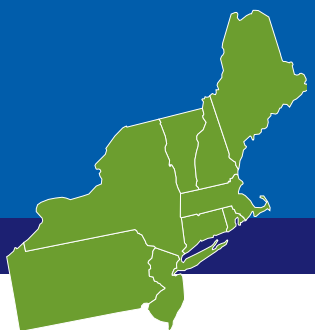
Vermont

Confronting Climate Change in the U.S. Northeast



From the Lake Champlain shore to the Connecticut River Valley, the climate of Vermont is changing. Records show that spring is arriving earlier, summers are growing hotter, and winters are becoming warmer and less snowy. These changes are consistent with global warming, an increasingly urgent phenomenon driven by heat-trapping emissions from human activities.

New state-of-the-art research shows that if global warming emissions continue to grow unabated, Vermont can expect dramatic changes in climate over the course of this century, with substantial impacts on vital aspects of the state's economy and character. If the rate of emissions is lowered, however, projections show that many of the changes will be far less dramatic. Emissions choices we make today—in Vermont, the Northeast, and worldwide—will help determine the climate our children and grandchildren inherit, and shape the consequences for their economy, environment, and quality of life.

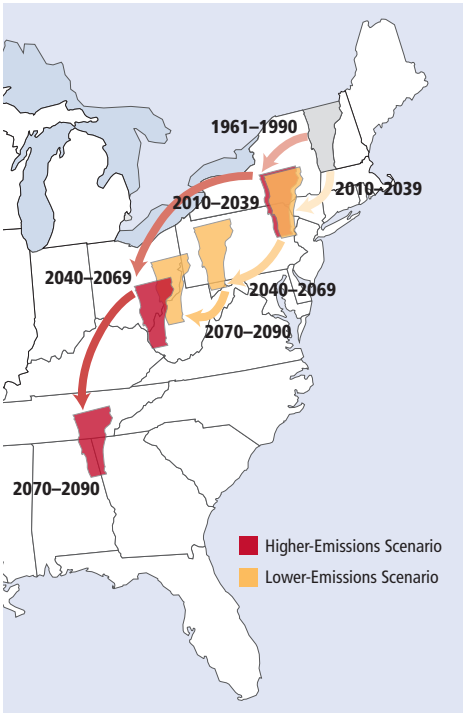
The research summarized here describes how climate change may affect Vermont and other Northeast states under two different emissions scenarios. The higher-emissions scenario assumes continued heavy reliance on fossil fuels, causing heat-trapping emissions to rise rapidly over the course of the century. The lower-emissions scenario assumes a shift away from fossil fuels in favor of clean energy technologies, causing emissions to decline by mid-century.

The research also explores actions that individual households, businesses, and governments in the Northeast can take today to reduce emissions to levels consistent with staying *below* the lower-emissions scenario and adapt to the unavoidable changes that past emissions have already set in motion.

VERMONT'S CHANGING CLIMATE

Temperature. Average temperatures across the Northeast have risen more than 1.5 degrees Fahrenheit (°F) since 1970, with winters warming most rapidly—4°F between 1970 and 2000. If higher emissions prevail, seasonal average temperatures across Vermont are projected to rise 9°F to 13°F above historic levels in winter and 7°F to 14°F in summer by late-century, while lower emissions would cause roughly half this warming. As in other Northeast states, Vermont can expect a large increase in the frequency of days over 90°F over the course of this century, with steep increases under the higher-emissions scenario.

Precipitation and winter snow. The Northeast region is projected to see an increase in winter precipitation on the order of 20 to 30 percent. Slightly greater increases are projected under the higher-emissions scenario, which would



Migrating State Climate

Changes in average summer heat index—a measure of how hot it actually feels, given temperature and humidity—could strongly affect quality of life in the future for residents of Vermont. Red arrows track what summers in Vermont could feel like over the course of the century under the higher-emissions scenario. Yellow arrows track what summers in the state could feel like under the lower-emissions scenario.

Photos: (from top) iStockphoto.com/Stephen Muskie; Mary Fratini; iStockphoto.com/Jan Tyler; iStockphoto.com/Christine Glade; AP Photo/Craig Line

also feature less winter precipitation falling as snow and more as rain.

Snow is an iconic characteristic of Vermont winters and an integral part of many favorite winter activities and traditions. But rising temperatures over the past few decades have caused snow to become wetter, or more "slushy," and decreased the average number of snow-covered days across the state. If higher emissions prevail, Vermont's snow season could be cut by more than half by late-century. Under the lower-emissions scenario, this change would be more modest—a decrease of roughly one-third.

Heavy, damaging rainfall events have already increased measurably across the Northeast in recent decades. Intense spring rains struck the region in both 2006 and 2007, for example, causing widespread flooding. The frequency and severity of heavy rainfall events is expected to rise further under either emissions scenario.

Drought. In this historically water-rich state, rising summer temperatures coupled with little change in summer rainfall are projected to increase the frequency of short-term (one- to three-month) droughts, particularly if higher emissions prevail. By late-century, for example, short-term droughts are projected to occur annually under the higher-emissions scenario (compared with once every two years, on average, historically), increasing stress on both natural and managed ecosystems. In contrast, little change in drought is expected under the lower-emissions scenario.

IMPACTS ON WINTER RECREATION

Snow and cold temperatures mean big business for the Green Mountain State. Vermont ski areas provide recreation for residents and visitors along with thousands of jobs, and contribute more than $1.1 billion a year to the state's economy. But Vermont winters have already changed and, over the course of the century, may look and feel profoundly different.

Snowmobiling. Vermont is part of a six-state network of snowmobile trails totaling 40,500 miles and contributing $3 billion a year to the regional economy. Snowmobiling, like cross-country skiing and snowshoeing, relies almost entirely on natural snowfall. Projected losses in natural snow cover and the impracticality of snowmaking on this vast system mean that Vermont's snowmobiling season could decline dramatically by late-century. Under the higher-emissions scenario the average season length across Vermont is projected to shrink to roughly 27 days by late-century—a nearly 70 percent decline below recent levels—and to roughly 40 days under the lower-emissions scenario.

Skiing. Milder winters are expected to shorten the Vermont ski season and, under the higher-emissions scenario, the state's ski areas may no longer be viable by late-century. Under the lower-emissions scenario many Vermont ski areas are expected to persist and may be in a position to benefit economically due to reduced competition. However, the long-term viability of these resorts may depend on skiers' willingness to travel greater distances and the resorts' access to the water needed for substantial increases in snowmaking (which will also increase operational costs).

Lake ice. Ice fishing and pond hockey are winter favorites in Vermont. However, global warming will render lake ice cover increasingly thin and shorten its duration. Ice cover duration on Lake Champlain has already declined in recent decades.

IMPACTS ON FORESTS

Forests cover nearly 80 percent of the Vermont landscape, extending from the Northeast Kingdom to the outskirts of Bennington. The state's forest-related manufacturing, recreation, and tourism sectors contribute more than $1.4 billion to the state's economy and provide jobs for many residents. These woodlands also provide wildlife habitat, protect watersheds, conserve soil, and store carbon. Climate change has the potential to dramatically alter the character of Vermont's forests.

Particularly vulnerable are the state's spruce/fir forests, which are treasured for their scenic, recreational, and timber value. Climate conditions suitable for these forests are expected to decline in Vermont by late-century under both emissions scenarios, with the steepest losses under the higher-emissions scenario. Losses in spruce/fir forests will eventually affect the animal species dependent on them, such as the Canada lynx, snowshoe hare, and Bicknell's thrush. Under the lower-emissions scenario, patches of the high-elevation spruce/fir habitat required by the Bicknell's thrush could persist in the mountains of northern New England, but under the higher-emissions scenario this bird's distinctive song could eventually be muted across the entire region as its suitable habitat gradually disappears.

The maple/beech/birch forests that dominate much of the state's landscape dazzle us each autumn with colorful foliage and provide sap for maple syrup. Ongoing winter warming is expected to further disrupt the pattern of freezing nights and warm days necessary for optimal maple syrup production, posing additional challenges to Vermont's $11 million industry. Warmer temperatures could actually increase the productivity of these forests in the near term, but by late-century under the higher-emissions scenario, climate conditions suitable for these forests are expected to decline substantially in large parts of the state. Under the lower-emissions scenario, these suitable conditions would be retained throughout Vermont.

USDA NRCS

Rising summer temperatures, changes in peak and low stream flow, and reduced winter ice and snow cover can harm native brook trout. In addition, under either emissions scenario the hemlock woolly adelgid (an invasive insect) is poised to threaten hemlocks as far north as the Canadian border by late-century.

In both of these forest types, long-lived trees may persist for some time even as the climate becomes unsuitable for them; however, they may also become more vulnerable to competition from better-suited species (such as oak and hickory) and other stresses such as pests and disease.

IMPACTS ON AGRICULTURE

Agriculture has long been a vital part of Vermont's character and economy. Global warming will present both opportunities and challenges to Vermont's growers; for example, increases in the frequency of short-term drought (see p.2) could necessitate increased irrigation and operational costs, while a longer growing season could benefit those farmers seeking to invest in warmer-weather crops that are currently hard to grow in the state.

By late-century under the higher-emissions scenario, increasing summer temperatures and heat stress could depress the yields of some of Vermont's economically important cool-weather crops. Northward expansion of agricultural pests and weeds are expected to further impede crop production during this time frame, and potentially pressure farmers to increase their herbicide and pesticide use (or, in the case of organic farms, invest more heavily in labor-intensive weed and pest control). Under the lower-emissions scenario, crop impacts this century are expected to be relatively minor in Vermont.

IMPACTS ON HUMAN HEALTH

From more intense summer heat waves to deteriorating air quality, global warming is expected to increase the risks of a number of health problems.

Extreme heat. While Vermont residents are accustomed to the occasional summer heat wave, the number of hot days is projected to increase substantially in much of the state by late-century, with some areas experiencing temperatures over 90°F on more than half of July days. Very hot days are not only unpleasant but also dangerous, as they increase the risk of heat stress and even death. The state will need to prepare for an increase in dangerously hot conditions by taking steps (e.g., establishing heat warning systems) that will lessen the impact of extreme heat on vulnerable people.

Air quality. Higher temperatures and increasing levels of plant-stimulating carbon dioxide (CO_2) in the air are also expected to accelerate seasonal pollen production over the next several decades under the higher-emissions scenario. This could extend the allergy season, increase asthma risks, and exacerbate symptoms for residents of Vermont.

Vector-borne disease. Mosquitoes and ticks carry West Nile virus (WNV) and Lyme disease-causing bacteria, respectively, and spread them to animals and humans. Factors affecting vector-borne diseases are complex; however, projections for the Northeast of warmer winters, hotter summers, and more frequent summer dry periods punctuated by heavy rainstorms are the same conditions that can set the stage for more frequent WNV outbreaks.

WHAT WE CAN DO

Vermont's reputation as a "green" state is renowned. Today the state is poised to continue this legacy by leading the effort to reduce heat-trapping emissions and combat the dangerous effects of global warming. By reducing emissions today, we have an opportunity to help protect our children and grandchildren from the most severe consequences of global warming. At the same time, effective adaptation strategies are needed to help reduce the vulnerability of Vermont's residents, ecosystems, and economies to those changes that are now unavoidable.

Here in Vermont, and across the world, there is growing momentum to meet the climate challenge. Of course our actions alone will not be sufficient to avoid dangerous climate change. But with its reputation for sensible and resourceful people who have undertaken foresighted, successful efforts to

preserve their quality of life, Vermont (along with the rest of the Northeast) is well positioned to help drive national and international progress. Concerted, sustained efforts to reduce emissions in the region—on the order of 80 percent below 2000 levels by mid-century and just over 3 percent per year on average over the next several decades—can help pull global emissions below the lower-emissions scenario described here.

State and local governments have a rich array of strategies and policies at their disposal to meet the climate challenge in partnership with other states, businesses, civic institutions, and the public. These strategies and policies can reduce emissions in the following sectors:

Electric power. While very little of the state's electricity is currently generated from fossil fuels, Vermont could greatly diversify and enhance the security of its supply and promote economic development by promoting on-site renewable generation throughout the state. As the first state in the region to commit to auctioning 100 percent of the emissions permits created under the Regional Greenhouse Gas Initiative, Vermont will have substantial additional resources to invest in energy efficiency and renewable energy development.

Buildings. Vermont has the second oldest building stock in the nation; 50 percent of its homes predate any energy-efficiency standards for buildings and 70 percent rely on high-emission fossil fuels like home heating oil, kerosene, and propane. Creating a statewide effort to upgrade water- and space-heating efficiency modeled on Vermont's award-winning program for electricity efficiency could yield substantial emissions reductions along with great cost savings. In addition, local governments can amend zoning laws to encourage and/or require that new construction and substantial renovation projects achieve the U.S. Green Building Council's LEED certification and/or energy-efficiency levels that qualify for the Environmental Protection Agency's (EPA) Energy Star Building designation.

National Renewable Energy Laboratory

The Searsburg, VT, wind project reduces CO_2 emissions in New England by over 6,600 tons annually—the equivalent of taking over 900 cars off the road.

Transportation. Cars and trucks account for 56 percent of Vermont's total carbon emissions. The state was the first in the region to adopt California's tailpipe emissions standards, which require reductions of approximately 30 percent below 2002 levels by 2016, beginning with the 2009 model year (implementation is contingent upon a ruling expected from the EPA). The state and its local governments can help further reduce vehicle emissions through increased investment in public transit designed to work in Vermont's rural landscape, incentives to purchase low-emissions vehicles, and continued emphasis on "smart growth" strategies that concentrate development near existing downtowns and infrastructure. Vermont can also adopt standards to reduce the carbon content of fuels.

Forestry and agriculture policies in Vermont can be refined to promote management practices and systems that cost-effectively reduce emissions. Such practices include increased carbon capture in soils, more efficient use of nitrogen fertilizers, and expanded on-farm use of wind and bioenergy—provided the latter is produced in a sustainable manner. Capturing and using methane to power farm operations is another successful strategy already under way on many farms.

CONCLUSION

Global warming represents an enormous challenge, but we can meet this challenge if we act swiftly. The emissions choices we make today in Vermont, the Northeast, and globally will shape the climate our children and grandchildren inherit. The time to act is now.

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This summary was prepared by the Union of Concerned Scientists based on *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions*, a report of the Northeast Climate Impacts Assessment (NECIA, 2007). NECIA is a collaborative effort between the Union of Concerned Scientists and a team of independent scientific experts to assess how global warming may further affect the climate of the U.S. Northeast and to explore options for meeting the climate challenge.

For more information on our changing Northeast climate and what you can do, or to download a copy of the full report and additional state summaries, visit *www.climatechoices.org*.