Vermont Municipal Vulnerability Index

This 6-point scale identifies the Vermont communities that may be the most adversely affected by climate change. The multivariate score is based on 3 categories worth 2 points each: reliability, social vulnerability, and connectivity. **A higher score indicates greater vulnerability.**

Reliability

Outage Frequency: The number of outages for a given town was divided by the number of buildings in that town to determine an "outages per building" metric. The town with the most outages per building is Victory (0.83654) while a few towns had no outages. Based on these limits, we created a ceiling of 0.83654 to adjust each town value to a percentile rank between 0 and 1. The calculation for this score was:

(# outages/# buildings)/0.83654

The data used for this is from 2017, 2018, and 2019 and was provided by Corey Chase (corey.chase@vermont.gov) at DPS.

Outage Duration: The number of 24+ hour outages for a given town was divided by the number of buildings in that town to determine an "outages per building" metric. The town with the most 24+ hr outages per building is Landgrove (0.18023) while a few towns had no 24+ hr outages. Based on these limits, we created a ceiling of 0.18023 to adjust each town value to a percentile rank between 0 and 1. The calculation for this score was:

(#24+ hr outages/# buildings)/0.18023

The data used for this is from 2017, 2018, and 2019 and was provided by Corey Chase at DPS.

Social Vulnerability

CDC Index: For 1 point of the social vulnerability score, we've used the CDC's Social Vulnerability Index (SVI) which provides a composite score based on 15 census variables across 4 categories: socioeconomic status, household composition & disability, minority status & language, and housing & transportation. This measure was developed by the CDC to identify communities that "may need support before, during and after disasters." Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). For towns that contain portions of **two or more census tracts** within their boundaries, the **highest CDC SVI score** was used.

> Note: Our map shows slightly different tract level SVI values than those shown in the CDC's map because we are using state-level data, which is scaled differently. From an email exchange with CDC SVI Coordinator:

> "You are correct in that the **RPL_THEMES** variable represents overall social vulnerability. Second, the discrepancy you find is due to your use of two different databases – our U.S.-specific CDC SVI database and the Vermont-specific CDC SVI database. The U.S.-specific CDC SVI database compares the social vulnerability of a census tract (or county) to all tracts (or counties) in the U.S. The state-specific CDC SVI databases only compare the social vulnerability of a census tract (or county) to all tracts (or counties) within a particular state of interest. Within the CDC SVI Interactive Map, we show the U.S.-specific CDC SVI database. For your download, you likely obtained the CDC SVI database for Vermont. If you are only interested in how areas in Vermont compare to other areas in Vermont in terms of social vulnerability, then the state-specific database is sufficient."

Energy Burden: The other point for social vulnerability was determined by town energy burden data from Efficiency Vermont's 2019 report. The lowest energy burden is 5.6396% (Norwich) while the highest energy burden is 16.3839% (Irasburg) were used to create an artificial floor and artificial ceiling to adjust town values to a 0-1 percentile score. This was then scaled to a 0-1 percentile using the formula:

(Energy Burden-5.6396)/(16.3839-5.6396).

> Note: The town of Lemington has an outlier energy burden of 20.3%. The score for this town was set at 1 as this is the highest score possible.

Connectivity

Fiber/Cable: For this section, we assumed that buildings with fiber or cable connections are more vulnerable during outages because these systems rely on electricity. Buildings without fiber or cable are connected by copper and are able to make calls even without power. The percent of buildings in a given town with (# buildings with fiber or cable/ total # buildings). As some towns have 0% fiber/cable and others have 100% penetration, no additional scaling was needed. The data used for this is from 2017, 2018, and 2019 and was provided by Corey Chase at DPS.

Cell: DPS drive test cellular data measurements were used to calculate average town signal values. Signal strength is measured in RSRP in dBm (Reference Signals Received Power in decibel-milliwatts), where a more negative measurement is a worse signal. The worst average signal is -113 (Granville, Averill, etc.) while the best average signal is -76.42 (Mount Tabor). Based on these limits, we created an artificial floor of -76 and artificial ceiling of -113 to adjust average town values to a scale of 37. This was then scaled to a 0-1 percentile using the calculation:

(|signal|-76)/37

Towns with no drive test data were pinned at the ceiling level (i.e. worst signal) and given a score of 1. This choice was based on the assumption that if a town is so remote there's not even a major road through it, then it probably doesn’t have great cell service!

Note on excluded towns: 8 towns have been excluded from the final ranking because there was no energy burden data available for them: Averys Gore, Buels Gore, Ferdinand, Glastonbury, Lewis, Somerset, Warners Grant, and Warren Gore.