

	2025	2035	2050
Without Industrial (MWh)	8,572	10,926	14,160
Industrial Only (MWh)	2,782	3,597	4,828
Total (MWh)	11,354	14,523	18,988
Total Electric Energy Saved (MWh)	1,958	3,953	7,393
Residences that have increased their Electric Efficiency	30%	58%	98%
Commercial and Industrial Establishments that have Increased Their Electric Efficiency	30%	58%	98%

Source: LEAP Model

**Please note that industrial electricity use is recognized as the most difficult element to project in the LEAP model, because of regional discrepancies in data from the commercial and industrial sector. Therefore, projected electricity use and total energy use are reported two ways: with industrial electricity use included and excluded.*

Table B5. Projected Total Energy Use Per Capita (Including Industrial Electricity Use*) 2015-2050

	2015	2025	2035	2050
Total Energy Use (MMBtu)	347,154	313,943	255,652	189,967
Population	3,064	3,144	3,193	3,344
Total Energy Use Per Capita (MMBtu)	113	100	80	57
Reduction in Total Energy Use Per Capita since 2015	--	-12%	-29%	-50%

Source: LEAP Model

**Please note that industrial electricity use is recognized as the most difficult element to project in the LEAP model, because of regional discrepancies in data from the commercial and industrial sector. Therefore, projected electricity use and total energy use are reported two ways: with industrial electricity use included and excluded.*

Table B6. Projected Total Energy Use Per Capita (Excluding Industrial Electricity Use) 2015-2050

	2015	2025	2035	2050
Total Energy Use (MMBtu)	340,464	304,452	243,380	173,494
Population	3,064	3,144	3,193	3,344
Total Energy Use Per Capita (MMBtu)	111	97	76	52
Reduction in Total Energy Use Per Capita since 2015	--	-13%	-31%	-53%

Source: LEAP Model

**Please note that industrial electricity use is recognized as the most difficult element to project in the LEAP model, because of regional discrepancies in data from the commercial and industrial sector. Therefore, projected electricity use and total energy use are reported two ways: with industrial electricity use included and excluded.*

C. Projected Renewable Energy Generation Potential

This guide also reports how much wind and solar generation potential exists in the municipality, and sets targets for additional renewable energy generation within each municipality. However, the generation targets are technology neutral, meaning a municipality can use any form of renewable generation (wind, solar, biomass, hydroelectric, etc.) to meet its goals. For more information on how these targets were determined, please see Draft 2018 ECOS Plan Supplement 6 – Energy Analysis, Targets, & Methodology, available here: http://www.ecosproject.com/2018-ecos-plan/

Prime solar or wind areas are areas where models show the appropriate conditions for electricity generation, and where there are no constraints. Base solar or wind areas are areas where models show the appropriate conditions for electricity generation, but where there are possible constraints, which must be considered during development and may reduce the development potential of a site. The draft 2018 ECOS Plan indicates that *"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."* Please see Table C4 for the list of constraints.

A municipality's reported land available for wind and solar generation and generation potential are based on models of the elevation, slope, and aspect of land, or the modeled wind speed, in a municipality. These models do not remove existing impervious surfaces. Therefore, land-based generation potential may be over-estimated for municipalities with a high percentage of impervious surface, including Burlington, Winooski and Essex Junction.

Table C1. Land Available for Wind and Solar Generation

	Prime Potential	Base Potential
Solar	795 acres (2% of town)	4,487 acres (14% of town)
Wind	366 acres (1% of town)	10,139 acres (31% of town)

Source: CCRPC and the Department of Public Service

Table C2. Projected Renewable Electricity Generation Potential

	Power (MW)	Energy (MWh)
Rooftop Solar*	2.4	2,985
Ground-Mounted Solar* – Prime	99	121,934
Ground-Mounted Solar* – Base	75	91,707
Wind – Prime	15	44,492
Wind – Base	406	1,243,438
Hydro	See Hydro Map	
Biomass	See Biomass Map	
Methane	Unknown	Unknown
Other	Unknown	Unknown

Source: CCRPC and the Department of Public Service

*Rooftop solar potential is calculated by assuming that a certain percentage of rooftops can hold solar systems. Ground-mounted solar potential reports how much land could be developed with solar based on its aspect and elevation, and does not remove space taken up by impervious surfaces like roofs. Therefore, rooftop solar potential cannot be added to ground-mounted solar potential, as this would lead to some generation potential being double counted.

Table C3. New Renewable Electricity Generation Targets

	2025		2035		2050	
	Low	**High**	**Low**	**High**	**Low**	**High**
Generation Targets – Any Technology (MWh)	2,473	4,284	4,946	8,569	8,656	14,995

Sources: LEAP Model and CCRPC Modeling

These targets are in addition to what the municipality is already generating.

Table C4. State/Local Known and Possible Constraints

State Known Constraints	State Possible Constraints	Local Known Constraints	Local Possible 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)	Agricultural Soils + Hydric Soils Act 250 Ag. Soil Mitigation Areas FEMA Special Flood Hazard Areas VT Conservation Design Highest Priority Forest Blocks (Forest Blocks – Connectivity, Forest Blocks – Interior, Forest Blocks - Physical Land Division) Highest Priority Wildlife Crossings Highest Priority Wildlife Crossings Protected Lands (State fee lands and private conservation lands) Deer Wintering Areas	Above 1,500 ft. Elevation	Slopes 15% or greater Mt. Mansfield Scenic Preservation District Wetlands and associated buffers, Surface Waters and buffers

D. Mapping

The maps in this section meet the Act 174 Mapping standards for your municipality. Municipal plans must include the maps contained within this section. These maps identify potential areas for development and siting of solar and wind generation which account for areas that are unsuitable for siting renewable energy generation because of the presence of state/local known and possible constraints, identified in table C4. Maps showing preferred sites/existing renewable generation facilities, hydro and biomass generation are also included.

These maps should be used in conjunction with complementary policies in the town plan. The map identifying constrained areas is a visual representation of the constraints listed above. A certified Enhanced Energy Plan means that a municipality's "land conservation measures and specific policies" might be given substantial deference during project review under 30 V.S.A. § 248. However, for these measures and policies to be given substantial deference, they must be clearly included in the text, as a map may lack sufficient clarity or granularity regarding the area in which a project is proposed.

Existing Renewable Energy Sites & Preferred Sites

Underhill, Vermont
Act 174
The Energy Development Improvement Act of 2016

This map and the corresponding data is intended to be used to inform energy planning efforts by municipalities and regions. They may also be used for conceptual planning or initial site identification by those interested in developing renewable energy infrastructure. They should NOT take the place of site-specific investigation for a proposed facility and should not be used as "siting maps."

N

0 0.75 1.5 3 Miles

Existing Site Type

- Wind Site
- Hydropower
- Methane
- Wood Chip or Pellet Heat
- Solar Site

Preferred Sites

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

Sources:
Closed Landfill-ANR
Sand or Gravel Pit--ANR
Parking Lots-CCRPC
3-Phase Power-VCGI, BED
Existing Sites-EAN, 10.2017
Major Roads and Railroad - VTrans
Town Boundary and Water Body - VCGI
Map produced with ArcGIS,
State Plane Coordinate System NAD83.

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\Towns\ExistingGeneration\ExistingGenTownPortraitTemplate.mxd

Date: 2/12/2018

Fairfax
CAMBRIDGE RD
Westford
Cambridge
15
PLEASANT VALLEY RD
RIVER RD
Jericho
Stowe
Bolton

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State Known Constraints

Underhill, Vermont
Act 174
The Energy Development Improvement Act of 2016

Known local constraints are listed in the text.

Document Path: D:\Projects17\Act174\Maps\Towns\KnownConstraints\KnownConstraints_TownTemplatePortrait_20180212.mxd

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- Vernal Pools (Confirmed)
- Vernal Pools (Unconfirmed)
- FEMA Floodways
- Vermont Department of Environmental Conservation River Corridors*
- State-significant Natural Communities & RTE Species
- Class 1 and 2 Wetlands

*Note: River corridors are comprised of meander belt and riparian buffer components for the purpose of achieving and maintaining stream equilibrium conditions. Small streams draining 0.5 to 2 square miles and a 50 ft. buffer are also included.

N

0 0.5 1 2 Miles

Fairfax
CAMBRIDGE RD
Westford
Cambridge
15
PLEASANT VALLEY RD
RIVER RD
Jericho
CHITTENDEN COUNTY

Sources:
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, VSWI Advisory Layer, 2017

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Possible State Constraints

Possible Local Constraints are listed in the text

Underhill, Vermont
Act 174
The Energy Development Improvement Act of 2016

- FEMA Special Flood Hazard Areas
- Agricultural Soils
- ACT 250 Ag Mitigation Parcel
- Hydric Soils
- Deer Wintering Areas
- Protected Lands
- Priority Forest Blocks (Connectivity)
- Priority Forest Blocks (Interior)
- Priority Forest Blocks (Physical Landscape Diversity)

N

0 0.5 1 2 Miles

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Fairfax
CAMBRIDGE RD
Westford
Cambridge
15
PLEASANT VALLEY RD
Essex
RIVER RD
Jericho

Sources:
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

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Potential Solar Energy Resource Areas

Underhill, Vermont
Act 174
The Energy Development Improvement Act of 2016

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N

0 0.5 1 2 Miles

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

3 Phase Power Lines

Transmission Lines

Sources:
Solar Energy Resource Areas;VCGI,2017
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Date: 2/12/2018

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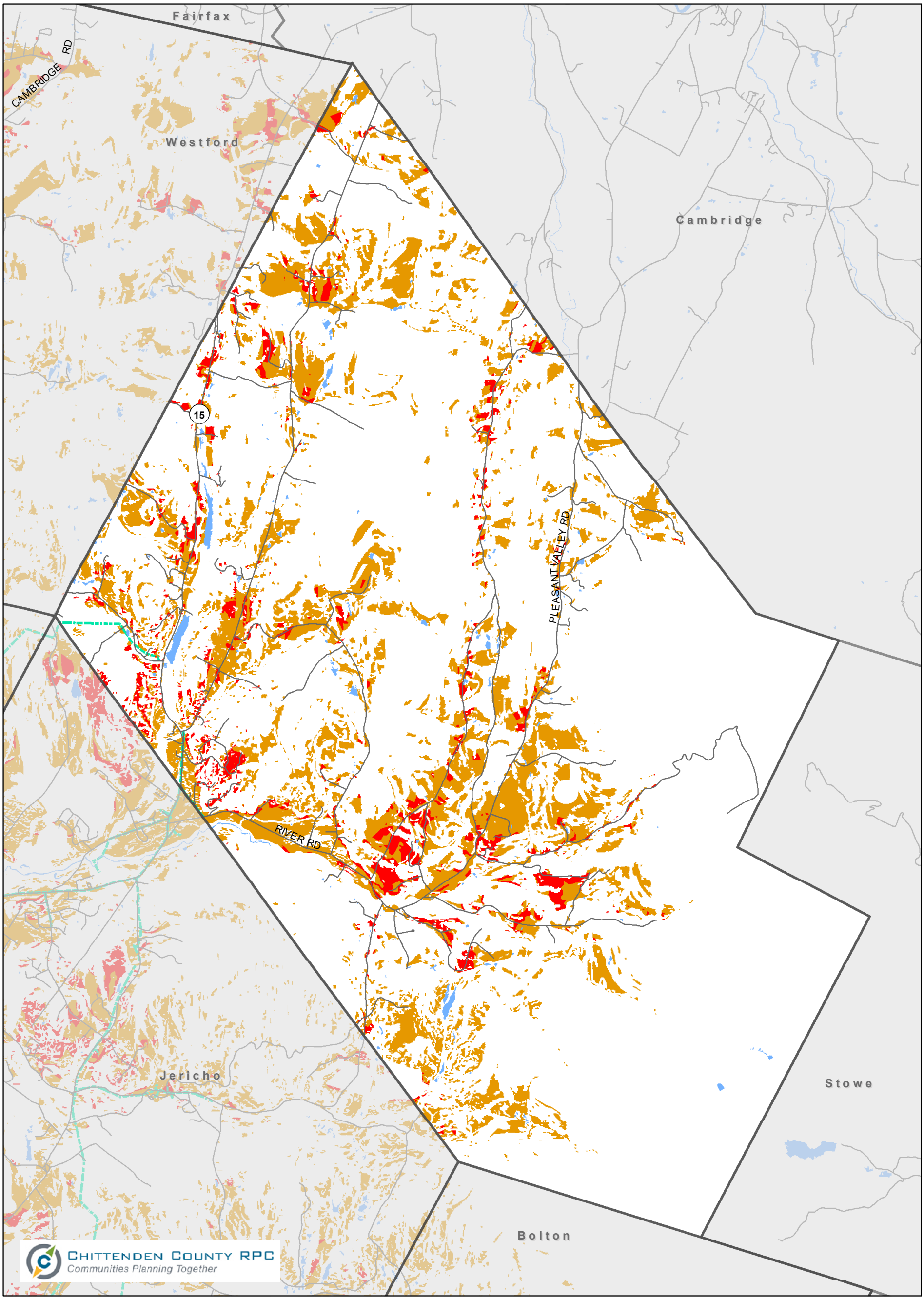

Potential Wind Energy Resource Areas

Underhill, Vermont
Act 174
The Energy Development Improvement Act of 2016

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N

0 0.5 1 2 Miles

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

3 Phase Power Lines

Transmission Lines

Sources:
Wind Energy Resource Areas;VCGI,2017
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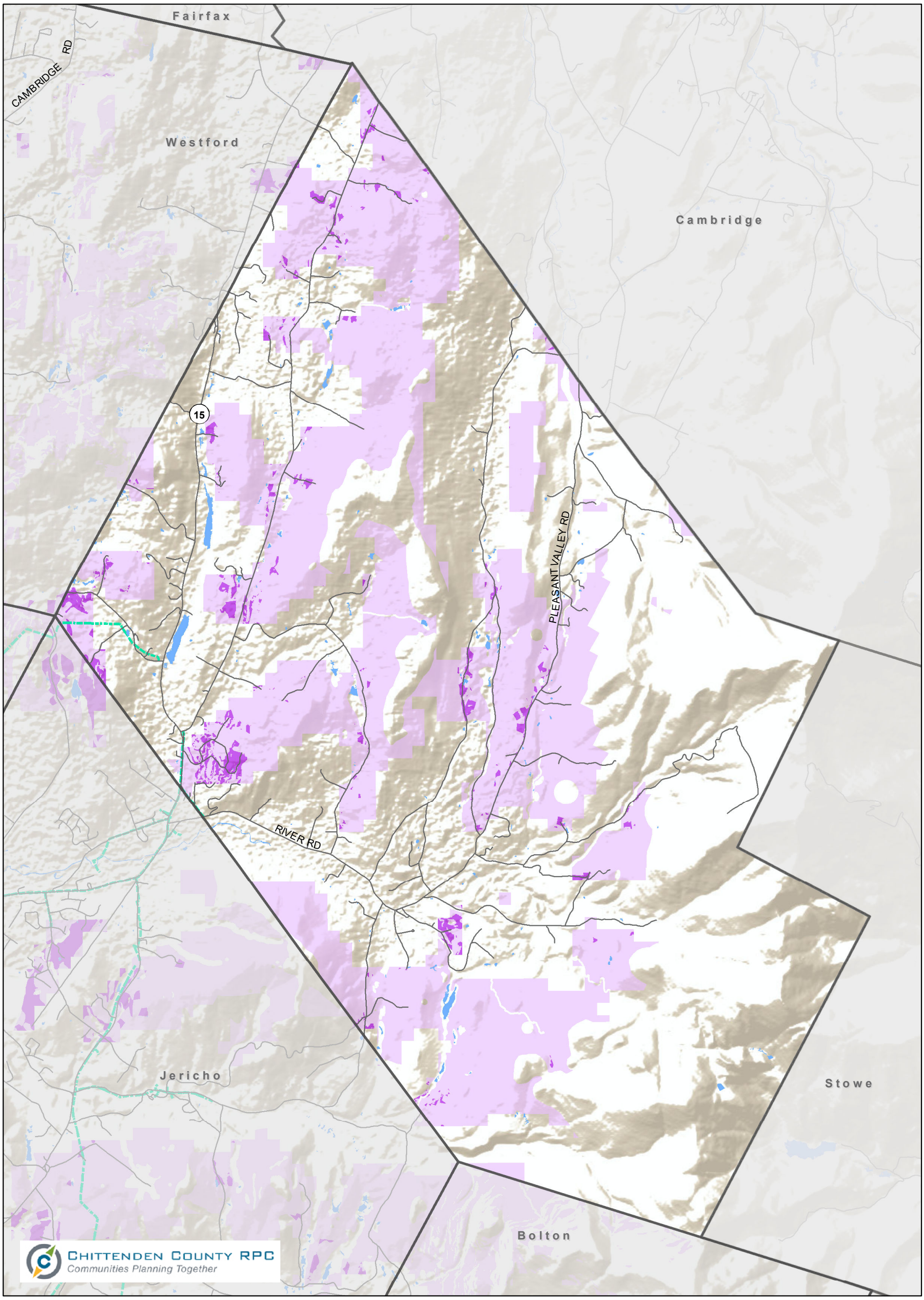
Date: 2/12/2018



Woody Biomass Resource Locations

Chittenden County, Vermont
Act 174
The Energy Development Improvement Act of 2016

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0 1.75 3.5 7 MilesB

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Legend

Woody Biomass Resource Areas

N

Date: 4/29/2017

DRAFT

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

CHITTENDEN COUNTY

Note: These maps are intended to provide guidance regarding appropriate and inappropriate places for renewable energy development based on a GIS analysis and to act as an initial resource for identifying suitable areas for energy siting and our region.

What these maps don't do. Take all local 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.

These maps are not intended to be used without the accompanying policies contained within the regional energy plan.

Hydro- Electric Energy Resource Locations

Chittenden County, Vermont
Act 174
The Energy Development Improvement Act of 2016

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0 1.75 3.5 7 Miles

Document Path: D:\Projects17\Act174\Maps\County\Act174EnergyMap_CC_HydroGen.mxd

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
- Transmission lines
- OH_Primary
- UG_Primary

N

Date: 4/26/2017

DRAFT

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

CHITTENDEN COUNTY

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