**4-3: Wind**

High wind can be the result of any of the following:

* **Wind Storm:** high wind event without precipitation.
* **Hurricanes/Tropical Storms:** the most significant impacts from hurricanes/tropical storms in Vermont are inundation flooding and fluvial erosion (see: Inundation Flooding & Fluvial Erosion). Wind implications of hurricanes/tropical storms are addressed below.
* **Thunderstorm:** high wind event with the potential for compounding impacts due to precipitation (see: Inundation Flooding & Fluvial Erosion), lightning (see: Wildfire), and/or hail (see: Hail).
* **Tornado:** a violently rotating column of air extending from a thunderstorm; not common in Vermont.

The Beaufort Wind Scale is a tool to measure wind speeds and anticipated effects. Hurricane and tornado strength are categorized with the Saffir-Simpson Hurricane Wind Scale and Fujita Scale respectively.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 31: Beaufort Wind Scale** | | | | |
| **Force** | **Wind (mph)** | **WMO**  **Classification** | **Appearance of Wind Effects** | |
| **On the Water** | **On Land** |
| 0 | < 1 | Calm | Sea surface smooth and mirror-like | Calm, smoke rises vertically |
| 1 | 1-3 | Light Air | Scaly ripples, no foam crests | Smoke drift indicates wind direction, still wind vanes |
| 2 | 4-7 | Light Breeze | Small wavelets, crests glassy, no breaking | Wind felt on face, leaves rustle, vanes begin to move |
| 3 | 8-12 | Gentle Breeze | Large wavelets, crests begin to break, scattered whitecaps | Leaves and small twigs constantly moving, light flags extended |
| 4 | 13-18 | Moderate Breeze | Small waves 1-4ft becoming longer, numerous whitecaps | Dust, leaves, and loose paper lifted, small tree branches move |
| 5 | 19-24 | Fresh Breeze | Moderate waves 4-8ft taking longer form, many whitecaps, some spray | Small trees in leaf begin to sway |
| 6 | 25-31 | Strong Breeze | Larger waves 8-13ft, whitecaps common, more spray | Larger tree branches moving, whistling in wires |
| 7 | 32-38 | Neal Gale | Sea heaps up, waves 13-19ft, white foam streaks off breakers | Whole trees moving, resistance felt walking against wind |
| 8 | 39-46 | Gale | Moderately high (18-25ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks | Twigs breaking off trees, generally impedes progress |
| 9 | 47-54 | Strong Gale | High waves (23-32ft), sea begins to roll, dense streaks of foam, spray may reduce visibility | Slight structural damage occurs, slate blows off roofs |
| 10 | 55-63 | Storm | Very high waves (29-41ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility | Seldom experienced on land, trees broken or uprooted, considerable structural damage |
| 11 | 64-72 | Violent Storm | Exceptionally high (37-52ft) waves, foam patches cover sea, visibility more reduced | Very rarely experienced on land, accompanied by widespread damage |
| 12 | 73+ | Hurricane | Air filled with foam, waves over 45ft, sea completely white with driving spray, visibility greatly reduced | Devastation |
| *Source: http://www.spc.noaa.gov/faq/tornado/beaufort.html* | | | | |

Wind Storm:

High winds pose a threat to the safety of Vermont’s citizens and property. The National Weather Service (NWS) issues a wind advisory when winds are sustained at 31 to 39 mph for at least one hour or any gusts 46 to 57 mph. Sustained winds of 40 to 73 mph or gusts of 58 mph or higher cause the NWS to issue a High Wind Warning[[1]](#footnote-2).

Hurricane/Tropical Storm:

A hurricane is a tropical cyclone with sustained winds that have reached speeds of 74 mph or higher. A storm reaches hurricane status only after strengthening over a period of days or even weeks. A tropical storm has a maximum sustained one-minute wind speed of 39 to 73 mph. As a hurricane moves toward the coast, it loses wind speed and may be downgraded to a tropical storm. This is the case in many of the tropical storms that have reached Vermont. In general, severe hurricanes are not considered likely, nor do they pose a recurring threat for Vermont.

Hurricanes and tropical storms are hazard events that often result in high winds, inundation flooding, and fluvial erosion impacts. The topography and landscape in Vermont contribute to the risk associated with these three hazard impacts. Many of Vermont’s villages, towns and cities are located in or proximate to the floodplain and many roads in Vermont run parallel to rivers (see: Inundation Flooding & Fluvial Erosion).

The Saffir-Simpson Hurricane Wind Scale is a categorical rating system between 1 and 5, which corresponds to the sustained wind speed of hurricanes (Table 32). This scale serves as an estimate of potential property damage during hurricanes. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and property damage. The Saffir-Simpson Hurricane Wind Scale serves as a good measure for sustained wind speed; however, this scale does not account for the compounding impacts (i.e., inundation and erosion).

The Atlantic Ocean hurricane season runs from approximately June 1 through November 30, with the majority of hurricane activity occurring between mid-August through October[[2]](#footnote-3) (Figure 39).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 32: Saffir-Simpson Hurricane Wind Scale** | | | | |
| **Tropical Depression** | | ≤38 mph, ≤33 knots, ≤62 km/h | **Tropical Storm** | 39–73 mph, 34–63 knots, 63–118 km/h |
| **Category** | **Wind Speed** | **Types of Damages Due to Hurricane Winds** | | |
| 1 | 74-95 mph  64-82 kt  119-153 km/h | Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. | | |
| 2 | 96-110 mph  83-95 kt  154-177 km/h | Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. | | |
| 3 (Major) | 111-129 mph  96-112 kt  178-208 km/h | Devastating damage will occur: Well-built frame homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. | | |
| 4 (Major) | 130-156 mph  113-136 kt  209-251 km/h | Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. | | |
| 5 (Major) | ≥ 157 mph  ≥ 137 kt  ≥ 252 km/h | Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. | | |
| *Source: https://www.nhc.noaa.gov/aboutsshws.php* | | | | |

Thunderstorm:

Thunderstorms can produce downburst winds that affect the land immediately beneath a storm. These downburst winds are called microbursts and macrobursts, which move outward from the base of a thunderstorm and can reach speeds in excess of 80 mph. Microbursts (the smaller of the two in terms of area affected) pose an extreme threat to aircraft.

Thunderstorms can range in size and type. An ordinary cell thunderstorm consists of one cell with an updraft and downdraft and produce strong winds, rain, lightning, and even hail. Multicell cluster thunderstorms consist of several ordinary cell thunderstorms in the vicinity of each other. Multicell cluster thunderstorms are extremely prone to causing flash flooding. Squall line thunderstorms move in a line or front that can exceed 100 miles in length, with the strongest rains and winds at the front of the storm. Supercell thunderstorms are the largest, longest lasting, and most devastating thunderstorms. Nearly all tornadoes are formed from supercell thunderstorms. Lightning, hail, flash flooding, and tornadoes are all associated with this type of thunderstorm (see: Hail and Inundation Flooding & Fluvial Erosion).

In Vermont, high winds are most often seen accompanying severe thunderstorms. In fact, straight-line winds are often responsible for most of the wind damage associated with a thunderstorm. These winds are frequently confused with tornadoes because of similar damage and wind speeds; however, they are not rotating like the winds of a tornado.

Thunderstorms and associated hazards can occur anywhere in Vermont at any time of the year; however, spring and summer are the most common times for severe thunderstorms.

Tornado:

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds capable of reaching in excess of 250 mph. Damage paths can be in excess of a mile wide and 50 miles long. The Enhanced Fujita Scale is a categorical rating system between EF0 and EF5 for wind speed during a tornado (Table 33).

Since 1950, Vermont has experienced 49 tornadoes, 14 of which were magnitude F2 (significant) and 19 magnitude F1 (moderate) on the Fujita Scale. F2 tornadoes have maximum wind speeds of 113 to 157 mph, while F1 tornadoes range from 73 to 112 mph. Damage from tornadoes has ranged from a few downed trees to seven injuries during a 1970 tornado in Franklin County. These injuries occurred when a waterspout – a tornado that originates over water instead of land – moved from Lake Champlain to the southern part of Swanton, where it struck a cabin. Property damage has totaled over $5.5 million overall in the State of Vermont due to tornado damage. There have been no deaths as a result of a tornado in Vermont since 1950.

Tornadoes typically occur in Vermont between March and August; however, tornadoes can strike at any time of the year if the essential conditions are present[[3]](#footnote-4).

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 33: Enhanced Fujita Scale** | | | |
| **Scale** | **Wind Speed** | | **Types of Damages Due to Hurricane Winds** |
| mph | km/h |
| EF0 | 65-85 | 105-137 | *Minor or no damage.* Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0. |
| EF1 | 86-110 | 138-177 | *Moderate damage.* Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| EF2 | 111-135 | 178-217 | *Considerable damage.* Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| EF3 | 136-165 | 218-266 | *Severe damage.* Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged. |
| EF4 | 166-200 | 267-322 | *Devastating damage.* Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated. |
| EF5 | >200 | >322 | *Extreme damage.* Strong-framed, well-built houses leveled off foundations are swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks, and train cars can be thrown approximately 1 mile (1.6 km). |
| *Source: http://www.spc.noaa.gov/efscale/ef-scale.html* | | | |

Location

Wind, which typically flows from west to east across Vermont, is most significant on mountain peaks, where wind speeds are highest. Downslope windstorms can occur as a result of cold dense air traveling over a mountain peak and accelerating down the slope, reaching high wind speeds at the base of the mountain. Wind flow that is orthogonal to mountains will cause more damaging downslope windstorms than wind flow running parallel[[4]](#footnote-5). Thus, areas of Vermont that are located at the base of the Green Mountains are especially vulnerable to wind-related hazards.

Wind History

* **Tornado, May 31, 1998:** Bennington County was hit with an EF2 tornado that damaged homes and property in North Bennington. The tornado originated near Round Lake, New York, and moved rapidly eastward into Vermont, producing damage in North Bennington before dissipating in Shaftsbury. Funnel clouds were also reported that day in the Brattleboro area, but no tornadoes were confirmed to have touched down. Strong straight-line winds also damaged areas of Bennington and Windham Counties. Estimated $630,000 in property damages from this event.
* **Tropical Storm Floyd, September 16, 1999 (DR-1307):** Strong winds reaching 51 mph combined with saturated soil from heavy rain resulted in trees and power lines being blown down, causing power outages. A death occurred when a tree fell on a mobile camper in Randolph. $675,000 in estimated damages from the wind.
* **Tornado, June 5, 2002 (DR-1428):** Thunderstorms spawned two tornadoes, one in Woodford Hollow in Bennington County (EF1) and the other one near Wilmington in Windham County (EF2). The first touchdown produced a swath 150 yards wide and a path length of one-half mile. Many trees as large as a foot in diameter were either knocked over or ripped apart. Trees also fell on three automobiles. The second tornado, four miles Northeast of Wilmington, was even stronger despite a narrower swath of 50 yards.
* **Wind Storm, April 15, 2007 (DR-1698):** High winds during this April storm resulted in many trees down and damage to some private homes and public infrastructure, primarily in southern Vermont. $4.8 million in estimated damages from the wind.
* **Tornado, July 18, 2008 (DR-1784):** A tornado was reported in Bakersfield (EF1), causing localized damages. A tornado with winds reaching 100 mph ripped an apartment’s roof off, snapped large trees, and destroyed a barn in the small town of Washington in May 2009. Estimated $150,000 in damages.
* **Wind Storm, December 1, 2010 (DR-1951):** Wind across the higher peaks of the Green Mountains caused strong to damaging down slope winds in excess of hurricane force to the western slope communities and wind gusts approaching 55 mph into the Champlain Valley. Much of this damage was in the form of downed limbs, branches, trees, playground sets and some isolated structural damage in the form of blown off roof shingles. Over 35,000 utility customers lost power with an estimated $3.35 million damages.
* **Tropical Storm Irene, August 28, 2011 (DR-4022):** While the vast majority of the impact from Tropical Storm Irene was due to flooding, damaging north winds of 35 to 45 mph sustained with gusts in excess of 60 mph buffeted Grand Isle County and Lake Champlain. Estimated wave heights of 4-6’ and possibly higher damaged boats, moorings and knocked down or uprooted numerous trees with thousands of customers without power. An estimated $1.25 million in property damage is attributed to wind.
* **Tornado, May 29, 2012 (DR-4066):** Severe storms rolled through the Northeast portion of the State. The tornado, rated as an EF0 by NOAA, had wind speeds that peaked at 70 mph, tearing 45 trees out of the ground and pelting area house with marble-sized hail. Estimated $10,000 in property damage.
* **Hurricane Sandy, October 29, 2012:** Hurricane Sandy came to the Northeast and did not significantly affect Vermont. Nevertheless, Vermont did experience high winds from the storm, especially in the southern part of the State. All of Vermont’s 14 counties experienced electric utility impacts, and approximately 64,600 customers lost power. All customers had their power restored in approximately 56 hours. Estimated damages were under $1 million.
* **Wind Storm, October 30, 2017 (DR-4356):** Numerous tree damage and power outages with wind gusts of 40 to 50 mph, reaching 60 mph in some locations. $2.25 million in property damages is estimated from this event. Maximum wind gusts from this event are mapped in Figure 40.
* **Thunderstorm, July 30, 2019:** Severe storms impacted the Northwest portion of Vermont, with winds ranging 57 to 76 mph. Scattered thunderstorms resulted in downed tree limbs, trees, and utility lines. The storms caused an estimated total of $235,000 in property damage. The storms within Champlain Valley in Chittenden County unfortunately caused the loss of 2 lives whilst kayaking near Thayers Beach.
* **Wind Storm, November 1, 2019:** Strong winds affected zones in each of Vermont’s 14 counties, resulting in downed tree limbs, power outages, and uprooted trees which affected transportation routes. Wind speeds ranged from 45 to 55 mph and resulted in $903,000 in total property damage. Within Chittenden County, estimated public infrastructure damage totaled close to $5 million, with 100,00 reported power outages.
* **Thunderstorm, August 26, 2022:** Scattered thunderstorms impacted western Vermont counties Chittenden and Rutland, with wind speeds reaching 75 mph. In Rutland County, the storm trapped 5 people and 75 cattle in a barn, resulting in 2 human injuries and the ultimate death of 50 cattle. As a result of the storm, property damage estimated at $506,000 and crop damage at $100,000, significantly affecting the economy of Rutland.
* **Wind Storm, December 23, 2022 (DR-4695):** Strong winds traveling southeast at speeds of 25-35 mph with gusts at 50-60 mph affected majority of the state, along with heavy rain and snow melt leading to flooding. 70,000 utility customers lost access to power at the peak of the storm, with almost 100,000 customers losing power in total as a result of the event. The wind storm resulted in $3.7 million in property damages and one fatality in Rutland County resulting from a falling tree.

[Fig 40, North country maximum wind gusts, 10/30/2017]

[Fig 41, federally declared wind disaster PA expenditure]

Wind Trends

Overall, the occurrence of wind events are considered by the Steering Committee to be Highly Likely in Vermont. Compared to other hazard impacts, the risk due to wind events is moderate for the built environment and minor for natural environment, people, and economy. However, it is likely that as climate change accelerates, we will see exacerbation of wind events such as hurricanes, tropical storms, and thunderstorms.

The strength of hurricanes and tropical storms have a direct relationship with ocean temperatures. As ocean temperatures increase, the rates of evaporation and condensation increase. The water vapor molecules are at a higher temperature due to the warming of the ocean water, and thus as condensation occurs, the atmosphere will consist of a higher concentration of water vapor particles as the high temperatures will allow more water vapor particles to exist in the gas phase. When precipitation eventually occurs, there will be a higher volume of rain releasing heat and subsequently creating stronger winds[[5]](#footnote-6). As more greenhouse gases are emitted, heat is being trapped in the atmosphere and is more readily absorbed by oceans due to the high heat capacity of water. Thus, as climate change accelerates, we can expect warmer temperatures of the ocean which can in turn lead to stronger hurricanes and tropical storms. Although Vermont is landlocked within New England, hurricanes and tropical storms that travel up the east coast can lead to inundation flooding, fluvial erosion, and high winds. As the severity and frequency of these storms intensify, these impacts may become even more damaging to towns that lie within floodplains.

Similarly, as the temperature of the atmosphere increases, thunderstorms could become more frequent events in Vermont. Warm, moist air can contribute to more severe thunderstorms in a similar way to how it intensifies hurricanes. More water molecules will exist in the gaseous phase due to their temperature, so there will eventually be more precipitation and a greater release of heat. As heat releases to the land, cooler air will take its place due to its higher density, creating wind[[6]](#footnote-7). Thus, as temperatures continue to rise in Vermont, thunderstorms could become much more frequent which could cause inundation flooding, fluvial erosion, and wind damage to the towns affected. Tornadoes are only the product of 20% of supercell thunderstorms, so it is difficult to predict whether tornadoes will increase in frequency or severity[[7]](#footnote-8), but it is crucial that Vermont is prepared in the case that such events do transpire.

**Vulnerability**

**People**

People who live in rural, isolated communities are particularly vulnerable to windstorms. High winds can take down trees and power lines, and thus block transportation routes, cut off electricity and telecommunication networks, and destroy property. The situation described can be life threatening when emergency and medical services are disrupted, due to either transportation or telecommunication errors. Thus, those who rely on electrical life support systems are particularly vulnerable in the case of a power outage, as well as those who rely on electrical heating and cooling systems. Poorly ventilated generators are also a risk in the case of a windstorm, as blockages caused by wind can potentially lead to carbon monoxide poisoning[[8]](#footnote-9).

In the case of telecommunication disruption during a windstorm, isolated populations may have limited access to information and resources that could prevent injury or death. People with limited range of motion might not be able to properly follow safety protocol.

In the event of a tornado, anyone in the direct pathway of the storm is vulnerable to injury or death. Debris could be picked up and cause injury or fatality if a storm shelter is unavailable. Direct deaths are possible from falling powerlines or trees, as well as object missiles that a high wind event might generate. It is important to note that those who reside in manufactured homes and mobile homes are 15 to 20 times more likely to be killed during a tornado, as homes may not be properly anchored to the ground[[9]](#footnote-10).

**Built Environment**

Severe thunderstorms are capable of producing high winds (including downdrafts), large hail, lightning, flooding, rains, and tornadoes. Thunderstorm winds are generally short in duration, involving straight-line winds and/or gusts in excess of 50 mph and tend to affect areas of Vermont with significant tree stands as well as areas with exposed property and infrastructure and aboveground utilities. Winds can cause power outages, transportation and economic disruptions and significant property damage, and pose a high risk of injuries and loss of life.

The most significant concern from a wind event is the impact on infrastructure, predominately utilities. Figure 42 shows the electric utility service territory across the State. High winds pose a serious concern for all electric and telecommunication utilities in Vermont due to the customer outages and damage to infrastructure they may cause. Power outages can have a significant impact on Vermonters, especially if they occur in the winter and summer seasons, impacting access to electrically operated heating and cooling systems.

As mentioned above, microbursts of wind can be especially dangerous for aircraft transportation. The downward wind can exceed the lift component of an aircraft, making it impossible to maintain altitude, which for low flying aircraft (especially during takeoff and landing) is extremely dangerous.

High wind events such as tornadoes have the potential to cause significant damage to buildings and building fixtures. Within documented history, Vermont has experienced tornadoes within the range of EF0-EF2. Tornadoes within this range can cause considerable damage to smaller homes and buildings, destroying roofs, foundations, and building fixtures such as solar panels. Mobile homes and manufactured homes are at a higher risk of property damage during a tornado, as both are nonpermanent and can be moved to an alternate location[[10]](#footnote-11). If manufactured homes are not properly anchored to the ground, they could be easily picked up or destroyed by EF1 and EF2 tornadoes, both of which have occurred within somewhat recent history. Small objects picked up by a tornado can become missiles as they generate speed from the wind, and have potential to cause injury, destruction of property, or death upon being thrown. Although Vermont has only experienced EF0-EF2 tornadoes within documented history, it is not impossible for a stronger storm system to affect the state. In this case, a tornado could destroy everything in its path, and create large-object missiles, intensifying the risk of injury, death, or property damage.

**Natural Environment**

High winds pose a danger to the natural environment, as downed trees and uprooted plants can threaten the integrity of the ecosystem. Trees provide habitat and other resources to local organisms. With the destruction of flora comes increased competition among fauna for resources, leading to a higher mortality rate. Along with diminished resources, the destruction of flora will lead to a decrease in carbon sequestration, which negatively affects Earth’s atmosphere.

**Economy**

Windstorms can also cause major economic loss in terms of forestry and agriculture. Sugar maples are essential to the State’s economy, and a severe windstorm could damage or uproot these trees, leading to a decline in the sugaring operation. Similarly, other crops with relatively shallow root systems could be uprooted by high winds, minimizing the economic gain associated with agriculture. Livestock also greatly contributes to Vermont’s economy through dairy and meat products. Windstorms can threaten livestock, as seen by the thunderstorm in Rutland County on August 26th, 2022, when the destruction of a barn killed 50 cattle, and caused $100,000 in crop damages alone[[11]](#footnote-12).

Additionally, wind has the capability to disrupt normal business travel, truck movement, and construction. Downed powerlines, tree limbs, and scattered debris can fall within transportation routes, which can affect commuters and product movement. Businesses may not be able to operate as planned, which can lead to economic decline. Similarly, strong winds can disrupt construction projects as small objects may be removed with wind gusts. A higher demand for reconstruction of buildings and homes may follow a windstorm, which would stimulate revenue for construction workers, but overall increase economic cost associated with the event.

Wind Current Capabilities and Mitigation

Several actions within this Plan address wind events (see: Mitigation Strategy), such as the strategy on resilient design and construction standards, including actions around developing sample building standards and educational resources for resilient design and construction. Maximization of Public Assistance (PA) hazard mitigation opportunities and BRIC project scoping funding when available can help put funds towards infrastructure planning and design for increased resilience. Other mitigation actions include increasing the capacity of the Public Service Department to utilize federal funds towards utility resilience implementation work and coordinating a State Energy Security Plan with the SHMP to identify interdependency of other systems on the grid and additional risk analysis requirements. Working to identify and evaluate the feasibility of microgrids for rural energy systems can allow them greater resiliency and independence should other systems fail. These infrastructure improvements, in coordination with utilities and RCP work under Act 174, work to ensure resiliency to a host of hazards beyond wind damage.

This Plan also includes a strategy to identify and protect vulnerable structures and critical infrastructure, with an action to provide technical assistance to utilities in long-range planning for transmission and distribution line upgrades and relocation to improve resilience. Additionally, this strategy includes an action to adapt the VTrans Methods and Tools for Resilience project (2018 SHMP subgrant) for use in mapping utilities and identifying vulnerabilities, which should not be a significant lift, given that the majority of utility lines in Vermont run along roadways.

Though several towns in the State are considering burying power lines for long-term mitigation against both wind and ice events, a statewide approach to power line burying is not being considered at this time due to being cost prohibitive.

1. https://www.weather.gov/btv/wwa\_reference [↑](#footnote-ref-2)
2. https://www.nhc.noaa.gov/climo/ [↑](#footnote-ref-3)
3. National Weather Service, http:/www.nws.noaa.gov [↑](#footnote-ref-4)
4. <https://www.trorc.org/event/downslope-windstorms-green-mountains-webinar/> [↑](#footnote-ref-5)
5. https://news.climate.columbia.edu/2022/10/03/heres-what-we-know-about-how-climate-change-fuels-hurricanes/ [↑](#footnote-ref-6)
6. https://www.eia.gov/energyexplained/wind/#:~:text=Warm%20air%20above%20land%20expands,take%20its%20place%2C%20creating%20wind. [↑](#footnote-ref-7)
7. https://education.nationalgeographic.org/resource/tornadoes-and-climate-change/ [↑](#footnote-ref-8)
8. <https://www.healthvermont.gov/sites/default/files/documents/pdf/English_CO_Safety_Tips.pdf> [↑](#footnote-ref-9)
9. https://www.washingtonpost.com/climate-environment/2023/03/28/mississippi-mobile-home-tornado-damage/ [↑](#footnote-ref-10)
10. https://www.washingtonpost.com/climate-environment/2023/03/28/mississippi-mobile-home-tornado-damage/ [↑](#footnote-ref-11)
11. <https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=ALL&beginDate_mm=08&beginDate_dd=26&beginDate_yyyy=2021&endDate_mm=11&endDate_dd=30&endDate_yyyy=2022&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=50%2CVERMONT> [↑](#footnote-ref-12)