

Underhill Climate Action Plan

Climate Action Task Force

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Table of Contents

Tables and Figures	3
The Climate in Vermont Has Changed	4
Underhill Climate and Natural Hazards	6
What is a Climate Action Plan?	8
Why have a Climate Action Plan?	8
Underhill Community Profile	9
Equity in Addressing Climate Change	10
Greenhouse Gas Inventory	12
Sector Targets and Actions	12
Transportation	12
Transportation Strategies	14
Buildings	15
Buildings Strategies	16
Renewable Energy	17
Renewable Energy Strategies	20
Natural and Working Lands	21
Natural and Working Lands Strategies	22
High Impact Actions	22
Adaptation and Resilience	24
Resilience and Adaptation Strategies	24
How to Prioritize Individual Actions	26
Municipal Next Steps	29

Appendices	31
Appendix 1 - Glossary.....	32
Appendix 2 - Funding	34
Appendix 3: Implementation Guidance.....	36

Tables and Figures

Table 1. Federal Disaster And Emergency Declarations For	6
Table 2. Underhill Natural hazards impacts, 1990-2021	7
Table 3. Underhill Natural Hazards, 1990-2021	7
Table 4. Underhill demographics and housing, 2021	9
Table 5. Underhill Electric passenger vehicles targets.....	13
Table 6. Home weatherization and heating targets.....	15
Table 7. Underhill weatherization and heat pump data from efficiency Vermont.....	16
Table 8. Underhill potential locations for renewable energy. Base locations have constraints, Prime locations have no known constraints.	18
Table 9. Underhill renewable energy potential.	18
Table 10. Renewable energy generation targets for Underhill.....	19
Table 11. Timeline for Climate Action Plan.....	30

The Climate in Vermont Has Changed

In Vermont, over the past 50 years, the average air temperatures have increased 2° F in summer and 4° F in winter, annual precipitation has increased by almost 7 inches, and winters come later and springs come earlier. Additional warming will continue and is likely to reach 1.5 °C (2.7° F) globally by 2052. Beyond mid-century, the extent of the warming will depend on what actions we take now to reduce greenhouse gas emissions.



*Source: Vermont Health Department website, www.healthvermont.gov/health-environment/climate-health/climate-change

This rate of warming is likely to increase risks to health, livelihoods, food security, water supply, property, human security, and economic growth.

The Intergovernmental Panel on Climate Change (IPCC) report and other summaries of climate change impacts warn that without immediate concerted action coral reefs will disappear, coastal cities will flood, drought will deplete the breadbaskets that today feed the world and ecosystems will fail.

“Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a livable and sustainable future for all.”

- Co-Chair Intergovernmental Panel on Climate Change (IPCC) Working Group II



92 bird species of Vermont, including the common loon and hermit thrush, are expected to disappear from the landscape within the next 25 years.



Climate change exacerbates the threats that invasive plants, insects, and diseases already pose to the health of Vermont's forests.



Climate change will have a negative impact on fruit-bearing species like apple trees that require a sufficient over-wintering period for success in the next growing season. The maple syrup industry is also at risk due to variations in winter temperatures.



In 2017, Vermont had the highest rate of reported confirmed and probable Lyme disease cases in the U.S. 1,093 cases of Lyme disease were reported to the Health Department in 2017, the highest annual count ever recorded in Vermont.¹ In the early 1990s, the Health Department received a dozen or fewer confirmed reports of the illness each year.



Flooding is the most likely natural disaster to occur in Vermont; however, extremes will become more common, such as drought. Additionally, more precipitation damages roads and property and increases runoff creating favorable conditions for cyanobacteria blooms which are harmful to human health.



Increases in natural disasters in Vermont will likely increase the risk of injury, illness, and death.



Impacts could affect the quality and safety of food and water, which could lead to increases in food and water-borne illnesses.



Impacts could contribute to mental health challenges.



Children, people over 65 years of age, people of low socioeconomic status, Indigenous people, or people with previous health issues are more vulnerable to the health effects of climate change.

Source: Vermont Climate Assessment, 2021 (<https://site.uvm.edu/vtclimateassessment/>) and Vermont Department of Health, Climate Change in Vermont (<https://www.healthvermont.gov/health-environment/climate-health/climate-change>)

Underhill Climate and Natural Hazards

Changeable weather is common in Underhill but the extreme weather events that result in significant damage to town infrastructure, property, and natural resources are of special concern. The town's north-south hill and valley topography can create localized conditions, such as wind tunnels, in different parts of town. The steep slopes of Mount Mansfield heighten surface soil runoff velocity during storms, leading to flash flooding and significant fluvial erosion especially during intense rain events. Winter storms with high winds are also frequent in Underhill and have resulted in significant property damage over the past several decades.

The Town of Underhill has been included in eleven Federal Disaster or Emergency Declarations since 1990, all but two as a result of severe storms or flooding (Table 1). During this time period there were 320 hazard events resulting in \$9,118,500 of property damages and \$540,000 of crop damages. The Town Hazard Mitigation Plan identifies hazards expected over the life of the Plan (5 years). While climate hazards will change in the future, many of the current hazards are likely to continue and will likely intensify.

TABLE I. Federal Disaster And Emergency Declarations For Chittenden County, Including The Town Of Underhill (1990-2021)¹

Tropical Storm Henri, August 2021
Vermont Covid-19 Pandemic, April 2020
Vermont Covid-19 Pandemic, March 2020
Severe Storm and flooding, January 2020
Severe Storm and flooding, June 2015
Severe Storm and flooding, August 2013
Tropical Storm Irene, September 2011
Severe Storm and flooding, June 2011
Snowstorm, April 2001
Severe Storm and flooding, July 1998
Ice jams and flooding, January 1996
Flooding, June 1990

¹ Underhill Hazard Mitigation Plan, 2022 [Hazard Mitigation Plan - CCRPC \(ccrpcvt.org\)](https://www.ccrpcvt.org/)

TABLE 3. UNDERHILL NATURAL HAZARDS, 1990-2021³

<u>High Hazards</u>
Severe Winter Storm
Flood
Severe Rainstorm
<u>Medium Hazards</u>
Fluvial Erosion
Human Infectious Disease
Wildfire
<u>Low Hazards</u>
Invasive Species
Extreme Temperatures

TABLE 2. UNDERHILL NATURAL HAZARDS IMPACTS, 1990-2021²

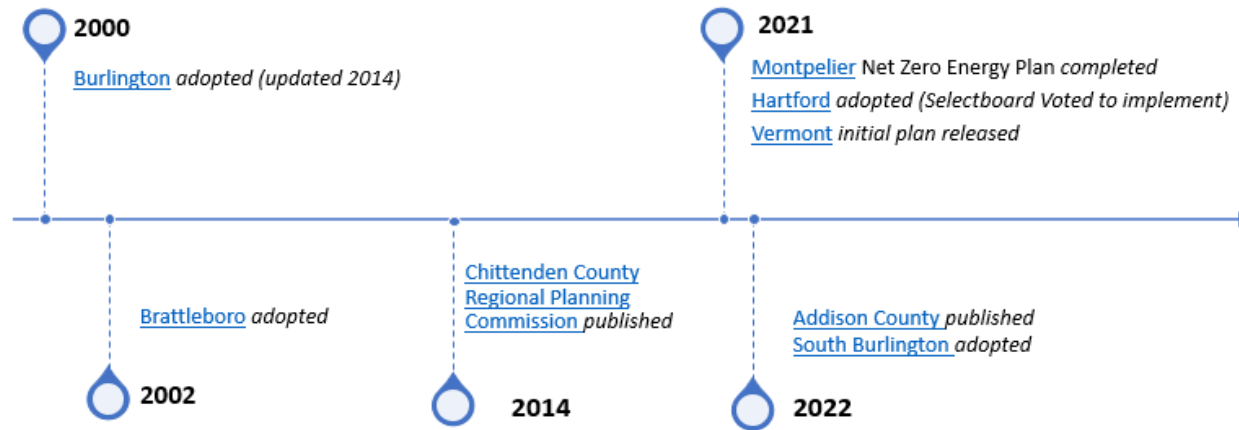
Event Type	Number of incidents	Direct Deaths	Direct Injuries	Property Damage	Crop Damage
Cold/Wind Chill	10	0	0	0	0
Extreme Cold/Wind Chill	5	0	0	0	0
Flash Flood	8	0	0	\$3,675,000	0
Flood	11	1	0	\$133,000	0
Frost/Freeze	2	0	0	0	\$25,000
Hail	11	0	0	0	0
Heat	2	0	0	0	\$500,000
Heavy Rain	6	0	0	\$50,000	0
Heavy Snow	5	0	0	\$107,000	0
High Wind	25	0	1	\$2,161,000	0
Ice Storm	1	0	0	\$200,000	0
Lightning	1	0	0	0	0
Strong Wind	35	0	0	\$412,000	0
Thunderstorm Wind	7	0	0	\$39,000	0
Winter Storm	90	0	2	\$1,658,000	\$15,000
Winter Weather	98	1	0	\$683,500	0
Total	320	2	3	\$9,118,500	\$540,000

² Underhill Hazard Mitigation Plan, 2022

³ Underhill Hazard Mitigation Plan, 2022

What is a Climate Action Plan?

A climate action plan is a framework for measuring and reducing greenhouse gas emissions and to prepare the municipality for impacts of a warming climate. Climate action plans include an inventory of existing emissions, reduction goals or targets, and prioritized reduction actions. They may also identify resilience and adaptation needs that prepare communities and natural resources for climate impacts, as this one does. The initial statewide climate action plan for Vermont was released in 2021. Several town and regional governments in Vermont have climate action plans.



Why have a Climate Action Plan?

Climate action plans address the greenhouse gas emissions (GHG) that are causing global warming. Transportation from internal combustion vehicles and delivered heating fuel are the primary sources of Underhill's greenhouse gas emissions.

Electricity in Vermont has much lower GHG emissions than in the past due to the state's creation of a Renewable Energy Standard (RES) in 2017. Green Mountain Power (GMP) is now 100% carbon free and Vermont Electric Coop (VEC) is now 90% carbon free.

Underhill can reduce its climate pollution from transportation and delivered heating fuel by implementing actions that reduce the need for and accelerate the transition to electric appliances, vehicles and heat sources, such as heat pumps. Additionally, nature-based solutions such as protecting forests for carbon sequestration and resilience and adaptation solutions such as smart growth land use strategies can support decarbonization efforts and prepare for a changing climate.

Underhill Community Profile

When implementing actions to reduce greenhouse gas emissions and increase resilience to climate change impacts, implementing equitable actions requires an understanding of Underhill’s demographics, housing, income, and vulnerable populations (Table 4).

TABLE 4. UNDERHILL DEMOGRAPHICS AND HOUSING, 2021⁴

Population	Households	Owner Occupied Homes	Median Home Value ⁵	Median Household Income ⁵	Median Age
3,561	1,426	84.4%	\$340,100	\$85,769	41

Vulnerable Households⁶

The Underhill Hazard Mitigation Plan identifies vulnerable populations as residents under 18, residents 60 and over, and residents whose income is below the poverty line. For climate resilience, additional vulnerable populations would include households already financially stretched and less able to withstand serious property damage or other hazard-related issues. In Underhill, 38.4% of households with mortgages pay 30% or more of their income on housing (Figure 1). Residents who own their own homes without a mortgage and still pay greater than 30% of their income on housing include 29 Underhill households.

Housing Costs as a Percent of Income

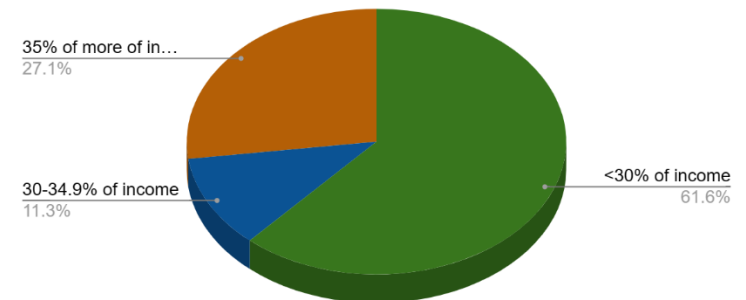


FIGURE 1. UNDERHILL DATA ON RESIDENT'S HOUSING COSTS AS A PERCENTAGE OF INCOME, 2021

⁴ American Community Survey 2017 - 2021 ACS 5-Year Data Profile

⁵ More recent data (2022) shows that median home prices for Underhill are now \$486,500 and median household income is \$87,227. These data from www.housingdate.org are compiled from the following: American Community Survey (ACS) 5-year estimates from the U.S. Census Bureau, the Multiple Listing Service (MLS), the Vermont Department of Taxes, and the National Low Income Housing Coalition’s (NLIHC) Out of Reach report.

⁶ American Community Survey 2017 - 2021 ACS 5-Year Data Profile

Of the 1,426 homes, 1,189 are occupied by the owner with an average of 2.3 people living in the home. There are 219 houses occupied by renters with an average of 3.7 people living in each home.

Vulnerability can also be associated with location. Underhill has 18 structures in the Special Flood Hazard Area, 17 residential and 1 non-residential for a total of 40 residents. These buildings are at risk during flooding, with the potential residential losses estimated at \$5,081,541 and potential non-residential losses estimated at \$135,305.⁷

Vehicle Use⁸

Not every home in Underhill has a car. There are an estimated 47 homes that don't have cars. An additional 326 homes have only 1 vehicle and there are 432 homes that have 3 or more vehicles. Green Mountain Transit has one stop in Underhill Flats via the [Jeffersonville Commuter Route](#) with 2 morning and 2 evening bus options to Burlington. Underhill also subscribes to SSTA for use by seniors to travel to Essex Junction.

Home Heating Fuels⁹

Most residents in Underhill heat their homes with fossil fuels (71.1%). Wood fuel is used as a primary heating source by an estimated 24.6% of homes and is currently the largest renewable energy source used in Underhill.

Equity in Addressing Climate Change

Climate change policies burden renters, people living in multi-unit housing, lower income and fixed income households, Black, Indigenous, and people of color, and seniors. The risk of inequity arising due to unforeseen burdens, as well as the opportunity for positive benefits or co-benefits from a target policy are key components of equity considerations. As Underhill climate action plan policies are considered and implemented, it is important to ask the questions below for more inclusive decision-making.

⁷ Flood Ready Vermont [Welcome to Flood Ready Vermont | Flood Ready](#)

⁸ American Community Survey 2020, 5-year data

⁹ American Community Survey 2020, 5-year data



Who is helped?



Who is harmed?



Who is missing?

Things to consider from the [State of Vermont Climate Council's Guiding Principles for a Just Transition](#):



All recommendations directly identify and support relevant impacted and frontline communities.



Investments, policies, administration, and oversight tackle the needs of impacted people first, providing the greatest benefits of transitions to these communities.



Future climate goals must be broad for the well-being of all Vermonters and include targeted strategies for different groups that take into account their specific histories, sociocultural and economic realities.



Where plans and policies create burdens, these burdens are shifted away from impacted communities.

Greenhouse Gas Inventory

The Chittenden County Regional Planning Commission (CCRPC) conducted a regional Greenhouse Gas (GHG) Emissions Inventory as part of the *Chittenden County Climate Action Guide (2014)*. The GHG Emissions Inventory provides an accounting of the primary contributors of greenhouse gas emissions within Chittenden County and its municipalities for the identified 2010 base year. To note, certain data necessary to measure greenhouse gas emissions may deviate from the base year due to data availability.

According to the GHG Emissions Inventory estimates, the Town of Underhill emits 17,787 metric tons of carbon dioxide-equivalent greenhouse gasses.

In 2010, the largest source of emissions was transportation, making up 66% of Underhill's GHG emissions. Transportation emissions were determined on a county-wide basis using vehicle miles traveled (VMT), and Underhill's proportionate share of transportation emissions were calculated from vehicles moving within Underhill's boundaries, including through traffic originating within county boundaries. VMT originating outside of Chittenden County were not included. For a more detailed analysis of the GHG inventory and data collection methods, see [Chittenden County Regional Climate Action Guide \(2014\)](#).

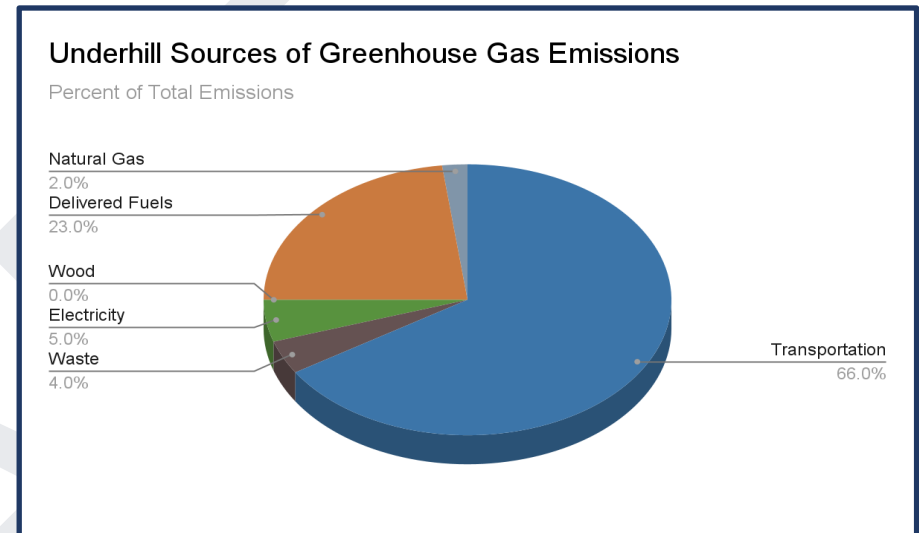


FIGURE 2. UNDERHILL GREENHOUSE GAS EMISSIONS AND SOURCES, 2010.

Sector Targets and Actions

Transportation

The transportation energy targets for the Town of Underhill (Table 5) will result in more than 70% reduction in total transportation energy use over the coming 25 years. This represents an ambitious electrification of the transportation sector. Achieving this goal will primarily consist of converting fossil fuel vehicles to efficient electric vehicles. The electrification of cars and small trucks (i.e. light duty vehicles) will lead to a dramatic increase in electricity usage, but at the same time, a decrease in gasoline consumption. Electric vehicles require roughly 70% less total energy to accomplish their transportation function. With respect to heavy-duty vehicles, transitioning to biodiesel as the primary fuel source as an interim strategy

pending better solutions is the principal strategy. To achieve the transportation energy target for heavy-duty vehicles, 96% of fleet vehicles would need to be converted by 2050.

TABLE 5. UNDERHILL ELECTRIC PASSENGER VEHICLES TARGETS.¹⁰

Vehicle Type	2025 MMBTU ¹¹	2025 % of Vehicles	2035 MMBTU	2035 % of Vehicles	2050 MMBTU	2050 % of Vehicles
All Passenger Vehicles	141,728		89,775		39,128	
Electric Passenger Vehicles	1,890	6%	13,028	41%	27,495	89%
Combustion Engine Vehicles	139,838	94%	76,748	59%	11,633	11%
Biodiesel Heavy-Duty Vehicles		33%		58%		96%
Fossil Fueled Heavy-Duty Vehicles		67%		42%		4%

To meet Underhill’s GHG emissions reduction goals, 41% of cars and small trucks need to be electrified by 2035. At least half of vehicles should be all electric and the remainder should be plug-in hybrid EVs. Transportation emissions from combustion engines will also be reduced somewhat due to improvements in Corporate Average Fuel Economy (CAFÉ) standards. Reducing travel to work by supporting internet connectivity expansion and upgrades will be another major boost. Further, applying smart growth principles of compact villages with a strong local economy will reduce vehicle miles traveled. Future goals addressing electrification of large trucks and heavy-duty equipment will be needed.

¹⁰ Underhill Town Plan, 2021

¹¹ MMBTU=Million British Thermal Units, a measure of heat and energy

TARGET: Transition 41% of cars and small trucks to electric or plug-in hybrid (PHEV) by 2035, reduce vehicle miles traveled (VMT)¹², and reduce total transportation energy demand by 37% by 2035

PROGRESS: As of January 2022: There were 45 electric vehicles registered in Underhill. This represents about 1.4% of Underhill's light duty vehicles electrified. According to Drive Electric Vermont, this percentage is in line with state-wide numbers.

Transportation Strategies

1. Promote a change over from fossil fuel vehicles to electric vehicles.
2. Increase infrastructure to support electric vehicles use.
3. Support actions that reduce individual vehicle use.
4. Reduce miles traveled by providing telecommuting options and supporting local economic activity.

HIGH IMPACT ACTIONS:

- Adopt a policy to require all new buildings to have the appropriate amount of electric vehicle charging equipment and 200-amp electric service.
- Partner with Green Mountain Power and VT Electric Coop to speed up EV adoption in Underhill by providing incentives and adding more charging stations.
- Install public charging stations on town properties and encourage private businesses to do the same.
- Expand bike/walking opportunities on town highways and consider people with limited mobility: for example, by pursuing a River Road bike lane and a sidewalk in Underhill Center, and by reducing speed limits so pedestrians are safer.
- Ensure high internet speeds to encourage the use of remote work, school, healthcare, and other services by Underhill residents. Pursue joining Chittenden County Communications Union District.

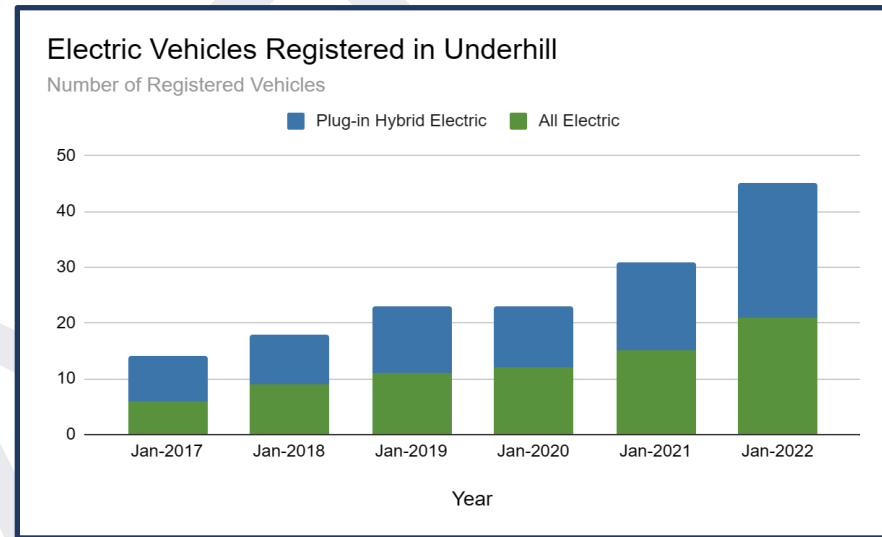


FIGURE 3. ELECTRIC VEHICLES REGISTERED IN UNDERHILL THROUGH JANUARY, 2022.

¹² Underhill Town Plan, 2021

- Expand public transit and peer-to-peer/rideshare opportunities.
- Pursue "smart growth" land use principles to support village center development and pedestrian and transit accessibility

Buildings

The second largest source of emissions is delivered heating fuel (specifically fuel oil, kerosene, and propane) consumption in residential and commercial buildings, making up 23% of Underhill's GHG emissions.

The residential energy targets for the Town of Underhill outlined in Underhill's 2021 Town Plan call for 36% of residences to be weatherized and 37% of residences to transition to efficient electric heat pumps for heating and cooling by 2035 (Table 6).¹³

TARGET: Weatherize 36% of homes and electrify (heat pumps) 37% of homes by 2035¹⁴ and reduce total building energy demand by 15% by 2025

TABLE 6. HOME WEATHERIZATION AND HEATING TARGETS.

Home Heating Energy Use	2025 MMBTU	2025 % of Homes	2035 MMBTU	2035 % of Homes	2050 MMBTU	2050 % of Homes
Total Home Heating Energy Use	103,340		87,620		60,655	
Weatherization energy saved	4,824	14%	13,176	36%	41,241	100%
Energy Use from Heat Pumps	6,698	18%	13,780	37%	20,203	60%
Energy Use from Wood Heat	18,977	14%	18,995	14%	16,690	14%

¹³ Underhill Town Plan, 2021.

¹⁴ Underhill Town Plan, 2021

PROGRESS: From 2016-2021: 57 residences were weatherized, and 219 heat pumps were installed (Table 7).¹⁵

Much of the progress toward achieving our goals and targets will be dependent on our ability to track progress quantitatively (“you get what you measure”). This will likely require State intervention to establish tracking means and metrics for the 2 critical contributors to Underhill’s fossil fuel consumption: delivered heating fuels and vehicle fuel consumption. Both of these can be measured effectively and directly on a town-by-town basis and the results used to guide our greenhouse gas actions in the future.

TABLE 7. UNDERHILL WEATHERIZATION AND HEAT PUMP DATA FROM EFFICIENCY VERMONT.

	2016	2017	2018	2019	2020	2021	Total
Homes Weatherized	7	3	6	15	11	15	57
Heat Pumps Installed	24	38	32	21	48	56	219

Electricity from Green Mountain Power and Vermont Electric Coop is now 100% and 90% carbon free respectively. This means that lighting and electric appliances are not significantly contributing to GHG emissions and emissions reductions can be met via the electrification of residential heating. Policies should also focus on efficiency measures (weatherization), such as insulation, windows, and air sealing to reduce energy use and make electrification more affordable.

Buildings Strategies

1. Minimize fossil fuel use to heat and cool buildings
2. Weatherize buildings to conserve energy used to heat and cool
3. Develop building standards that increase energy efficiency while using less carbon rich materials
4. Implement these strategies without undue burdens to vulnerable populations
5. Improve information on progress towards targets

¹⁵ Vermont Community Energy Dashboard: [Community Progress Maps | Community Energy Dashboard \(vtenergydashboard.org\)](https://vtenergydashboard.org)

HIGH IMPACT ACTIONS:

- Expand and promote the program to provide free pre-audit for energy audits
- Develop education strategy on weatherization and electric heat pumps including current incentives and tax rebates
- Create an energy revolving loan fund for community members to make weatherization and heat pump upgrades. Seed with grant funding or excess revenue or establish a “Penny for climate change” tax – a new tax with designated purpose.
- Implement an ordinance requiring new buildings to have 85% of heating come from renewable sources.
- Increase electric capacity in existing structures to allow 200-amp capacity for heat pumps and electric vehicle plug in.

Renewable Energy

The renewable energy generation targets in the Underhill Town Plan can use any form of renewable generation (wind, solar, hydroelectric, etc.). After much deliberation, the Town concluded that the best way to attain its renewable energy targets, and at the same time maintain the Town’s goals, policies and strategies of the Town Plan, is to prohibit new industrial-scale wind power generation in Underhill. This is based on Underhill’s long-time prohibition of all development above 1,500 feet elevation, and the incorporation of State and local known and possible constraints in the planning process. However, small-scale wind power generation is encouraged. The Town still has the means to achieve its renewable energy targets through solar power generation alone.¹⁶

“Prime” solar or wind areas are locations where models show suitable conditions for electricity generation and are not limited by any known or possible constraints identified in Table 3.1 of Underhill’s Town Plan. “Base” solar or wind areas are locations where models show the appropriate conditions for electricity generation, but also incorporate areas containing possible constraints, which must be considered during development (Table 8 & 9).

¹⁶ For more information on how these targets were derived, please refer to the 2018 Chittenden County ECOS Plan Supplement 6 – Energy Analysis, Targets, & Methodology, available at: <http://www.ecosproject.com/2018-ecos-plan>.

TABLE 8. UNDERHILL POTENTIAL LOCATIONS FOR RENEWABLE ENERGY. BASE LOCATIONS HAVE CONSTRAINTS, PRIME LOCATIONS HAVE NO KNOWN CONSTRAINTS¹⁷.

	Prime Potential		Base Potential	
	Acres	% of Town	Acres	% of Town
Solar	795	2	4,487	14
Wind	366	1	10,139	31

TABLE 9. UNDERHILL RENEWABLE ENERGY POTENTIAL¹⁸.

Renewable Source	Power (MW)	Energy (MWh)
Rooftop Solar	2.4	2,985
Ground-Mount Solar (Prime)	99	121,934
Ground-Mount Solar (Base)	75	91,707
Wind (Prime)	15	44,492
Wind (Base)	406	1,243,438
Others	Unknown	Unknown

¹⁷ Underhill Town Plan, 2021

¹⁸ Underhill Town Plan, 2021

To advance the state’s renewable energy generation goals, CCRPC developed a range for estimating the region’s share of the state’s renewable energy generation targets. The low range target reflects Chittenden County’s share of the state’s energy **resource areas** for wind and solar generation and its share of the state’s population. The high range total target reflects Chittenden County’s **share of the state’s population**. These county estimates were then reduced to town estimates based on area and population. Below are the low and high targets for Underhill. (For more information on this methodology, see the [2018 Chittenden County ECOS Plan, Supplement 6.](#)) These targets will be updated in 2023.

TARGET: Generate between 4,946 MWh and 8,569 MWh of new renewable energy by 2035¹⁹

TABLE 10. RENEWABLE ENERGY GENERATION TARGETS FOR UNDERHILL.

	2025		2035		2050	
	Low	High	Low	High	Low	High
All New Renewable Energy Generation MWh	2,474	4,284	4,946	8,569	8,656	14,995
Installed Solar Photovoltaic (MW)	2.01	3.48	4.02	6.96	7.03	12.17
Installed Solar Photovoltaic (Acres)	16	28	32	56	56	98

¹⁹ Underhill Town Plan, 2021

PROGRESS: According to the VT Public Service Department, as of August 2022, Underhill's total renewable energy generation was 2,253²⁰MWh. Since 2018, Underhill added 1,488 MWh of renewable energy generation in the form of solar energy. This is about 60% of the 2025 low target for new renewable energy generation and about 35% of the high 2025 target.

Renewable Energy Strategies

1. Increase local electric generation from solar, residential wind and other renewable sources.
2. Promote energy storage options.

HIGH IMPACT ACTIONS:

- Promote renewable energy development for wind and solar by proactively identifying preferred sites in the Underhill Comprehensive Energy Plan. Create a “renewable energy zone” where many of the constraints are either absent or of minimal impact.
- Pursue a solar co-op to make town land available for solar development and enable residents to buy into it.
- Investigate availability of USDA Rural Energy for America Program (REAP) funds for renewable energy systems for agriculture and rural small business, which increased in the Inflation Reduction Act (IRA).
- Investigate availability of EPA's Greenhouse Gas Reduction Fund for financial support for low and zero carbon technologies.
- Invest in solar panels in developed locations like school and town office parking lots.
- Promote community solar, group purchase, and community energy hubs.
- At identified Prime solar and Prime wind locations, contact landowners to inform them of this potential.

²⁰ Department of Public Service Draft Generations Scenario Tool (August 2022)

Natural and Working Lands

Forests and trees play a key role in mitigating climate change by removing CO₂ from the atmosphere and helping to regulate the planet's climate. Forests are also vulnerable to changes in climate and their survival and health may depend on current management strategies to create resilient and adaptable ecosystems

In their role as mitigators of atmospheric CO₂, the area forested, and the types and ages of trees all influence how effective they are. According to the Land Emissions Removal Report, generated by CCRPC for Underhill, between 2001 and 2019, Underhill lost around 77 hectares (191 acres) of forest land, largely converted to grassland (Figure 4). Underhill needs to prioritize retention of forests because any loss of these major carbon sinks will add quantifiable carbon to the atmosphere.

The report's calculations show that Underhill's forest uptake of CO₂ exceeds emissions from fossil fuels (although much of this uptake is actually included as part of the natural carbon cycle even without any additional human emissions at all). This outcome can be expected for communities with a low population and large forest area. Underhill should consider two targets, one for reducing emissions and one for maintaining or increasing forest.

Carbon sequestration is not the only important benefit of protecting forests. Historically, Underhill is susceptible to intense rain and flooding events. Forests improve stormwater management on hillsides and streambanks; provide shade to cool homes and lands; filter pollutants and other materials to provide clean water and air; and provide essential habitat for wildlife and many plants and animals.

Agricultural lands and best management practices are also relevant to carbon sequestration and emissions of GHG. In addition, growing food locally, especially using soil regenerative practices reduces GHG emissions and increases resilience.

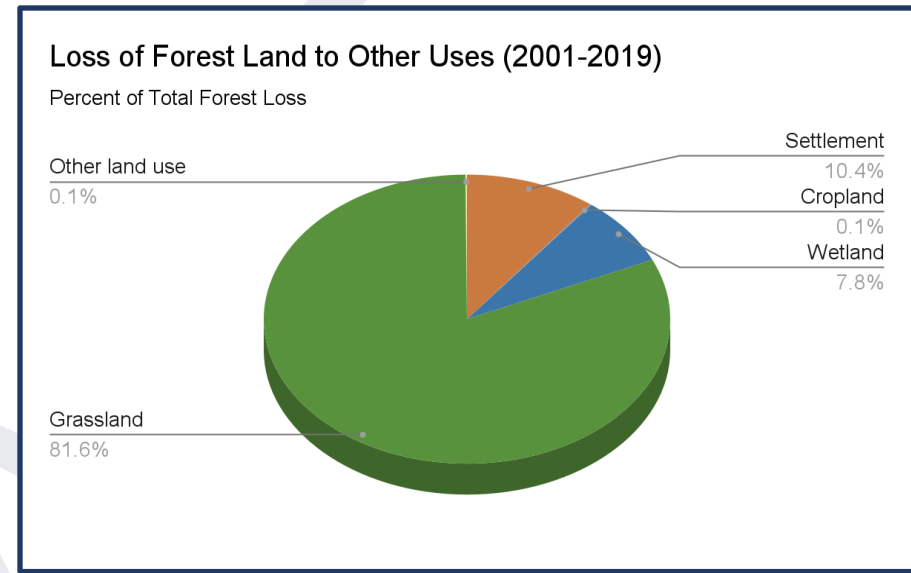


FIGURE 4. LOSS OF FOREST LAND TO OTHER USES (2001-2019).

TARGET: Ensure land is managed to maintain and increase current levels of carbon sequestration²¹, ecosystem services, and provide food security

Natural and Working Lands Strategies

1. Conserve forestland and promote forest management that will maintain and increase carbon sequestration.
2. Promote agricultural practices that improve soil carbon sequestration and reduce the use of fossil fuel-generated products.
3. Support local food systems to reduce transportation emissions and provide food sovereignty.
4. Implement land use policies that minimize forest clearing and preserve agriculture and agricultural soils.

High Impact Actions

Forest Carbon Sequestration²²

- Update the Town Open Land contracts to encourage forest land carbon sequestration and regenerative agricultural practices.²³
- Conduct forest inventories to educate and encourage forest landowners about the value of carbon sequestration in forests.
- Create an informational program and materials for residents that highlights the value of forests as carbon sinks and encourages wise, climate smart management.²⁴
- Pursue landowner incentives to keep forests forested.
- Research and promote available resources through IRA or State funding that can benefit forest landowners
- Investigate green burial options in Underhill to provide an environmentally friendly and no or low carbon option for burial.

Agriculture²⁵

- Hold forums for farmers (big and small) to understand their operations and support their efforts.²⁶
- Promote regenerative agricultural practices.
- Minimize development of agricultural soils outside of the village centers and areas planned for growth.

²¹ Underhill Town Plan, 2021; Chapter 3, Policy 6.

²² Underhill Town Plan, 2021; Chapter 2, Goal 1.

²³ Underhill Town Plan, 2021; Chapter 3, Policy 6.

²⁴ Underhill Town Plan, 2021; Chapter 3, Policy 6.

²⁵ Underhill Town Plan, 2021; Chapter 1, Goal 1.

²⁶ Underhill Town Plan, 2021; Chapter 8, Policy 2.

Land Use²⁷

- Regulate (minimize) clearing associated with development.
- Avoid fragmentation of forest blocks.
- Avoid new development in the Soil, Water and Forest Conservation District.
- Direct development away from forested and working lands.

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²⁷ Underhill Town Plan, 2021; Chapter I, Goal I.

Adaptation and Resilience

Adaptation and resilience to the impacts of climate change means identifying vulnerabilities and preparing for increased precipitation, extreme heat, and extreme weather events. In Underhill, this will require a commitment to address anticipated power outages, improve stormwater infrastructure to reduce road damage, and develop the social connections essential to weathering storms and extreme heat and the resulting damage. Food systems should be considered to increase food security. Land use regulations should be updated to prepare for climate change and climate migration and to support the goals in the natural and working lands sector.

TARGET: Prioritize town investments and climate mitigation approaches for implementation to minimize risk and maximize adaptation to climate change.

Resilience and Adaptation Strategies

1. Minimize impacts from weather related damage to buildings, roads and other infrastructure.²⁸
2. Protect the health and wellbeing of residents.
3. Support the development of a stronger local economy.²⁹
4. Promote climate smart land management to provide resilient and adaptable neighborhoods and natural habitats.³⁰
5. Protect significant forest blocks and wildlife corridors to allow for natural climate migration and adaptation of species.³¹
6. Enact smart growth principles in anticipation of increased migration of climate refugees.³²
7. Protect the functionality of Underhill's hydrologic resources, including stream channels and banks, floodplains, wetlands and beaver ponds, and land cover particularly on vulnerable slopes.³³
8. Increase native species establishment in riparian areas to increase fluvial erosion control, in collaboration with landowners.
9. Enhance the town's emergency response and recovery capabilities relative to storm and other community impact events.³⁴

²⁸ Underhill Town Plan, 2021; Chapter 2, Policy 9.

²⁹ Underhill Town Plan, 2021; Chapter 8, Goal 2.

³⁰ Underhill Town Plan, 2021; Chapter 2, Policy 1.

³¹ Underhill Town Plan, 2021; Chapter 2, Goal 1.

³² Underhill Town Plan, 2021; Chapter 1, Policy 2.

³³ Underhill Town Plan, 2021; Chapter 2, Policy 3, 6, 10.

³⁴ Underhill Town Plan, 2021; Chapter 6, Goal 2, 3.

HIGH PRIORITY ACTIONS

- Review Town regulations and update to reflect optimal levels of protection for hydrologic resources (e.g., streams, riparian areas, floodplains, and wetlands).
- Identify vulnerable streams, roads and infrastructure, and take steps to buttress them in preparation for climate impacts.
- Promote or incentivize home energy systems including renewable energy generation and storage/battery back-up to address power outages.
- Create a neighborhood assistance task force to foster neighborhood associations with action plans to check on neighbors during/after extreme weather events.
- Enhance community-building activities such as programs currently promoted by the Recreation Committee, the Food Shed, and the Underhill Sunday Soup Supper Group.
- Invest in/apply for grants to fund stormwater infrastructure to protect roads, especially unpaved roads, and to minimize excess runoff from extreme weather.
- Promote climate-adapted forest management techniques and support maintaining or purchasing large forest blocks.
- Update Town road, driveway and trail ordinance to account for increased rainfall, reduce erosion and forest fragmentation, and promote development in the villages (e.g. reduce the allowable road and driveway length and grade).
- Develop a tick-borne illness education campaign.
- Develop plans to help seniors and vulnerable residents to prepare for extreme weather events.
- Prepare residents for emergency events and/or situations (e.g. power outages) by establishing town contacts, improve website information and notifications, establish easily accessible emergency shelters and cooling centers, develop an emergency alert system and communicate guidance on situational responses.
- Review Town flood hazard regulations to account for increased rainfall and storm intensity and update where necessary to protect public infrastructure and promote public safety.
- Enhance critical response capabilities of Town services and facilities, including Town Hall and garage, with adequate emergency power supplies and communications.
- Identify and secure critical response sources of materials (e.g. gravel and drainage supplies) for emergency response.

Food Systems

- Partner with Jericho's "Transition Town Jericho" group and Town of Jericho initiatives to launch a Nature Based Solutions Program that includes food systems, farms, and food security.

- Encourage producing, selling and purchasing of locally grown foods in Underhill, Jericho, and the surrounding communities.³⁵

Prepare for Climate Migration via Smart Growth Principles

- Encourage increased density in and around the village centers (e.g. reduce lot size requirements³⁶) so growth is concentrated in growth centers and avoids further forest fragmentation. CCRPC's [Climate Change and Land Use](#) document can be utilized as a resource.³⁷
- Protect and limit incursion into forests, wetlands, and wildlife habitats outside the village center to maintain ecosystem health and natural ability to adapt to climate changes.
- Create a village plan for both Underhill Center and Underhill Flats that considers increased populations from climate migration.
- Invest in water/wastewater infrastructure in both villages.
- Lower or reduce (or eliminate) minimum parking requirements, in particular to reduce stormwater runoff.

How to Prioritize Individual Actions

Although the climate problem is bigger than any one individual or community, there are still many useful actions that each individual can take. The cumulative result of many individual actions contributes to a shift in how we, as a state, nation or world, change the systems in place that support our daily lives.

For example, when we shift to an EV, we not only reduce our direct contribution of CO2 from burning gasoline, but we contribute to the shift of the entire transportation system to electricity.

Any switch to electric energy is only as effective in mitigating GHG as the current electricity grid sources. However, the grid keeps getting cleaner every year so it will be progressively better, and ultimately contributing to moving the entire transportation system to electrics.

Addressing the climate crisis will require action at every level of society, from individual, to town/city, to state, nation and internationally. As long as there continues to be demand for fossil fuel, production, refinement and delivery will continue. Since the source of demand is the millions of homes and cars and products owned and purchased by all of us individual actions of everyone will be needed.

³⁵ Underhill Town Plan, 2021; Chapter 8, Policy 1.

³⁶ Underhill Town Plan, 2021; Chapter 7, Policy 1.

³⁷ Underhill Town Plan, 2021; Chapter 7, Goal 2.

Over the next decade (2022-2035), there are a number of individual investments that are expected to translate into meaningful GHG reductions, mostly because they would be replacing fossil fuel energy. Some of these include:

- Weatherization (building shell improvements): Saving energy costs by weatherizing saves money (ca. 20% for residential buildings) and GHG emissions and is especially important for homes heated with fossil fuel.
- Home heating: Install heat pumps for room heating and cooling and hot water, replacing oil or propane furnace. Where wood heat is used, replace it with an efficient stove or furnace.
- Electric vehicles: By 2035, new, light-duty internal combustion engines will be phased out, so when you need to switch vehicles, EV will be the best option.
- Green transportation, walk/bike/public transportation: When possible, reach your destination using less fuel; if/when considering a move, choose a location near services and destinations, walkable/bikeable streets, and where public transit is available.
- Minimize air travel.
- Home/individual renewable-energy: Invest in rooftop or ground mounted solar and/or small-scale wind installations, especially coupled with battery storage. You'll save money and reduce overall GHG.
- Upgrade home electric service to a minimum of 200 Amp to support electric vehicles, heating and appliances
- Eat a diet rich in plants, light in meat; reap the health benefits as well as carbon reduction since growing plants takes much less energy than raising meat; reduce food waste not only to save you money, but reduce the energy required to grow the food and the GHG emitted when decomposing.
- Patronize local foods; reduce energy used to transport food from far away and support our local food sources and businesses through Community Supported Agriculture (CSA), personal gardens, farm markets, and local farmers.
- Clean cooking: Replace gas (especially propane) stoves and ovens with electric.
- Trade your lawn for natural/native landscape; especially reduce the use of products created using fossil fuels like chemical pesticides, weed management and fertilizers which also result in ecosystem damage through runoff and direct impacts; take a break from continual gas-powered mowing; participate in No Mow May.

Community building/resilience: Equally important to the specific climate mitigations that we undertake is the building of resilient communities. Not only are these better able to survive and thrive under climate stressors, but they enhance the ability of their citizens to pursue a rewarding ecologically sound lifestyle while pursuing climate mitigations.

Build and support community institutions and activities: local government, activities and gatherings (e.g. libraries), organizations (e.g. Mount Mansfield Villages, soup suppers, local music and arts, Farmers Market and Harvest Market, food shed and community recreation opportunities, especially outdoor/nature based).

Many climate mitigations will require cooperative action at higher levels, from local, to state to national and beyond. One of the greatest contributions an average citizen can make is to become and remain aware and active on climate issues in political and social circles. Support social and political action to reduce carbon and to preserve ecosystems we depend on.

One way to weigh the pros/cons of different individual strategies would be to use a carbon footprint analysis that allows you to get results on any change to your transportation, weatherization, heating/cooling, or appliances. These won't be exact but can be valuable.

www.conservation.org/carbon-footprint-calculator#/

<https://www3.epa.gov/carbon-footprint-calculator>

Examples of behavior changes and greenhouse gas reductions

Every region has unique estimates, so the data below may be different for you. To provide a frame of reference, an average household in our region might emit 20-40 MTCO₂e/yr. so changes in our daily living can make a difference. Note: GHG measurements are standardized to metric tons of carbon dioxide equivalent (MTCO₂e)

- For every 5-mpg improvement in fuel efficiency you would save 0.9 MTCO₂e/yr.
- For every day you don't eat red meat you would save 0.4 MTCO₂e/yr.
- For every day you telecommute from home you would save 0.7 MTCO₂e/yr.
- For every medium length flight, you replace layovers with a direct flight you would save 0.055 MTCO₂e/flight
- For every degree you turn down your thermostat in winter you would save 0.06 MTCO₂e/yr.
- For clothes purchases, if 1 out of 2 items are second hand you would save 0.5 MTCO₂e/yr.

Each mature tree absorbs approximately 0.07 MTCO₂e/yr. (mature tree in New England)

Municipal Next Steps

The Town of Underhill will need to prioritize the implementation of the climate actions in this plan. Some actions require policy or regulatory changes, some require investments, some require administrative focus, and some require volunteer resources and community-building.

The Underhill Climate Change Task Force will bring the recommendations found in the conclusion/implementation plan to the Planning Commission for consideration. Some recommended actions are already identified in the Underhill Town Plan of 2021, the Hazard Mitigation Plan of 2022, and by other Town Committees. These actions should be prioritized for implementation by committees.

Additional steps will be needed to track progress on the CAP and make revisions as needed. The Resilience and Adaptation sections should be regularly reviewed to ensure actions are appropriate to changing climate conditions.

Ultimately, policy changes and investments will need to be voted on by the Underhill Selectboard – in the form of ordinances, policies, regulations, and budget proposals. Equity should be considered as each action is implemented. Ideally, the Underhill Selectboard would be informed by its various town committees as it assesses actions it can take and should consider appointing an Equity Committee to assess the potential effects on vulnerable populations.

TABLE 1 I. TIMELINE FOR CLIMATE ACTION PLAN.

TIMELINE FOR CLIMATE ACTION PLAN

PHASE	DETAILS	TIMELINE												
		JUN	JUL	Q3			Q4			NOV				
1	Finalize Draft CAP - Text portion - Appendix A -Appendix B, Implementation Plan	█												
			█											
				█										
2	CAP Outreach to Planning Commission - Finalize presentation - Meet with PC chair - Present overview of CAP to PC, distribute CAP - Present and discuss Energy Sections with PC - Present and discuss Adaptation and Resilience Section with PC - PC recommendations to the SB		█											
			█	█										
					█									
						█								
							█							
								█						
3	CAP Outreach to Selectboard - Present overview of CAP to SB and discuss PC recommendations - Additional discussions with SB, funding potentials, implementation plan - SB recommendations for follow up													
									█					
										█				
4	Finalize CAP - Policy and regulatory actions added to Town Plan as an addendum - Prioritize climate actions already in the Town Plan and outreach to Committees - Outreach to community as a climate summit													
5	Climate Change Task Force Disbands - Official task force duties completed - Future CAP implementation in the hands of Town Administrator and Committees -2024 Enhanced Energy Plan will be required by CCRPC with Town Plan addendum													

PROJECT END

Appendices

Appendix 1 – Glossary

Appendix 2 – Funding Opportunities

Appendix 3 – Implementation Guidance

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Appendix I - Glossary

Adaptation: Adjusting social, ecological, or economic systems in response to actual or expected climatic events and their effects or impacts.

Climate migration/climate refugees: The movement of people from one place to another due to the impact of sudden or gradual climate change. This can include environmental disasters such as floods and wildfires, or persistent concerns like drought conditions.

Climate-smart building: Construction of buildings to increase their resilience to climate change while conserving energy through weatherization, and using renewable energy heating systems.

Climate-smart forest management: A collection of strategies and management actions that increase carbon storage in a way that also increases forest resilience to climate change.

Extreme heat: Temperatures 10 degrees or more above the average high temperature for the region and lasting for several weeks. National Weather Service Extreme Heat Warnings are issued when apparent temperatures (Heat Index) reach 105 degrees. A 2016 Vermont Health Department Report, "Heat Vulnerability in Vermont: Local Indicators of Heat Illness Risk" concluded that "Vermonters are at greater risk for serious heat-related illnesses, and even death, when the statewide average temperature reaches 87°F or hotter." Heat is one of the leading weather-related killers in the United States, despite the ability to prevent or reduce the risk of heat exhaustion and heat stroke through outreach and intervention.

Flash flood: A flood caused by heavy or excessive rainfall in a short period of time, generally less than six hours. Events are usually characterized by raging torrents after heavy rains that rip through riverbeds, streets, or mountain canyons sweeping everything before them. They can occur within minutes or hours of excessive rainfall, or even if no rain has fallen, such as after a dam has failed, or after a sudden release of water by a debris or ice jam.

Flood recurrence interval: 10-year flood recurrence has a 10% annual chance of occurrence; 50-year flood recurrence has a 2.0% annual chance of occurrence; 100-year flood recurrence has a 1% annual chance of occurrence; and a 500-year flood recurrence has a 0.2% annual chance of occurrence.

Fluvial erosion: The detachment of material of a river or stream bed and sides. Erosion starts when the flow energy of the water exceeds the resistance of the material of the riverbed and banks. Flow energy and velocity depend on depth of the water and the gradient.

Hazard ratings: Low risk hazard occurrence is rare and impact is low; Moderate risk hazard occurrence is likely at least once within the next 25 years and impact is moderate; High risk hazard occurrence is expected at least once within a 12-month period but may occur multiple times within a year and impact is high.

Mitigation: Addressing global warming by reducing greenhouse gas emissions, and preserving and enhancing natural systems to sequester and store carbon.

Nature-based solutions: Actions to protect, sustainably manage, or restore natural ecosystems in ways that address climate change, human health, food and water security, and disaster risk reduction effectively and adaptively.

Open land: Undeveloped land that may include fields, shrubland, forests, and wetlands.

Open Land contracts: Tax stabilization agreement for farm, forest and open space lands as a means of reducing the pressure to subdivide and/or develop such lands, and to encourage the preservation of the farms, forest and open spaces which characterize the Town's landscape.

Regenerative agriculture: Regenerative agriculture is a conservation and rehabilitation approach to food and farming systems. It focuses on topsoil regeneration, increasing biodiversity, improving the water cycle, enhancing ecosystem services, supporting biosequestration, increasing resilience to climate change, and strengthening the health and vitality of farm soil.

Resilience: The ability to cope with and manage the impacts of climate change by assessing the current and future risks and taking steps to better prepare for and respond to these risks.

Revolving fund: A fund or account established with federal or other external funds that remains available to finance actions towards the CAP targets. It may be to continue town operations without any fiscal year limitation or other high priority actions, and the funds are replenished by repaying money used from the account.

Smart growth principles: Development and conservation strategies that help protect our health and natural environment, and make our community more attractive, economically stronger, and more socially diverse. Included are compact, walkable villages, where development is concentrated in village centers so that open space, farms and forests, can be preserved.

Solar cooperative: Partnership between individuals and/or businesses to combine their buying power to save money going solar. This is different from community solar, where a single solar array benefits multiple customers.

Tickborne illnesses: Ticks in Vermont are known to transmit 6 different diseases: Lyme, Anaplasmosis, Ehrlichiosis, Babesiosis, Powassan Virus and Borrelia miyamotoi.

Vulnerability: Residents may be at risk based on proximity to hazard-prone areas. Vulnerable populations are more susceptible to the impacts of disasters and may experience more long-term effects with a loss of their social support networks. Some residents may be considered vulnerable due to their everyday living conditions.

Appendix 2 - Funding

There are currently many funding opportunities to help implement the CAP in addition to the town's general fund. The specifics for each of these grants or funding sources will need to be researched to find the best fit for each action. The Chittenden County Regional Planning Commission has compiled a listing of funding options for towns that should facilitate finding suitable funds for many of the climate actions. Funding sources do change their requirements or priorities frequently, so viewing the latest information is key. Sources of particular interest to this CAP are listed below.

Transportation actions:

- Inflation Reduction Act (IRA): [Credits and Deductions Under the Inflation Reduction Act of 2022 | Internal Revenue Service \(irs.gov\)](#)
- Vermont Municipal Grants in Aid: [VTrans Grants in Aid Program | Agency of Transportation \(vermont.gov\)](#)
- Municipal Highway and Stormwater Mitigation Grants: [Municipal Highway and Stormwater Mitigation Program | Agency of Transportation \(vermont.gov\)](#)
- Green Mountain Power Workplace Charging: [Workplace Charging - Green Mountain Power](#)
- Vermont Electric Cooperative, Electric Vehicle Charging Incentive: [Energy Transformation Programs — Vermont Electric Coop](#)
- Bicycle and Pedestrian Program: [Bicycle and Pedestrian Program | Agency of Transportation \(vermont.gov\)](#)
- Building Resilient Infrastructure and Communities (BRIC) Grant: [Hazard Mitigation Funding Programs | Vermont Emergency Management](#)

Buildings actions:

- Inflation Reduction Act (IRA): [Credits and Deductions Under the Inflation Reduction Act of 2022 | Internal Revenue Service \(irs.gov\)](#)
- Efficiency Vermont: [Efficiency Vermont](#)
- Electric Vehicle Charging Equipment-State Contract Pricing: [Electric Vehicle \(EV\) Charging Stations | Buildings and General Services \(vermont.gov\)](#)
- Homeowner and Renters Assistance: [Champlain Valley Office of Economic Opportunity — CVOEO](#)

Renewables actions:

- Inflation Reduction Act (IRA): [Credits and Deductions Under the Inflation Reduction Act of 2022 | Internal Revenue Service \(irs.gov\)](#)
- Rural Energy For America (REAP): [Rural Energy For America Program \(REAP\) | Rural Development \(usda.gov\)](#)

Natural and Working Lands:

- Forest Economy Program, Northern Border Regional Commission: [2023 FEP Program Manual_FINAL.pdf \(nbrc.gov\)](#)
- Farmer Resilience Grants: [Farmer Resilience Grants | NOFA Vermont \(nofavt.org\)](#)

Adaptation and Resilience:

- 2023 State funds for towns with climate action plans that include adaptation and resilience: TBD

- Clean Water Initiative Program Enhancement Development Design and Implementation Grant: [Funding Opportunities | Department of Environmental Conservation \(vermont.gov\)](#)
- Clean Water State Revolving Loan Fund: [Clean Water State Revolving Fund | Department of Environmental Conservation \(vermont.gov\)](#)
- Engineering Planning Advance: [Engineering Planning Advance | Department of Environmental Conservation \(vermont.gov\)](#)
- Climate adaptation forest management for landowners: [Managing Your Woodlands | Department of Forests - Parks and Recreation \(vermont.gov\)](#)
- Road infrastructure: VTrans Better Roads Program: [Better Roads | Agency of Transportation \(vermont.gov\)](#)
- Hazard Mitigation Funding Programs: [Hazard Mitigation Funding Programs | Vermont Emergency Management](#)

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Appendix 3: Implementation Guidance

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