Vermont Climate Action Plan 2025

VERMONT CLIMATE COUNCIL

Contents

1. Letter from the Council

The destabilization of the climate, primarily driven by the burning of fossil fuels, is causing increasing costs and harms to Vermonters and people around the world. Vermont is experiencing this disruption in many ways, especially from the increasing frequency and severity of extreme weather. In this context, we recognize a responsibility to work together, both to respond to the effects that climate disruption is having on Vermont and to do our part to reduce the pollution that is at the source of the problem.

This *Vermont Climate Action Plan 2025* (CAP), a requirement of Vermont's Global Warming Solutions Act (GWSA), provides important recommendations for how we can adapt our communities and built environment to a warming planet, work to protect natural and working lands from the damage created by climate change, support and enhance the resilience of Vermont's landscape and communities amidst a changing climate, and do our part to reduce climate pollution toward meeting our legal commitments. Our recommendations were selected in consideration of multiple criteria, including cost-effectiveness, equity, and feasibility.

We recognize a particular urgency to this work because of the degree to which climate disruption is already harming Vermonters. Of the 62 federally declared disasters since 1953, 31 were made between 2011 and 2024 alone, with 2011, 2023 and 2024 having particularly high numbers of declarations. Lamoille and Washington counties accounted for some of the highest numbers of disaster declarations in the 2011–2024 period.[1]

1 FEMA Data Visualizations, last modified July 30, 2025.
(Note: Interactive data tools are no longer available through FEMA.gov as of June 30, 2025. Data may still be accessed through OpenFEMA application programming interface.)

We also recognize that this work will not get easier in the years ahead. Important federal programs and resources that Vermont relied on after our *Initial Climate Action Plan* was passed in 2021, both for disaster response and for pollution reduction, are now ending or—at best—facing an uncertain future as we look ahead to the 2025–2029 period that this updated plan is designed to cover. This will put additional pressure on state-specific action and necessitate a continuation and deepening of multi-state and regional collaboration.

Many carefully researched reports provide underlying data and analysis that underpin our work and help point the way forward. Additionally, the Council benefitted from robust public participation in the development of this plan. After widespread engagement in 2024, we sought feedback on early drafts of our recommendations in the spring of 2025 via 12 input sessions (three virtual, nine in-person) across Vermont, attended by over 400 people.[2] We also appreciated and incorporated information provided via written comments from more than 250 Vermonters or Vermont-based organizations.

We are grateful for the dozens of devoted subcommittee members; the many committed participants, from members of the public to technical consultants, who attended our meetings and events; and the thousands of Vermonters who were able to engage with us in this process. Many of you spent countless hours helping us develop this *Vermont Climate Action Plan 2025*—thank you.

The Climate Action Plan is intended to be accessible to the widest possible audience, regardless of technology or ability. Should you experience any difficulty accessing the Plan, please don't hesitate to contact the Agency of Natural Resources; they will provide you information in a format that meets your needs.

Citation:
Vermont Climate Council. *Vermont Climate Action Plan 2025.* Montpelier, VT, 2025.

2 Consolidated Summaries of Vermont Climate Action Plan Engagement, Spring 2025, last modified June 12, 2025.

2. Land Acknowledgement

April 14, 2025

Kwai Nedobak, hello friends,

For four years we have gathered on Zoom, greeting each other in a tick-tack-toe screen of videos, making decisions about the land we live on and the people we live with. We (the Vermont Climate Council) have gathered from places far and wide, from hill and dale, and from many corners of Vermont. We join this meeting from the cities of Brattleboro, Montpelier and Burlington, the rural areas of Calais, Essex Town, West Hartford, Middlesex, Swanton and Worcester, the glacial terraces of Wantastiquet, the Kingsbury Branch of the Winooski River, and so many more places. Here is a collection of our words and reflections.

Today, we take time to step on the land in all of these places and, using every sense we have, we give honor and acknowledge the beautiful land around us. The first thing many of us honored was the warmth of the sunshine on our faces and that no coats were needed.

Today, the land is breathing early spring, and the smell of the earth is brought to us by a mild north wind. The gentle breeze is everywhere. The Gluskobe and the Wind Eagle story reminds us that we need the wind, for things will shrivel and die without it because the sun is so strong. Today, we honor and acknowledge the wind and the sun and the balance they have found together. We are grateful.

Some cold spots remain covered in shrinking snow piles in Montpelier, Calais and West Hartford. A poor man's fertilizer, it's sometimes called. These late snowfalls contain and deliver nitrogen and other plant nutrients to the soil as the snow slowly melts. We honor and acknowledge the role and beauty of the snow that we still see on April 14 and how this cycle continues.

The gentle winds have brought us music today in the form of swaying trees, bird songs of many kinds, insects buzzing in the green grass, busy squirrels, a female bear exploring, a phoebe singing her famous song, and the brown crunchy leaves still here from last fall blowing in the wind. There is a view of three mallard ducks that dive and shake, cleaning themselves in the water. The splashing is a wonderful noise to behold. We honor and acknowledge all the sounds of the music we witness today. It is a true chorus—teaching us how to work with one mind and heart for the good of the earth.

Getting outside allows us to feel and witness firsthand the cycles of seasons that the world around us is embarking on once again. We see the beautiful pale green and reds of the buds returning and the color of flowers—purple, white, yellow, green and red. There is an almost spicy smell in the air from the new growth emerging. Last year's Queen Anne's lace seeds smell like coriander; smells are everywhere. The smell of the river waking up again is back and smells like life. A lone Canada goose sitting on a collection of stones in the middle of the river awaits a partner so their cycle together can continue too. There are different textures everywhere: fuzzy moss, smooth rocks, and rough tree bark—they all remind us that life continues. We honor and acknowledge these beautiful cycles and work to allow them to always be here with us.

We are also reminded of our work and why we have gathered today. The wispy cirrus clouds are dancing northward across the blue sky. There is a lot of pollution collecting against the mountains to the east. Cars and trucks are sliding up the slight incline of the road next to a former farm field. We see it, we smell it, and we taste the pollution. We grieve the changes and strive to return to a place of balance—braiding together different diversities, knowledges and patience to achieve our goals. We honor and acknowledge those who shared their wisdom before us, and we gather and hope for the strength to continue.

We also would like to take the time to acknowledge those that came before us. N'dakinna is the homeland of many various Abenaki tribes as well as that of the Mohican. We acknowledge those who had their homeland stolen from them, those who had their homeland abused but continued to care for the land. Despite all odds, they are here today and still working to continue to care for the land they love and call mother. Aki, the birthing place of all living things.

Ktsi wlini Ktsniwaskw (thank you, Creator)!!

3. Executive Summary

Taking Action on Climate Change

The Vermont Climate Council adopted the *Initial Vermont Climate Action Plan* in late 2021. In the nearly four years since the Initial Plan was finished and this *Vermont Climate Action Plan 2025* was written, Vermont has experienced a series of climate disasters.

Many Vermonters are still reeling from the disastrous floods that occurred across the state in the summers of 2023 and 2024. Vermonters are also experiencing other impacts of a changing climate, including:

- increased health risks, particularly for vulnerable Vermonters, from more days with poor air quality from wildfire smoke and high heat
- impacts on farm and forest workers' livelihoods from changing temperatures and precipitation
- reduced drinking water quality and harmful algae blooms that limit access to lakes and ponds
- damage to electricity infrastructure and power outages from winter ice storms and freezing rain

These are the consequences of climate pollution. They are relentless and will continue to worsen.

In 2020, the General Assembly made clear with the Global Warming Solutions Act (GWSA or Act 153) that Vermont has a responsibility to reduce our harmful climate pollution. The GWSA required the creation of the Vermont Climate Council (the Council) and directed us to prepare a Climate Action Plan (CAP).

The CAP is updated every four years. It identifies the strategies and programs necessary to achieve greenhouse gas (GHG) emissions levels at three milestone dates: January 1, 2025; January 1, 2030; and January 1, 2050. The annual *Greenhouse Gas Emissions Inventory and Forecast* tracks compliance with these targets. Because data for certain sectors lags, the official inventory for any compliance year is published more than two years after the milestone date.

The proposed actions in this 2025 update to the CAP are intended to meet the 2030 milestone. By January 1, 2030, Vermont must achieve GHG emission levels of no less than 40% below Vermont's 1990 emissions. The CAP also addresses other obligations of the GWSA to create a more resilient Vermont and support a just transition in the way climate actions are taken.

Council's Charge and Work

The 23-member Council is made up of eight administration officials and 15 members appointed by the Legislature to represent various sectors and interests. We are charged with the following tasks to achieve Vermont's GHG reduction requirements and build climate resilience:

- Identify, analyze and evaluate climate strategies and programs, including their cost-effectiveness and impact.
- Adopt the *Initial Vermont Climate Action Plan* and update it at least once every four years.
- Prepare Vermont's communities, infrastructure, economy and environment to adapt to current and future effects of climate change.
- Track progress towards meeting the GHG emission reduction requirements and increasing resilience.

Subcommittees

The GWSA, in addition to creating the Council, established four subcommittees and charged them to assist in the work needed to develop the CAP. The four subcommittees identified by the GWSA are: Rural Resilience and Adaptation; Cross-Sector Mitigation; Just Transitions; and Agriculture and Ecosystems. The GWSA also allowed the Council to create additional subcommittees. To address the technical complexity and data needed for this effort, we created a fifth subcommittee: Science and Data.

The core function of the subcommittees is to evaluate and recommend draft initiatives, programs and strategies for the Council to review, refine and compile into the CAP. As described in the GWSA, subcommittees should support the Council in developing recommendations which also:

- Prioritize strategies for climate action that are cost-effective, technologically feasible, fair and just.
- Reflect the relative contribution of GHG emissions from different areas of the economy in overall emissions reductions.
- Minimize negative impacts on rural communities, individuals with low and middle incomes, and frontline and impacted communities.
- Ensure that all regions of Vermont benefit from GHG emissions reductions.
- Support economic sectors and regions that face the greatest barriers to emissions reductions, especially rural and economically distressed regions and fossil fuel–based businesses and industries.
- Support climate-friendly industries, technologies and training that provide jobs and new business opportunities.
- Support natural and working lands to reduce GHG emissions, take up and store carbon, and increase resilience.
- Maximize Vermont's involvement in interstate and regional initiatives and programs designed to reduce GHG emissions, and build upon state, national and international partnerships and programs.

To ensure the subcommittees have a range of expertise and lived experience needed to fulfill their charges, members have been recruited from the Council and from the public. The intent is for subcommittees to have the knowledge and skills necessary to create the work, represent diverse geographic areas of Vermont, and be able to speak to specific challenges presented by climate change.

Throughout the development of these recommendations, the Just Transitions Subcommittee supported the CAP update by providing input and feedback on how the plan actions should be made to benefit and support all residents of the State of Vermont in a fair and just way. The subcommittee promoted broad and diverse public engagement and made sure that Council and subcommittee meetings discussed topics from multiple points of view and focused on equity. There was an intentional effort in the recruitment process to bring on subcommittee members with diverse lived experiences, including from communities disproportionately harmed by climate change. The Council continues to work on diversifying its subcommittee membership and is dedicated to collaborating with everyone living in Vermont to ensure that equity is woven into every step of this and future CAP updates.

The recommendations for climate action put forward in this CAP reflect the collective work of the subcommittees. The recommendations were handed off to the Council in December 2024, at which point we began our review. The result is the set of actions contained in this document, which fulfill the requirements of the GWSA.

The recommendations are organized around four areas of climate action:

Cross-Sector Mitigation: Reducing planet-warming emissions

Agriculture and Ecosystems: Building resilience and adaptation in Vermont's natural and working lands

Rural Resilience and Adaptation: Building resilience and adaptation in Vermont's communities and built environment

Cross-Cutting Solutions: Education, workforce, finance and funding

Engagement

We understand that a complete rethinking in every area, at every level, is needed to meet the goals of the GWSA. Ongoing engagement with Vermonters is essential to receiving broad-based input on possible approaches to climate action and to better understanding the barriers to taking action. One important lesson from the Initial Plan was the need to involve Vermonters continuously and include their input throughout the entire update process. To achieve this in the CAP update, we started the engagement process in early 2024 and continued until the CAP was finished in June 2025. Community input was shared with us every three months via Vermont Voices on Climate engagement reports.

We hosted events throughout the development of the CAP to share information, answer questions, hear new ideas, consider community priorities, and receive feedback on the work in progress. These sessions focused on different themes from the various subcommittees and, at key moments, community-based organizations and Regional Planning Commissions supported and collaborated on these events. The timing intentionally lined up with key decision-making and drafting periods of the planning process.

From June 2024 to May 2025, more than 850 public participants took part in a virtual or in-person input session. In addition, approximately 250 Vermonters or Vermont-based organizations submitted written comments by email or through the Public Comment Portal during the public input process.

After April 2025 engagement on the draft plan, the Council and Steering Committee met many times in May and June to consider input from public meetings and public comment and revise the emerging plan. Detailed considerations and changes can be found in Chapter 5 Public Engagement.

Priority Actions

In this CAP, we present a significant and broad set of recommendations intended to guide climate action over the next four years. At the heart of our efforts is a commitment not only to reduce emissions, but also to ensure Vermont remains a vibrant, healthy place for current and future generations.

In all, this 2025 update to the CAP identifies more than 250 recommended actions (see Appendix 2). In the chapters that follow, we highlight 52 priority actions. Below is a shortlist of the 10 highest priority actions, created in direct response to public input. The 10 actions are not listed in priority order; rather, they are equally important, as a collective suite of actions.

10 Highest Priority Actions

These 10 highest priority actions identify immediate steps needed to reduce climate pollution and make Vermont more resilient to climate-related hazards.

Make Vermont more resilient

- Expand and maintain a permanent Flood Resilient Communities Fund
- Invest in municipal infrastructure to support compact development

Support climate-informed land use

- Expand and adapt existing Vermont programs that achieve climate goals on farms and in forests
- Promote equitable landscape connectivity and conservation for 30x30 and 50x50 goals (Act 59)

Reduce climate pollution

- Weatherize homes, focusing on low- and middle-income households
- Take preparatory steps now and join a cap-and-invest program as soon as a viable option is available
- Support utility programs that ensure the electric grid supports customer electrification and resilience
- Reduce GHG emissions from vehicles and buildings through electrification

Identify funding and also support the needed workforce

- Identify revenue sources to immediately support these priority actions
- Implement the U.S. Climate Alliance's Climate-Ready Workforce Initiative and related actions

Moving the Plan Forward

Over the next four years, as the recommendations in the CAP move forward, the Council encourages the legislative and executive branches to be mindful of the following criteria when designing policies and programs:

- Minimize financial hardship of Vermonters living on low and middle incomes through the intentional design, prioritization, and pacing of programs, and ensure those in need receive timely financial support.
- Balance investment in emissions reductions and adaptation measures to strengthen resilience against current climate impacts.
- Ensure adequate capacity for state agencies to advance the actions (e.g., new staff, funding, technology).
- Identify revenue sources that are compatible with climate actions (e.g., raising the cost of electricity is not compatible with the adoption of climate-friendly electric heating and transportation options).
- Ensure necessary supporting technologies are being funded and implemented (e.g., residential electric panel upgrades, expanded availability of electric vehicle charging infrastructure).
- Support and develop enough trained workers to implement the actions.
- Take into account the costs of not acting, including Vermonters' continued dependence on price-volatile fossil fuels for home heat and transportation and the cost of rebuilding after all-but-certain future climate disasters.

This updated CAP includes actions that will reduce emissions now. It also contains critical steps we need to take on more complex efforts that will serve Vermont in the medium and long terms. Similarly, the plan urges the Legislature and administration to find funding sources that can be immediately put towards climate action while at the same time taking steps to secure sustainable, long-term funding for climate action.

As we undertake this work, we recognize that Vermont has a history of innovation to draw and build upon. The can-do ethos of Vermonters sees us through not only challenges but opportunities—including the opportunity to act together and nimbly as a small state.

While the Legislature, the Agency of Natural Resources, and other agencies of state government work to advance the actions put forward in this plan through legislative action and rulemaking, the Council will continue to do its work to move the plan forward. We will:

- Monitor and track the progress of CAP actions.
- Identify and champion additional work needed to make CAP actions possible.
- Convene Climate Council meetings on a quarterly basis to engage with the public.
- Bring subcommittees together as needed to support the work of the Climate Council.

These efforts and other related work will be reflected in the next update to the Vermont Climate Action Plan, scheduled to be delivered in July 2029.

4. Acknowledgements

The Vermont Climate Council expresses its deepest thanks and appreciation to all the people and organizations who contributed to this *Vermont Climate Action Plan 2025* (CAP).

Vermont Climate Council Members

Cabinet Members

- * Chair Sarah Clark, Agency of Administration
- * Secretary Julie Moore, Agency of Natural Resources
- Secretary Anson Tebbetts (Designee Ryan Patch), Agency of Agriculture, Food and Markets
- Eric Forand, Department of Public Safety, Director of Vermont Emergency Management
- Secretary Joe Flynn (Designee Michele Boomhower), Agency of Transportation
- Commissioner Kerrick Johnson, Department of Public Service
- Secretary Lindsay Kurrle, Agency of Commerce and Community Development
- Secretary Jenney Samuelson (Designee Shayla Livingston), Agency of Human Services

Members Appointed by the Senate Committee on Committees

- * Jared Duval, member of a Vermont-based organization with expertise in energy and data analysis, Science and Data Subcommittee Co-Chair
- * Kelly Klein, member to represent the small business community, Just Transitions Subcommittee Co-Chair
- Jaiel Pulskamp, member to represent the farm and forest sector, Agriculture and Ecosystems Subcommittee Co-Chair
- David Mears, member with expertise in the design and implementation of programs to increase resilience to and respond to natural disasters resulting from climate change, Rural Resilience and Adaptation Subcommittee Co-Chair
- Peter Sterling, member to represent the clean energy sector
- Dahlia Cohn, member to represent Vermont youth
- Will Eberle, member to represent the Vermont Community Action Partnership

Members Appointed by the House of Representatives

- * Liz Miller, member to represent distribution utilities
- Richard Cowart, member with expertise and professional experience in the design and implementation of programs to reduce greenhouse gas emissions, Cross-Sector Mitigation Subcommittee Co-Chair
- Dr. Lesley-Ann Dupigny-Giroux, member with expertise in climate change science
- Chris Campany, member to represent municipal governments
- Brian Dunkiel, member to represent Vermont manufacturers
- Matt Cota, member to represent the fuel sector
- * Johanna Miller, member to represent a statewide environmental organization
- Stephanie Moffett-Hynds, member to represent rural communities

** Asterisks indicate members of the Vermont Climate Council Steering Committee.*

A special thank-you to Dr. Mark Levine, Vermont's former Health Commissioner, who retired in March 2025 and served on the Climate Council as a designee of the Agency of Human Services.

Other Vermont Climate Council members who have since resigned but supported the development of this CAP include: David Deen, Bram Kleppner, Allie Webster, Paula Melton, and Denise Bailey.

Beverly Little Thunder was a member of the Just Transitions Subcommittee from its formation in 2021 through early 2025, when she was diagnosed with pancreatic cancer. She passed away a few months later. Beverly's words and wisdom helped shape the Climate Action Plan, particularly the Guiding Principles for a Just Transition. More importantly, her loving presence touched many of our lives. We send love to her family and thanks for all the ways in which she helped create a better future for Vermont.

Subcommittees

Co-Chairs, Members and Staff Support

- Rural Resilience and Adaptation Subcommittee
- Agriculture and Ecosystems Subcommittee
- Cross-Sector Mitigation Subcommittee
- Science and Data Subcommittee
- Just Transitions Subcommittee

Consultants

Thank-you to staff from Consensus Building Institute for facilitating meetings and supporting public engagement. Thank-you to Stockholm Environment Institute for providing reporting on business-as-usual and scenario modeling to the Climate Council.

Staff

Thank-you to the staff of the Climate Action Office in the Agency of Natural Resources for supporting the Climate Council during this CAP update and drafting key chapters in the CAP. Additional thanks to the staff of:

- Agency of Natural Resources (ANR)
- Department of Environmental Conservation (DEC)
- Fish and Wildlife Department (FWD)
- Forests, Parks and Recreation (FPR)
- Agency of Transportation (AOT)
- Public Service Department (PSD)
- Agency of Agriculture and Farm Markets (AAFM)
- Vermont Emergency Management (VEM)
- Agency of Commerce and Community Development (ACCD)
- Department of Children and Families (DCF)
- Agency of Administration (AOA)
- Agency of Human Services (AHS)

5. Public Engagement

Why Engagement Matters

The breadth and scale of the *Vermont Climate Action Plan 2025* impacts all Vermonters, in various ways. It is crucial to ensure that diverse voices, perspectives, and lived experiences are welcomed and valued throughout the process. It is especially important to prioritize the needs and considerations of frontline and impacted communities.

Frontline and impacted communities include those who:

- are highly exposed to climate risks, such as health impacts, flooding, and extreme temperatures
- experience oppression and racism, are excluded from opportunities, or have fewer resources to adapt to climate and economic change
- bear the brunt of pollution and negative effects from today's fossil fuel and extractive economies
- are more likely to experience a job transition as Vermont addresses climate change

To reach Vermonters from all walks of life, we need to adopt new and different engagement approaches, recognizing that not everyone has the time, means or ability to attend a typical government public meeting—yet it is still important to hear from them. These new approaches include:

- **Meet people where they are.** One approach involves speaking with people in places they already frequent. Meeting people where they are means having conversations that are accessible and transparent and providing information or resources that are of interest to them.
- **Get creative with communications and work with community partners.** Another approach involves collaborating with community partners on engagement and using creative communication methods to spread the message and reach larger audiences.
- **Redesign traditional public meetings.** Finally, recognizing that public meetings are still important avenues for sharing information, we can modify the design of those events to better welcome all.

Read on to see how these approaches were incorporated in the CAP update process. To succeed at these engagement activities, we must invest the necessary time and energy to build and maintain ongoing relationships and to ensure engagement is inclusive and accessible. This round of public engagement learned from and improved upon the engagement for the 2021 *Initial Vermont Climate Action Plan*. However, we recognize that there is still much work to be done to amplify the voices of those disproportionately affected by climate change impacts and to expand our reach further to Vermont communities we have not yet engaged with.

Engagement for the 2025 Update

One important lesson from the first CAP in 2021 was the need to involve Vermonters continuously and include their input throughout the entire process. To achieve this in the 2025 CAP update, engagement started in early 2024 and continued until the CAP was finished. Community input was shared with the Climate Council every three months via the Vermont Voices on Climate engagement summaries. This engagement also aims to influence ongoing climate-related programs and systems in Vermont beyond the creation of the CAP. To support this, the Vermont Voices on Climate summaries are regularly shared with the Inter-Agency Advisory Board to the Climate Action Office, the Civil Rights and Environmental Justice Unit, and other key partners.

Boots on the Ground Outreach

Starting in early 2024, the Climate Action Office, with help from Vermont engagement experts at the Consensus Building Institute, attended events across the state to respond to questions, hear concerns, and listen to ideas—all in service of building trust and engaging Vermonters in state climate action. Conversations covered many topics depending on the interests of the community member engaged; a few examples include flood recovery, home heating, health, and public transportation.

TABLE 5.1: Events Attended.

January 2024	
Community Dinner at Islamic Society of Vermont	Burlington
February 2024	
Northeast Organic Farmers Association (NOFA) Conference	Burlington
June 2024	
Vermont Afghan Alliance Lunch	Burlington
Capstone Community Action's annual gathering "Community Impact"	Hyde Park
Memory Lane Car Show	Essex Junction
Juneteenth Celebration	Winooski
Juneteenth Celebration	Burlington
3rd Annual "Summer Jam" free family day	Bennington
Lamoille Pride Event	Morrisville
July 2024	
Wellness Day	Barton
Vermont Council on Rural Development Community Forum	Johnson
Memphremagog Festival	Newport
Old North End Ramble	Burlington
August 2024	
Farmacy Distribution Day with Addison County Relocalization Network (ACORN)	Middlebury
Abenaki Land Link Harvest Festival	South Burlington
Vermont State Fair (2 days)	Rutland
First African Landing Day	Burlington
All Brains Belong Community Health Education Fair	Montpelier
October 2024	
Missisquoi Festival	Swanton
Intervale Fair Share Distribution Day	Burlington
November 2024	
Deer Check	West Enosburg
Vermont Maple Conference	Randolph
December 2024	
Youth Climate Leadership Academy	Fairlee
January 2025	
Free Ice Fishing Day	Barnard

Partnering with Community-Based Organizations

Over the past year, the Climate Action Office has worked to build relationships with various community-based organizations and Community Action Agencies (also known as CAP Agencies) around the state. In addition to working with many of them to attend events listed above, partnership has resulted in focus groups, small-group facilitated conversations, and inviting their constituents to climate-related events. Much of this work focuses on engaging frontline and impacted communities. These events often provided compensation and/or food and were held in familiar and accessible locations.

TABLE 5.2: Focus Groups.

January - March 2024	
Six introductory focus groups were held with linguistically diverse communities (Arabic speakers, French and Lingala speakers, Spanish speakers, Somali Bantu community, and Bhutanese Nepali community). These laid the foundation for the October 2024 focus group below.	Winooski, Burlington, Montpelier, and virtually
October 2024	
Community leaders within linguistically diverse Vermont communities	Winooski
November 2024	
Capstone Community Action focus group with weatherization clients and other program participants	Barre
January 2025	
Caregiver support group with Sunrise Family Resource Center	Bennington
April 2025	
Elder Caucus with Northeast Kingdom Organizing	Barton
University of Vermont Eco-Reps	Burlington
May 2025	
Youth Input Session in partnership with Vermont Energy Education Program	Virtual

An additional focus group was planned in collaboration with Bhutanese Nepali community members but had to be cancelled due to an emergency.

Summaries of these focus groups and others can be found in the Vermont Voices on Climate engagement summaries.

Climate Action Plan Events

The Vermont Climate Council, Climate Action Office, and Consensus Building Institute hosted events throughout the entire CAP update process to share information, answer questions, hear new ideas, consider community priorities, and receive feedback on work to date. These sessions focused on different themes from the various subcommittees. At key moments, community-based organizations and Regional Planning Commissions supported and collaborated on these events. The timing intentionally lined up with key decision-making and drafting periods of the planning process. Locations were chosen to cover a broad geographic range and reach areas that had not hosted an event during the drafting of the 2021 CAP.

Below are a few methods used to increase the accessibility and inclusivity of these events, recognizing that there is still much to be done:

- spreading the word to community-based organizations and community partners with whom relationships have been built
- availability of language interpretation, including automatically including a question in the registration form for participants to indicate whether language access services are needed
- only hosting events in physically accessible facilities
- offering multiple ways of providing input, including physical and virtual meeting options with various activities such as writing, small group conversation, and smartphone polling
- offering printed hand-outs of the PowerPoint slides
- hanging flyers in known community gathering places such as laundromats, general stores, hardware stores, gas stations, cafes and town halls

TABLE 5.3: Public Meetings.

June 2024	
Kick-Off Public Meeting #1	Virtual
Kick-Off Public Meeting #2	Virtual
October 2024	
Buildings and Thermal	Virtual
November 2024	
Municipal Day	Montpelier
Transportation	Virtual
Rural Resilience and Businesses	Virtual
Rural Resilience and Town Support	Virtual
Agriculture	Virtual
Municipal #1	Virtual
Municipal #2	Virtual
Natural Lands and Forestry Input Session	Virtual
April 2025	
Public Input Session #1	Virtual
Public Input Session #2	Hardwick
Public Input Session #3	Hinesburg
Public Input Session #4	St. Albans
Public Input Session #5	Bennington
Public Input Session #6	Rockingham
Public Input Session #7	Barre
Public Input Session #8	Rutland
May 2025	
Public Input Session #9	Virtual

FIGURE 5.1: Spring 2025 virtual event participants.

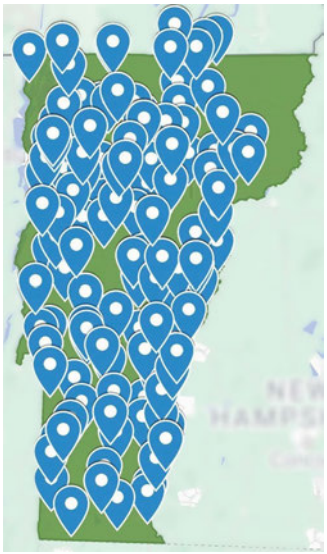
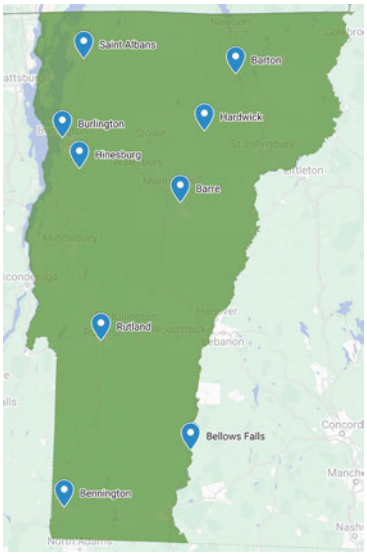


FIGURE 5.2: Spring 2025 in-person events.



View summaries of fall and spring input sessions.

FIGURE 5.3: Timeline.

	June 2024	Oct-Nov 2024		April 2025	April-May 2025
ENGAGEMENT ACTIVITIES	Virtual kick-off events (2) 117 participants	Virtual topic-specific input sessions (8) 300 participants	In-person focus groups with frontline and impacted communities (2) 25 participants	In-person input sessions (9) 245 participants	Virtual input sessions (3) 190 participants
CAP UPDATE STEP	Setting the stage, beginning subcommittee work	Before events, subcommittee recommendations were drafted/in progress. After events, subcommittee recommendations were finalized.		Before events, Climate Council recommendations were drafted. After events, Climate Council recommendations were finalized.	

Participation

Between June 2024 and May 2025, more than 850 public participants took part in a virtual or in-person input session. This figure may include some double-counting for Vermonters who attended more than one session.

Out of 18 Climate Councilors, 17 were able to attend events with most attending two events.

In addition to events, approximately 250 Vermonters or Vermont-based organizations submitted written comment by email or through the Public Comment Portal during the public input process. The Climate Council and subcommittees adopted an improved process for receiving written comments at meetings (see Chapter 8 Building Equity into the Climate Action Plan).

How Input Was Used

In the fall of 2024, subcommittees considered public comments while finalizing recommendations and pathways in the plan. Feedback from the events led to terminology and language becoming better defined and more inclusive and intentional in the updated CAP. Portions of subcommittee meetings were spent asking whether perspectives were missing, if programs were accessible, and how research and monitoring of the impact on individuals would occur. Additional, ongoing consideration of engagement occurred as ideas and comments were held in the minds of subcommittee members as they updated recommendations for inclusion in the CAP.

After the April 2025 engagement on the draft plan, the Climate Council and Steering Committee met many times in May and June to consider input from public meetings and public comment and revise the CAP. In response to feedback that there were too many priorities and that more focus was needed, the Council created a top-ten list of priority actions (out of the larger 52-item list). These include actions that public meetings revealed broad support for, including weatherization, cap-and-invest program, electrification, workforce development, maintenance and expansion of the Flood Resilient Communities Fund, investment in municipal infrastructure, and conservation that supports landscape connectivity.

> "Too many goals! Prioritize!"

> "Great ideas but too many. Whittle down to the most impactful, most likely to succeed and result in positive benefit and success."

The Council also made a new recommendation for a funding mechanism for these programs.

> "Need to ensure funding for actions" and "So many of the priorities are around increasing funding, but there is not necessarily a noted path forward to that funding. [Be] more specific and clear and make actual recommendations on funding sources."

In response to feedback that geothermal networks should be part of the priorities, the Council created a new recommendation.

> "There is no mention of geothermal networks in this draft. TENs (thermal energy networks) are CO_2 free; use the [rights-of-way] of gas and power companies; have the same worker skills and tools; and use off-the-shelf parts and technologies … [A] bill passed this year that allows towns, groups, and organizations to form companies to create TENs."

Many participants expressed that the CAP's language was difficult to understand and communications could be improved. The Council added an introduction to Chapter 12 Priority Actions to better communicate the overall plan and its goals. In 2026, a plain language summary of the CAP will be released as well.

> "The language used in these recommendations isn't accessible to many Vermonters; it would be so helpful to put these in plain language."

The introduction to Chapter 12 Priority Actions also responded to feedback emphasizing the importance of affordability by speaking about the actions with a heavy emphasis on affordability and how low- and middle-income Vermonters will see benefits from this plan.

> "Please be mindful of the impacts of the proposed actions on low- and moderate-income Vermonters. The cost of living is high in Vermont and adding more financial burden will only make people angry at the government."

Actions for which there was broad support at the meetings remain in the list of 52 priorities—these include public transit, education, and the utility-scale biomass study.

In addition, nuanced edits were made to actions about solar siting, climate-ready workforce, business emergency (BEGAP) funding, public health, and education and workforce actions were made in response to feedback.

> "I really appreciated the feedback we got from people in terms of their interests and goals related to different priorities, as well as their interest in ensuring our recommendations thoughtfully balance goals important to them—including cutting planet-warming pollution while also ensuring any solutions recognize and respond to the financial and other challenges Vermont families and communities are already facing today … We adjusted our [cap-and-invest] recommendation to aim to make clear … our goal in aiming to mitigate and avoid negative cost impacts to low-income Vermonters from any potential program, and [we] outlined some key principles … that any program is designed to not only deliver (real-time) direct financial relief to [low- and middle-income] households as well as direct benefits from clean energy programs, while also cutting climate pollution."
>
> *JOHANNA MILLER*
> *Vermont Climate Council member representing a statewide environmental organization*

> "We heard consistently during public meetings that members of the public would like to see the plan include a greater degree of prioritization among our recommendations, including the development of something like a "Top 10" list of the highest priority actions. As a Council, we followed through on that idea and, in addition to our list of 50-ish priority recommendations, have also worked to lift up a list of 10 top priority recommendations."
>
> *JARED DUVAL*
> *Vermont Climate Council member representing a Vermont-based organization with expertise in energy and data analysis*

Continued Engagement

Recognizing that engagement is a key component of successful climate action, efforts to reach Vermonters in all corners of the state will continue between now and the next CAP update in 2029. In the coming years, community engagement conducted by the Climate Action Office will seek to reach rural communities, geographic areas not yet engaged, and frontline and impacted communities. This work is aligned with and guided by broader state government efforts to improve engagement—including the Environmental Justice Law, subsequent agency-specific Community Engagement Plans, and the new Community Engagement Community of Practice.

6. Climate and Climate Change in Vermont

Citation: Dupigny-Giroux, L.A., Shafer, J., Kulkani, T., Bowden, B., Dow, J., Paske, C., Dejong, B., Kim, J., Myrick, E. "Climate and Climate Change in Vermont," *Vermont Climate Action Plan 2025*. Montpelier, VT, 2025.

Preface

This section of the *Vermont Climate Action Plan 2025* presents the land, air, water and plant dimensions of climate change in Vermont and the interconnected ways that we as peoples both affect and are impacted by such changes. From the homelands of the Abenaki and the Mohican, we honor all ways of knowing[3] and present mitigation, adaptation and resilience through the overlapping lenses of natural hazards, inclusion and vulnerability of peoples, the natural environment, and human infrastructure, as we seek to do no harm. For consistency with other state-level Climate Action Plans, this section uses data, methodologies and results developed in support of the 2023 Fifth National Climate Assessment (NCA5)[4] as well as those from multiple federal and State of Vermont agencies. Following the presentation style used in NCA documents, information here will be organized into Key Messages that highlight updates and developments made since the Initial Vermont Climate Action Plan of 2021.

3 Betts, A.K,. Climate change and society[J]. AIMS Geosciences, 2021, 7(2): 194-218. DOI: 10.3934/geosci.2021012

4 USGCRP, 2023: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

Setting the Stage for the Ongoing Impacts of Our Changing Climate

There are three main factors that influence our past, present and future susceptibility to weather and climate events and their changes. These include Vermont's geology, topography or physical geography, its culture and history that predate us, and which in turn have influenced the social and economic decisions and choices that have been made. The geology and physical geography of Vermont influence where natural hazards occur, their impacts on human settlements, the location of major roadways in steep V-shaped valleys, and our ability to increase resilience as a state. From a geologic perspective, large swaths of the state are inherently susceptible to failure due to the glacial stratigraphy (Figure 6.1a). For example, loose sand often directly overlies dense glacial till or glacial lake clays and silts, which sets up a significant permeability contrast and leads to saturation of the overlying sands. This saturation reduces soil cohesion, particularly when located along the steep slopes of the Green Mountains. The north-south spine of the Green Mountains along with the complex east-west valleys and the north-south ridges of the Taconic Mountains affect the movement of localized winds and the incidence of freezing rain conditions, produce enhanced orographic precipitation and associated flooding events, and control the incidence of air pollution and stagnation events as well as variations in freeze and frost dates. Figure 6.1a highlights the locations of landslides and mass movements across the state, while the 2023 U.S. Department of Agriculture's (USDA)'s Plant Hardiness Zone map shows the shift in zones as our climate has warmed (Figure 6.1b).

Apart from landslides, various online tools can be used to map Vermont's exposure to multiple weather and climate-related hazards in each of its 184 Census tracts. One such tool is the NOAA National Centers for Environmental Information (NCEI)'s Billion-Dollar Weather and Climate Disasters mapping tool.[5] Figure 6.1c shows the weather and climate risk from seven hazards. Vermont as a whole has a risk score of 7.52 compared to the national average of 13.30. However, it is important to note that some counties have higher risk scores, such as Windsor County (12.15), Rutland County (10.97) and Washington County (10.36). Also of note is that risk scores vary by hazard. For example, in the case of flooding, Vermont's risk score of 9.13 is the same as the national average, with Windsor County (16.07), Rutland County (14.16) and Washington County (13.77) again exceeding the statewide and national levels. Of particular note is Census tract 9660 (Town of Windsor) in Windsor County, which has the highest hazard risk both overall (23.95) and in terms of flooding (37.07).

5 After 2024, new data will not be added to this tool.

FIGURE 6.1a: Documented Landslides, Vermont Geological Survey.

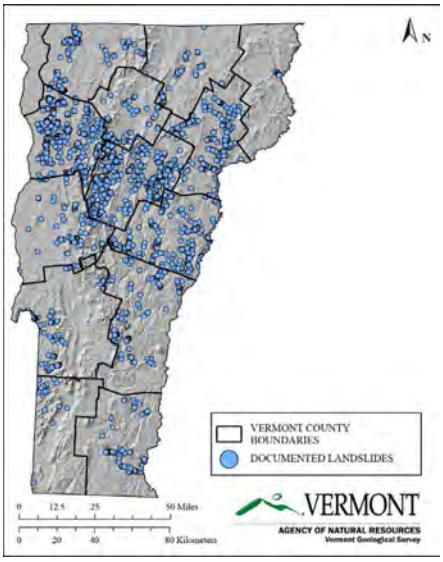


FIGURE 6.1b: 2023 USDA Plant Hardiness Zone Map.

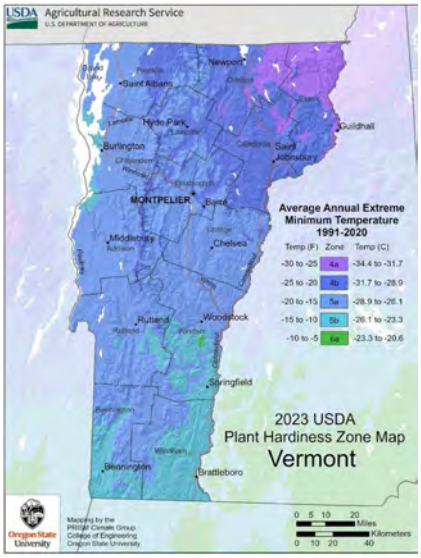


FIGURE 6.1c: Weather and Climate Hazard Risk.

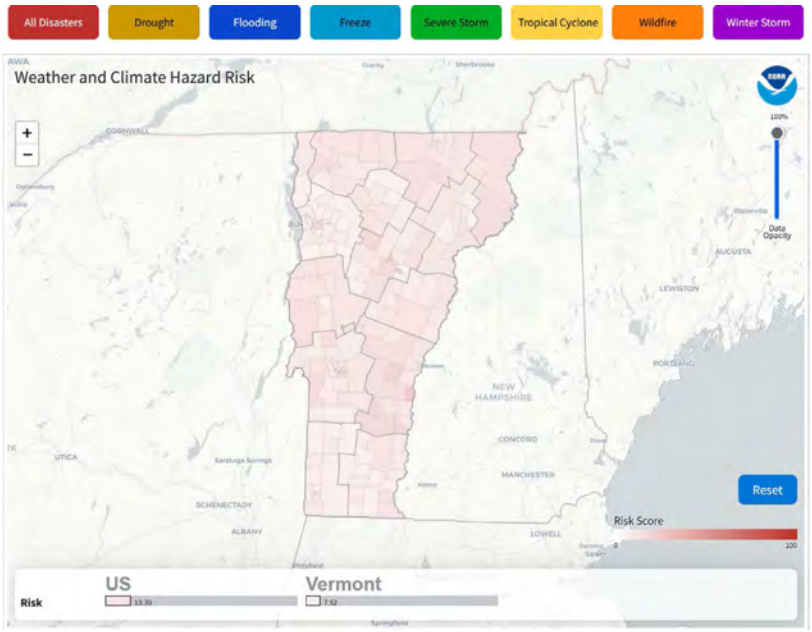


Figure 6.1: Maps of Vermont's counties and census tracts showing (6.1a) the locations where landslides have been documented (Vermont Geological Survey); (6.1b) showing the 2023 USDA Plant Hardiness Zone (Map by PRISM Climate Group, College of Engineering, Oregon State University)[(6)]; (6.1c) showing the degree of risk (0- 100) from seven weather and climate hazards (drought, flooding, freeze, severe storm, tropical cyclone, wildfire, winter storm, all) (NOAA National Centers for Environmental Information).[(7)]

6 USDA Plant Hardiness Zone Map, 2023. Agricultural Research Service, U.S. Department of Agriculture.

7 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2025). DOI: 10.25921

Key Message 1: Our seasons are changing, with the largest changes being observed during the winter

Vermont is characterized by a great deal of climate variability, particularly with regard to precipitation. Climate variability includes the variations that occur from one year to the next and can include changes in the storm tracks observed. Recent examples of the year-to-year differences in storm tracks (and resulting slope failures) were observed during the north-south flooding rains of July 2023 versus the northeast-southwest track of July 2024 (Figure 6.2d). While long-term trends show an increase in total precipitation across Vermont, this does not mean each individual storm is wetter than the last. In fact, as Figure 6.3b shows, in August 2011 Tropical Storm Irene produced more rainfall over a larger geographic area than the flooding rains of July 2023. Even more importantly, heavy precipitation (both snow and rain) can occur during single-day events as well as multi-day ones, where the latter have been increasing in frequency over time.[8] The National Weather Service also calculated that the number of days on which at least 1" of precipitation fell at the Burlington International Airport has recently increased from about 4 days per year (earlier in the record, which starts at 1940) to 6.5 days.

8 Crossett, C.C., Dupigny-Giroux, L.-A.L., Kunkel, K.E., Betts, A,K. and Bomblies, A., (2023) "Synoptic Typing of Multiduration, Heavy Precipitation Records in the Northeastern United States: 1895-2017, Journal of Applied Meteorology and Climatology"

FIGURE 6.2a: Map of annual exceedance probabilities.

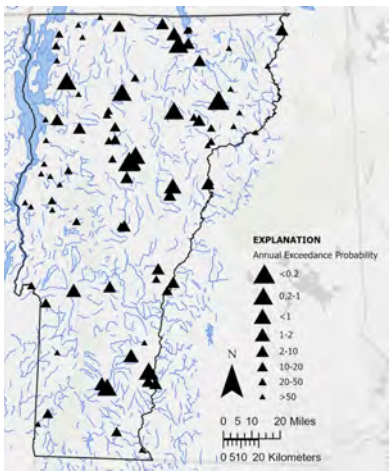


FIGURE 6.2b: Douglas Flood Rock.

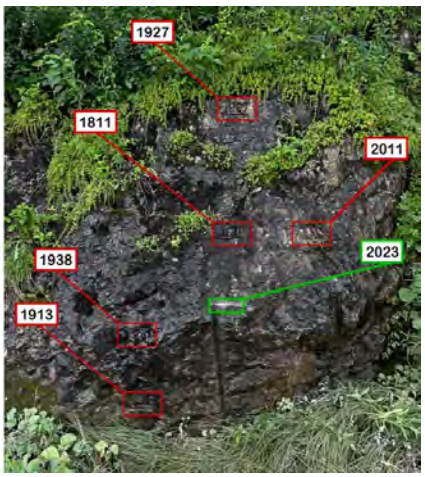


FIGURE 6.2c: Rainfall and roadway impact, July 10–11, 2023.

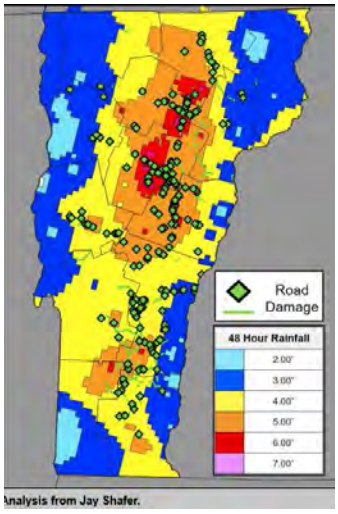


FIGURE 6.2d: Rainfall and landslides, 2023 and 2024.

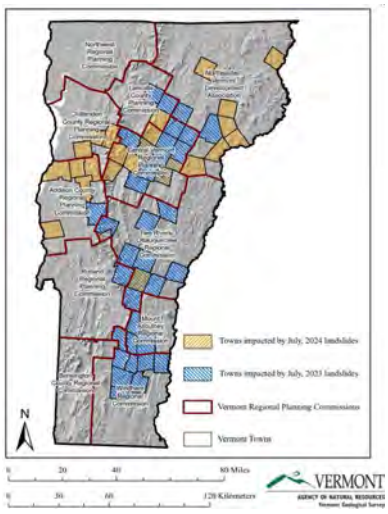


Figure 6.2: Spotlight on the catastrophic flooding of July 9–11, 2023.

(6.2a) "A map of annual exceedance probabilities calculated for the 82 stream gauges in Vermont for a July 2023 flood event. It shows the locations where events of various probabilities occurred, from the at-least-2-year events (smallest black triangles) up to the at-least-500-year events (largest black triangles)." (USGS New England Water Science Center)

(6.2b) "The "Douglas Flood Rock," has been used to document floods near Otter Creek in Pittsford, Vermont, since 1811. Local engravers mark the highest water level after every big flood event—including July 2023. Locally called "Flood Rock," this marble ledge is listed in the Pittsford Second Sentry Historical Book." (USGS New England Water Science Center)

(6.2c) Locations of road damage. (Jason Shafer, formerly of Disaster Tech)

(6.2d) North-south track of the rainfall and subsequent landslides in 2023 compared to the east-west rainfall track and landslides in July 2024. (Vermont Geological Survey, National Weather Service Burlington, Vermont)

FIGURE 6.3a: Top weather events for Vermont.

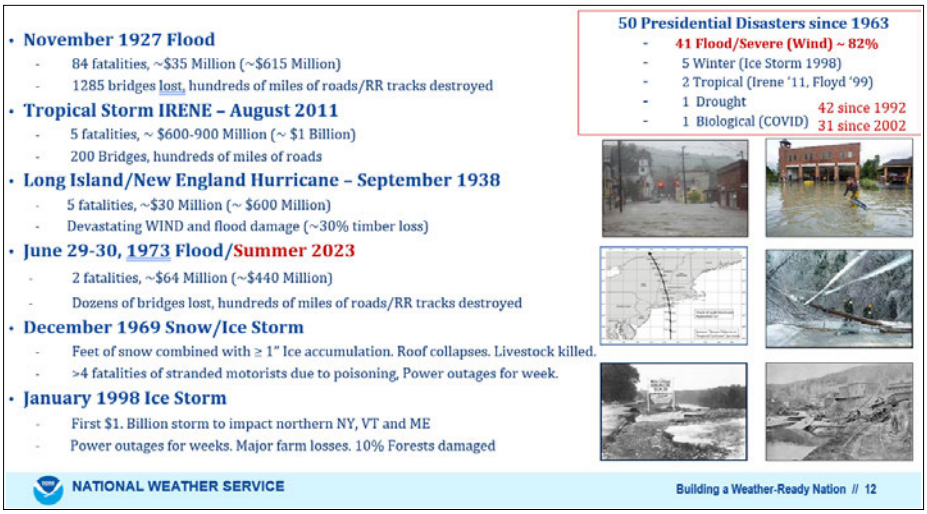


FIGURE 6.3b: Rainfall comparison July 10-11, 2023 and August 27-28, 2011

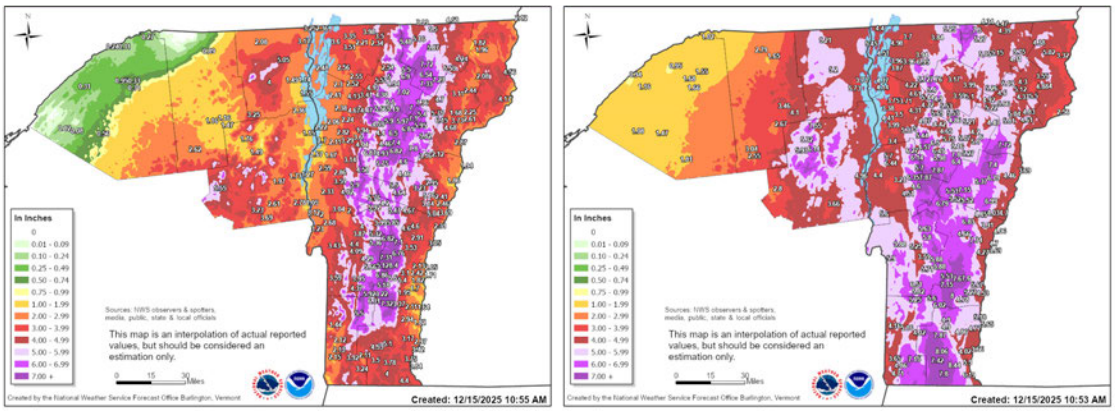


FIGURE 6.3c: North Country and Vermont storm total rainfall ending July 11, 2024.

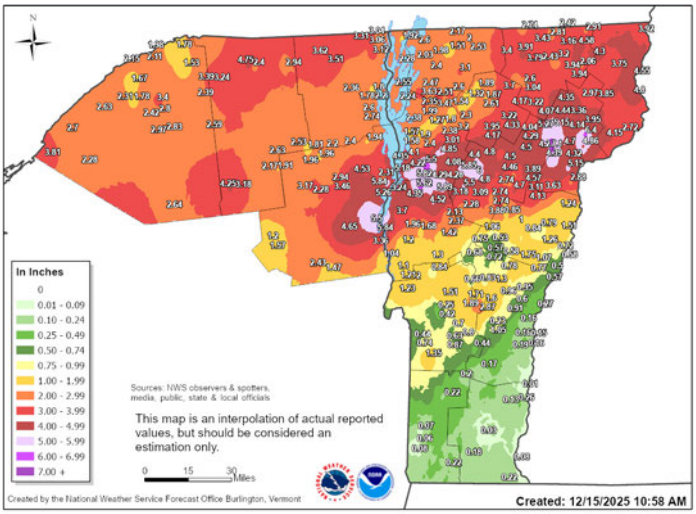


Figure 6.3: (6.3a) The most significant weather events across Vermont in the 1927–2023 period. Rainfall comparison among (6.3b) Tropical Storm Irene (August 27–28, 2011) and the flooding rains of July 10–11, 2023, and (6.3c) July 10–11, 2024. Note the heavier and more widespread totals during Tropical Storm Irene, the north-south track in 2023, and northeast-southwest track in 2024. (Data courtesy the National Weather Service Burlington, Vermont).

Increasingly, Vermont has also experienced what are called “temporally compounding” events where a hazard or event occurs one after the next.[9] Examples of such events include the frosts in the spring of 2023, which were followed by the droughts in June, wildland fire smoke from Canada in June and July, and the flooding rains of July and August of that year. Such back-to-back events have disproportionate impacts on key socioeconomic sectors such as agriculture. It is also very challenging to convey messaging to Vermonters about human and other responses to these complex, overlapping or sequential events.

Vermont’s seasons are changing[10] with backward or false springs[11], [12] during which snow and cold temperatures as late as April and May have been observed. It is important to note that our winters are changing the most rapidly. As Figure 6.4a shows, the 2023–2024 winter was the warmest on record since 1895 across almost all of Vermont, upstate New York and five other High Plains states. The National Weather Service calculates that the winters in the Champlain Valley have warmed by 8.4°F, compared to the annual value of 4.8°F. While seven of the warmest 10 winters in the 1941–2024 period at the Burlington International Airport (Figure 6.4b) were observed since the 2001–2002 winter, it is important to note that bone-chilling cold continues to occur across Vermont (e.g., January 31–February 6, 2021, as shown on Figure 6.4c). Warming winter seasons pose particular challenges for the utilities sector because increases in snowstorms lead to more outages from wet snow falling near the freezing mark. NOAA’s Billion-Dollar Weather and Climate Disasters tool (Figure 6.4d) shows that the greatest number of damaging events occurred in January during the 1980–2024 period. Shorter winters with increased precipitation also affect the timing and thickness of the ice that forms on lakes and ponds, as highlighted in “Conditions on the Ice Are Changing” (p. 32) which spotlights the braiding of Traditional Ecological Knowledge and Western science.

9 Singh, D., A.R. Crimmins, J.M. Pflug, P.L. Barnard, J.F. Helgeson, A. Hoell, F.H. Jacobs, M.G. Jacox, A. Jerolleman, and M.F. Wehner, 2023: Focus on compound events. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

10 Dupigny-Giroux, L.A., E.L. Mecray, M.D. Lemcke-Stampone, G.A. Hodgkins, E.E. Lentz, K.E. Mills, E.D. Lane, R. Miller, D.Y. Hollinger, W.D. Solecki, G.A. Wellenius, P.E. Sheffield, A.B. MacDonald, and C. Caldwell, 2018: Northeast. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 669–742. DOI: 10.7930/NCA4.2018.CH18

11 Dupigny-Giroux, L.-A.L., 2009: Backward seasons, droughts and other bioclimatic indicators of variability. In: Historical Climate Variability and Impacts in North America. Dupigny-Giroux, L.-A. and C.J. Mock, Eds. Springer Netherlands, Dordrecht, 231–250.

12 Runkle, J., K.E. Kunkel, S.M. Champion, L.-A. Dupigny-Giroux, and J. Spaccio, 2022: Vermont State Climate Summary 2022. NOAA Technical Report NESDIS 150-VT. NOAA/NESDIS, Silver Spring, MD, 4 pp.

FIGURE 6.4a: Temperature ranking, Dec 2023–Feb 2024 (since 1895–1896).

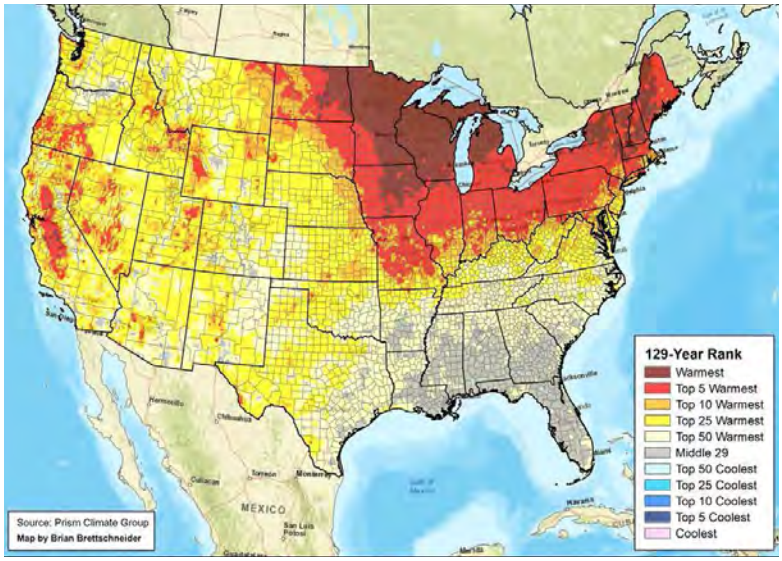


FIGURE 6.4b: Top 10 warmest winters at Burlington (1941–2024).

Rank	Season	Mean Average Temperature
1	2023-2024	30.7˚F
2	2015-2016	30.1˚F
3	2016-2017	29.5˚F
4	2022-2023	29.0˚F
5	2001-2002	28.7˚F
6	2011-2012	27.8˚F
7	2019-2020	26.1˚F
8	1948-1949	25.8˚F
9	1996-1997	25.6˚F
-	1952-1953	25.6˚F

FIGURE 6.4c: Extreme minimum temperature.

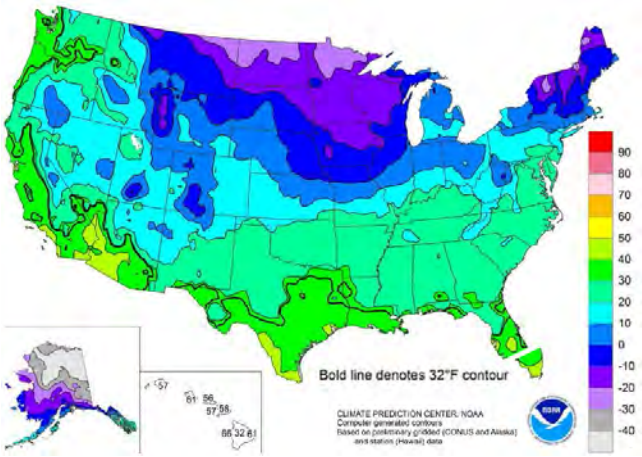


FIGURE 6.4d: Vermont billion-dollar disaster type counts by month, 1980–2024.

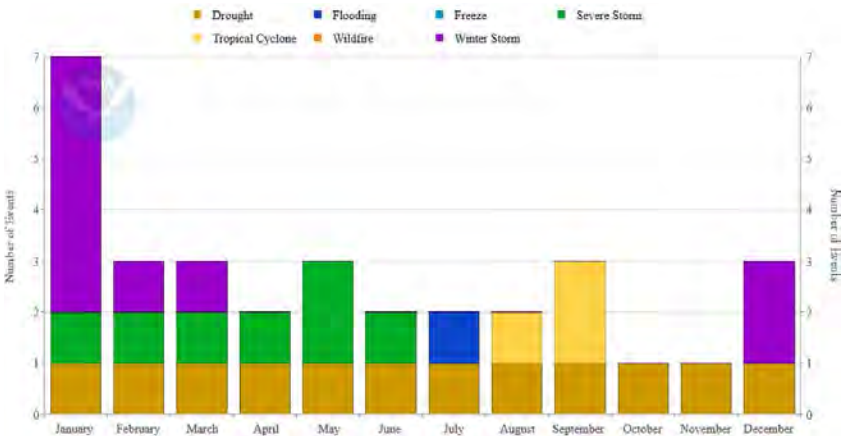


Figure 6.4: (6.4a) A map of the continental U.S. for the winter (December–February) of 2023–2024 showing the rankings by counties since the 1895–1896 winter. Counties with the darkest red experienced the warmest winter since 1985–1896. No counties experienced record cold conditions (NOAA and NOAA National Weather Service). (6.4b) A table of the top 10 warmest winters at the Burlington International Airport since 1941 (NOAA and NOAA National Weather Service). (6.4c) A map of the U.S. for January 31–February 6, 2021, when bone-chilling temperatures as low as -20°F were observed over most of Vermont (NOAA and NOAA National Weather Service). (6.4d) During 1980–2024, the costliest hazards in Vermont were winter storms in the month of January (NOAA NCEI Billion Dollar Disasters Tool).

Conditions on the Ice are Changing

by Judy Dow




Ice out is a special time for Wabanaki people. It is a sign of the arrival of spring, a sign of new beginnings. In the Wabanaki traditions gifts of seeds are placed on the flow to bring new life to places on the shoreline. *Ice out* is honored and respected.

Signs of thinning ice are when the ice pulls away from the shoreline leaving water exposed. Thinning ice is a hazard, yet people try to ignore the dangers to survive on the fish they catch. Traditional knowledges are forgotten and safety goes out the window when you are hungry.

When the ice starts to pull away from the shore and the ice looks black or honeycomb-like you should question going out. Honeycomb-like structures are porous and due to the hexagonal nature of ice crystals, water seeps through the cracks. It's not safe. Things are changing and moving. Show respect for the power of the ice.

Ice fishing on the edge of open water is dangerous especially with a strong south wind. The ice will soon be on the shoreline stacked up like checkers.

A good strong south wind will force the ice to break up and push under the attached ice sometimes reaching 16 inches or more of broken pieces of ice. It gives you a sense of security that is not there. The ice may seem thick but the ice is the deceptive honeycomb and not safe at all. Eventually it piles up on shore.

The National Weather Service (NWS) maintains a record of dates on which Lake Champlain was closed, dating back to 1816. This dataset provides a valuable 200-year proxy for historical winter severity and climate trends. The early part of the record is based on historical climate content analysis from reports and shipping logs, with observations beginning in 1906. In recent times, with the advent of low Earth orbit (LEO) satellites, data from the visible band images on cloud-free days are used to determine whether the lake is completely frozen over (closed). Since 2008, Lake Champlain has rarely closed.

Driven by the observations of drownings that happened when individuals fell through thin ice or capsized in a small boat while air temperatures were warm but water temperatures were cold (50°F or colder), the NWS undertook a study of the cold-water and ice-related injuries in Vermont and upstate New York for the 1990–2023 timeframe. The study highlighted the fact that the climatology of the ice has changed over time and "it's not your grandfather's ice" anymore.[13] Of the 59 incidents investigated, most occurred during ice fishing (45.2%) and driving/riding (29.8%) (Figure 6.5a). Children (aged 12 and younger) and individuals aged 50 and older were more often involved in ice-related incidents, while adults in the 20–29 age range accounted for the majority of cold-water boating accidents (Figure 6.5b).[14]

FIGURE 6.5a: What were people doing on the ice?

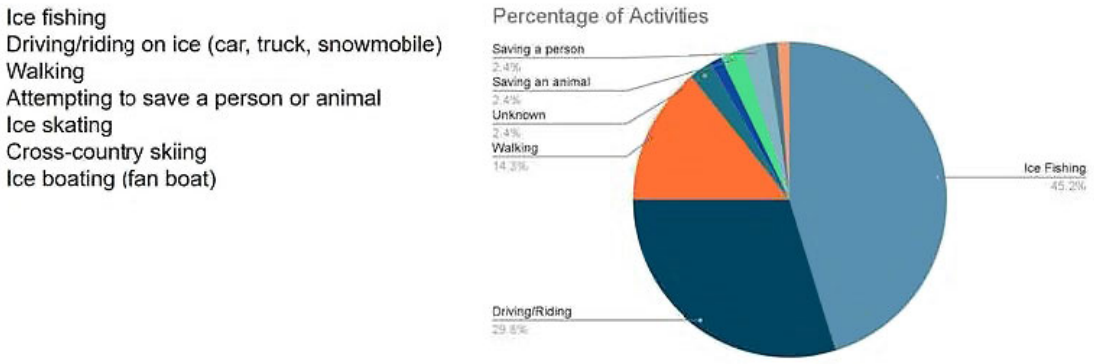


FIGURE 6.5b: Age distribution of those invloved in ice-related and cold water boating rescues or drownings (1990-2023)

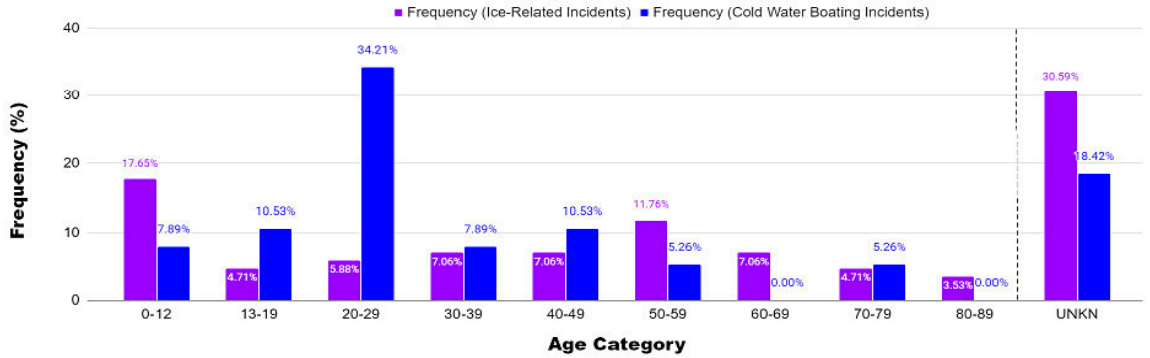


Figure 6.5b: Cold-water boating incidents most frequently involve people in their 20s. Ice-related incidents most frequently involve children (12 and under) and people in their 50s. (Data courtesy the National Weather Service)

13 Betts, A.K. (2011) personal communication.

14 Data courtesy National Weather Service Burlington, Vermont

Key Message 2: Vermonters are exposed to multiple hazards, all of which are complex, changing and interconnected

Across Vermont, natural hazards of varying intensity, duration and frequency occur. These include severe storms, winter storms, drought, flooding, wildfires, air pollution, ground-level ozone, temperature extremes, localized winds, and biotic elements (insects and disease). Some of these hazards are ubiquitous while others tend to occur at specific geographic locations. This poses varying exposure or risk and, therefore, societal vulnerability.

It is unequivocal that climate-related hazards are impacting Vermont with increasing frequency and intensity. The changing seasonality outlined above in Key Message 1 creates compound and cascading effects that strain emergency response systems and affect everyone, but that hit some Vermonters harder than others—like farmers dealing with unpredictable growing seasons, older residents during heatwaves, or manufactured housing communities during floods. Vermont's interconnected natural and human systems mean that impacts to one sector (such as agriculture or infrastructure) create ripple effects throughout communities. While individual extreme events cannot be directly attributed to climate change, the increasing frequency and severity of hazards aligns with scientific projections. These intensifying hazards often lead to increased emissions (when, for example, extreme weather damages infrastructure or forces greater energy use), creating a cycle that requires adaptation strategies to protect communities and mitigation efforts to reduce future impacts. This evolving landscape of hazards demands new approaches to planning that account for changing conditions and help communities become more resilient.

The Vermont Geological Survey (VGS) is at the forefront of this clarion call to action. It wasn't until Vermont was significantly impacted by landslide hazards following extreme precipitation events in July 2023 and July 2024 (Figure 6.3b, 6.3c), both of which resulted in federal disaster declarations, that the VGS more fully realized the state's susceptibility to unstable slopes. As a result of these storms, the VGS has responded to over 150 individual requests for landslide hazard assessments in 64 towns primarily located along the corridors of greatest rainfall, and it has supported Vermont Emergency Management in technical evaluations for 16 residential buyouts through the Federal Emergency Management Agency (FEMA). From these site visits, it has become clear that Vermont's slope susceptibility is not limited to the "typical" glacial stratigraphy associated with landslides, but rather that nearly all unconsolidated materials on slopes become prone to failure over some threshold precipitation amount. Significant failures have been observed on glacial till, lacustrine and fluvial sands, and artificial fill at residential and municipal parcels that hadn't shown signs of failure for decades to centuries.

In terms of socioeconomic vulnerability due to 11 factors (including age, income, mobility, and veteran status), the NOAA Billion-Dollar Weather and Climate Disasters mapping tool (Figure 6.6a) shows that Vermont has an overall vulnerability score of 9.95 compared to the national average of 13.5. However, as noted for weather and climate risks in Key Message 1, socioeconomic vulnerability varies by factor and by county, ranging from the highest values in Essex (11.67), Orleans (11.48) and Bennington counties (10.63) to the lowest in Chittenden (8.98) and Grand Isle (8.89) counties. In most counties, it is the Census tracts with the smallest geographic area that have the largest socioeconomic vulnerabilities. Census Tract 3 in Chittenden County has the largest overall socioeconomic vulnerability in Vermont with a score of 16.29. This tract, which runs along Riverside Avenue and into the Old North End in Burlington, is explored more fully in “The White Monsters and Vulnerability in Burlington’s Intervale” (p. 37). The components that contribute to a community’s resilience are shown in Figure 6.6b.

FIGURE 6.6a: Socioeconomic vulnerabilities.

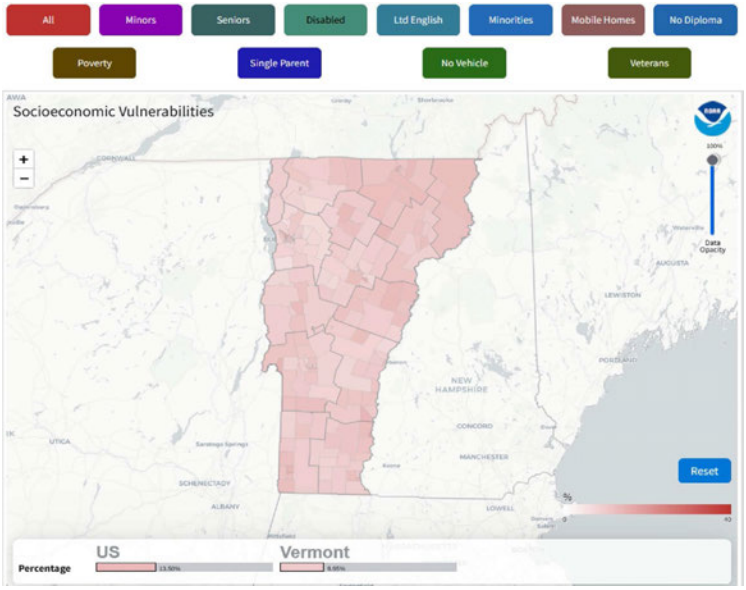


FIGURE 6.6b: Baseline resilience indicators for communities.

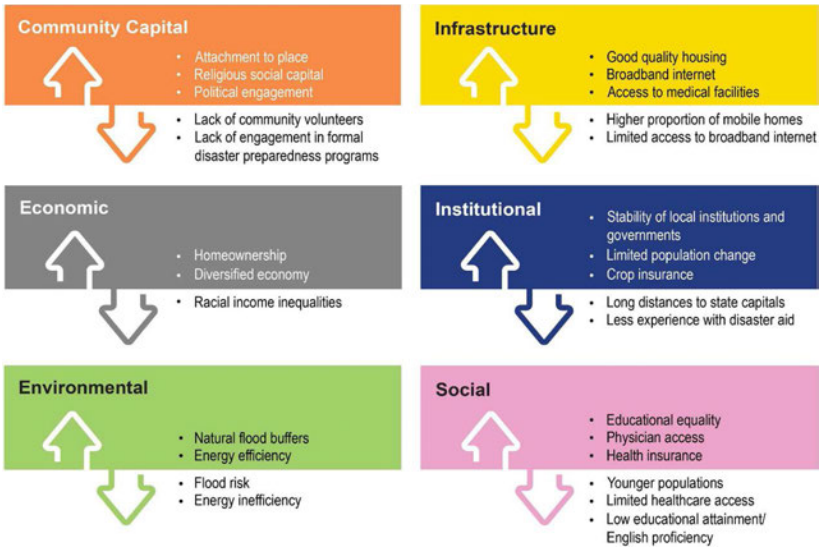


Figure 6.6: (6.6a) Map of Vermont's counties and census tracks showing the degree of socioeconomic vulnerability (0–40) due to 11 factors (NOAA National Centers for Environmental Information (NCEI)).[(15)] (6.6b) "The Baseline Resilience Indicators for Communities (BRIC) index is a composite measure of community resilience to natural hazards. It considers 49 indicators of existing attributes of resilience arranged in six broad categories: social, infrastructure, institutional, environmental, economic, and community capital. It can be used to compare community resilience within one county to that of another … Positive and negative drivers of resilience for rural counties are provided for each category." –Fifth National Climate Assessment (USDA).

15 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2025). DOI: 10.25921

The White Monsters and Vulnerability in Burlington's Intervale

by Judy Dow

As a child, I lived in Burlington and my relatives mostly lived near here. I am very familiar with the landslides in the area. The first photo-documented landslide of Riverside Avenue in Burlington was in 1929. Small mudslides continued with at least one or two each decade until 1955 when a major landslide occurred after receiving 2.37" of rain.[16], [17] That event was followed by three smaller mudslides in the same year. After a mudslide in 1958, it took 5,000 cubic yards of rock and other fill (that's a quarter of a football field filled up to the top of the goal posts) to make repairs to the area. Each decade after 1955 witnessed at least two landslides per year in this same area until August 2024 (personal observation).[18] When combined with large amounts of water, a landslide forms a flowing liquid creating a mudflow or mudslide, which has more fluid than a landslide. Here, I have used the terms landslide and mudslide as they have been used by the source.

There seem to be many drivers for these mudslides as excessive rain events continue and the land becomes more and more saturated leading to the landslides. The years of adding fill have contributed to a lack of successful drainage. The slope of the bank is steep and insufficient stabilization has contributed to landslides in this area. The city of Burlington has increased the width of roads and added sidewalks in this area, which have continued to push the buildings further toward the steep banks.[19] In addition, 25 to 37 train carloads of wood chips and approximately 20 18-wheeler truckloads of logs and wood chips travel this road each day on their way to McNeil Generating Station.[20] The weight alone adds pressure on the filled areas.

The parking lots and backyards of the businesses along this road show signs of future mudslides. Increased major precipitation events, cracks everywhere, illegal dumping, and the continued building on unstable land adds to a loss of land and healthy riparian zones, more precarious homes for people, and the loss of connectivity for animals and biodiversity. The future of this area looks tenuous with a serious risk of future mudslides. Predicted increases in storm event frequency and intensity will only exacerbate slope hazards by raising groundwater tables.

16 Traditional Ecological Knowledge.

17 Vermont Agency of Natural Resources GIS – Open Data: Landslides (2018).

18 Triantafillou, S., Morrison, A., Mischler, E. And Debber, J. (2020) Landslides along the Winooski River in Burlington, Vermont: Landscape change and slope stability, Department of Geology, University of Vermont.

19 Triantafillou et al. (2020).

20 Personal interviews with residents.

FIGURE 6.7a: Chittenden County Census tracts.

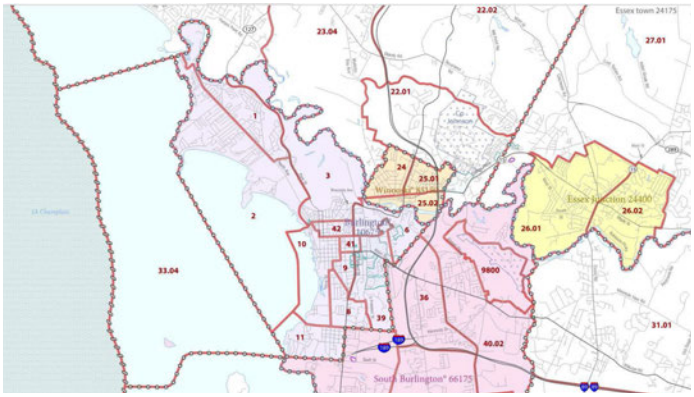


FIGURE 6.7b: Census Tract 3 socioeconomic vulnerabilities.

Data Type	Census Tract 3	Chittenden County	Vermont	U.S.
Age < 18	20.60%	18.20%	19.01%	22.36%
Age 65+	7.20%	14.10%	19.46%	18.37%
All Vulnerabilities %	16.29%	8.98%	9.95%	13.5%
Disabled Population	14.70%	11.60%	15.14%	15.92%
Limited English	8.80%	1.40%	0.36%	1.70%
Minority Population	38.30%	11.20%	5.99%	23.51%
Mobile Homes	--	4.50%	8.01%	12.93%
No High School Diploma	17.40%	5.90%	8.21%	13.41%
Below Poverty	22.80%	11.80%	11.27%	15.60%
Single Parent Households	10.60%	6.80%	7.59%	8.32%
No Vehicle	19.50%	7.30%	6.11%	6.35%
Veterans	3.00%	6.02%	8.32%	8.91%

FIGURE 6.7c: Census Tract 3 weather and climate risk.

Data Type	Census Tract 3	Chittenden County	Vermont	U.S.
Drought Risk	--	--	.36	11.61
Flooding Risk	8.19	5.92	9.13	9.13
Freeze Risk	12.10	11.22	12.45	15.72
Severe Storm Risk	10.22	6.35	6.66	16.99
Tropical Cyclone Risk	6.05	3.15	2.79	4.36
Wildfire Risk	.36	1.45	1.79	6.30
Winter Storm Risk	11.36	11.49	11.44	13.71

FIGURE 6.7d: 1929.

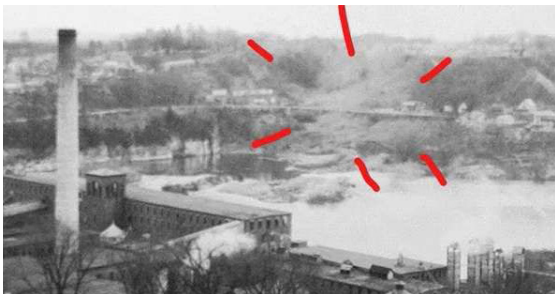


FIGURE 6.7e: 1955.

FIGURE 6.7f: 2020.

Figure 6.7: (6.7a) Spotlight on Census Tract 3 in Burlington, bounded by Riverside Avenue, Route 127 and the Winooski River (United States Census 2020). This Census tract has (6.7b) the highest socioeconomic vulnerabilities in Vermont, (6.7c) is prone to freezing, winter storm and severe storm risks (NOAA National Centers for Environmental Information (NCEI)).[21] It also has experienced (6.7d–f) multiple landslides along Riverside Avenue close to Winooski Intervale, as shown in the photos dating back to 1929 (courtesy Judy Dow).

21 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2025). DOI: 10.25921

The White Monsters Listen to the audio narration.

Pepe lived on the edge of town, high up on the bluff overlooking the Intervale and the Winooski River in a place called Moccasin Village. Moccasin Village was built on the top of an ancient sand dune nestled between the intervale and Lake Champlain. All 20 or so families living in Moccasin Village were French Indian people who had decided to stop traveling back and forth to Canada and settle down in one place; in 1886, Moccasin Village was called home. “Times were changing,” Pepe used to say, but living next to the Intervale was perfect because people could still hunt, fish, and gather off this open land. “Intervale” is an old English word that describes a long narrow valley between two high points with a river running down the middle. To us, it was the common pot, a huge bowl of food. This particular Intervale is called the Winooski Intervale. Burlington, Colchester and Winooski surround the 1,700 acres. Outside of New England, people never use this word to describe the land.

In the spring, when we visited Pepe, we would go to the Intervale to harvest fiddle heads and wild leeks. *Winooski* means “the place of the wild onions” in the Abenaki language. As soon as the snow was gone, the leeks would peek their heads out of the ground. You didn’t need many. They had a strong taste but added a lot of flavor to the roasted squirrel and baked beans that Pepe often had cooking on a small ledge in the wood-fired boiler downstairs in his house.

Pepe would tell me stories as we walked through the riparian forest, picking a few fiddle heads here and a few there until we had a pail full. “It was important not to pick all that we wanted in one place, picking all the heads on one bulb would kill the bulb,” Pepe explained. So, we walked all day long picking here and there. The heads we left behind would provide a beautiful spray of ostrich ferns that would eventually grow to cover the worn path we walked in early spring. As we slowly walked back to the house, I would tell Pepe how much I loved spending time in the Intervale. “Yes,” he would tell me, “it’s a great place to visit and get your food.”

Before I was born, Pepe would hunt for muskrats in the spring; he and my father would tan the hides in their backyard and sell them for 75 cents apiece. Muskrats live in the wetlands of the Intervale, making little push-ups for dens to protect the young from predators. When visiting Pepe during this time, it was not uncommon to see many hides stretched out drying in his backyard. People wanted the hides for their warm coats.

Sometimes in the spring we would fish for shad. When the shad trees were in bloom in the uplands where I live, the shad were spawning in the lowlands, where

Pepe lived. Pepe would go to the edge of the river where his two-ended boat was tied up, and we would fish for shad. The pesky little shad flies were out too, and they would land on every part of my body until I shooed them away. Pepe would say, “Never mind them. They won’t hurt you. They are food for the fish.” This cycle is confused now because of climate change. The shad flies are not always there in time for the shad run. My favorite berries were shadberries. We would pick baskets full of these little berries and bring them to Pepe because they didn’t grow in the Intervale and Pepe loved them. As we floated down river in the boat that Pepe’s brother had made, I looked up at the trees stretched out over the river and I dreamed of living in the Intervale. I never wanted to leave there, it was so beautiful.

In the summer, we made many trips to the intervale, picking raspberries, blackberries, and many different kinds of plants for food and medicines. We also fished for bass and perch and occasionally caught an eel. Pepe had stories for all of them. I can still hear him singing, “Little fishes in the lake come and bite upon my bait.” The eels were sweet and prized by the elders living down the road, so Pepe nailed their heads to the tree, cut around their throats, and pulled the skins off. He then had us deliver the eels to the old people living in Moccasin Village. I later found out that eels have a high nutritional value, something I’m sure Pepe knew all the time. That’s why the old ones got the eels.

When fall came, things were different. We went to the Intervale to gather butternuts. We would pick bushels of butternuts. Filling our backpacks with the heavy nuts, we would lug them back to Pepe’s house. We would place newspapers on the floor in the basement and spread the nuts out to dry. When it got cold outside, Pepe would slide the nuts into a vice that was anchored to his work bench and crack them open, one by one. He would place the special nut meat into canning jars and for Christmas everyone got a jar to celebrate the holiday. It was the greatest treasure to receive, and we were excited because with the nuts in hand we knew that my father always made penuche fudge.

It was in the fall that Pepe would hunt for deer, ducks and geese. His freezer was always full of frozen game and the pantry filled with canned fruit and vegetables. We grew plums, apples, pears and berries. Along with the harvest of our vegetable garden, we always had some awesome food come winter. Pepe made some of the most wonderful meals I ever had; the food he harvested from the Intervale was different than what we get at the grocery store today. In most grocery stores you can’t find venison, duck, goose and squirrel at the meat counter, or butternuts and fiddleheads on the shelves, but you could find them in the freezer and on the shelves at Pepe’s. Pepe knew the land. He knew when the fish were spawning, the ducks were migrating, and the deer were yarding up.

He knew when to burn the Intervale and where the burning was most beneficial for drawing out the muskrat in the spring. Pepe understood the cycles.

As soon as the ice froze in the flooded parts of the Intervale, we would be out there skating and sliding down the side of the 30-foot bluff into the Intervale. When the ice was frozen enough to walk on, Pepe would say, “It is time to burn the Intervale,” and my father and other neighborhood kids would gather to each light certain parts of the land on fire. This was often reported in the local papers as mischievous kids playing with matches. The wetland plants that once stood green and tall were frozen, brown and brittle now from the cold, and when touched by the fire they curled up and burned to little piles of ash that blew away in the wind. Pepe said, “The burning brings new plants in the spring like the cattails, sedges and arrowhead that the muskrats love to eat.” Then the cycle would continue, and Pepe would have more muskrat to harvest in the spring.

One beautiful winter day when we were snowshoeing through the Intervale, I blurted out, “Pepe, I love the Intervale. I want to live here when I grow up.” “You can’t live in the Intervale,” he said. “Why?” I asked. He then told me, “Not always, but sometimes the White Monsters come and destroy everything in the Intervale.” “The White Monsters,” I gasped. He said, “The Intervale is a place that we have to share with the White Monsters. It is their home, too. The White Monsters are what help to make the Intervale so special,” Pepe said. Slowly, we walked back to his house, and he told me the story of the White Monsters.

Pepe explained that the Intervale was a place that was supposed to receive excess water during times of flooding. “Flooding is important to the cycle of life,” he told me. “Flooding brings nutrients from upriver and spreads it all over the Intervale. The nutrients help the plants and animals to grow, and then help us by providing the plants and animals that we eat.” “But, Pepe, what are the White Monsters?” I asked. “The White Monsters are the big chunks of ice that float in the high water onto the Intervale floor. They often tear down buildings, houses, trees and bridges on their way to the Intervale. They are so big, sometimes they destroy everything in their way, and that’s why you can’t live in the Intervale. You just never know when they are coming. People should live high up on the bluffs and visit the Intervale, but they shouldn’t live there unless they are prepared to lose everything they worked hard for.”

I was sad thinking about not being able to live in the Intervale, but I understood what Pepe was telling me. Sharing the Intervale with the White Monsters was not so bad because I still got to visit during the times they weren’t there. On their occasional visits, I would be sure to greet them from high on the bluffs overlooking the Intervale, just as my ancestors had done before me.”

Key Message 3: Climate change increases challenges for Vermont's most vulnerable peoples

The impact of climate change on the health of Vermonters is covered in depth in Chapter 7, Understanding the Indirect Impacts of Climate Change on Human Health and Wellbeing in Vermont. This Key Message provides a preview of how climate change impacts Vermont's most vulnerable communities. Vermont is at risk of loss and destruction of some of its most sacred places. Increasing heatwaves create serious health risks, especially for older adults, children, outdoor workers, and those without air conditioning. These rising temperatures bring cascading effects: worse air quality, more disease-carrying ticks and mosquitoes, and harmful algae blooms in our lakes and ponds. More frequent and severe flooding threatens not just homes but entire communities, leading to displacement and long-term health issues from mold and moisture damage. This is especially true for manufactured homes, which have suffered disproportionate damage in past floods despite making up a small portion of Vermont's housing (Figure 6.8). When extreme weather knocks out power, it creates dangerous situations that disrupt communications and particularly affect rural residents and those who rely on electric medical equipment or may need access to emergency services. These impacts hit hardest in lower-income communities, where affordable housing often faces greater exposure to floods and storms. The loss of culturally significant and sacred places adds another profound dimension to these challenges, affecting community identity and wellbeing.

FIGURE 6.8a: Manufactured housing communities.

FIGURE 6.8b: Summary of vulnerability by level of scale in manufactured housing communities.

MHC scale	Common observations from Vermont MHC fooding events
Household level	Households with limited financial resources
Household level	Older adults (65+ years or older)
Household level	Pre-existing health or mobility concerns
Household level	Households needing to remain close to employment, education, and other critical community resources
Housing structure level	Housing units unable to be feasibly repaired from flooding damages
Housing structure level	Older units contained hazardous materials
Housing structure level	Lack of homes properly elevated and anchored
Community level	Parks sited in FEMA-mapped floodways, 100-year and 5—year floodplains
Community level	Aging infrastructure concerns
Community level	Threat of whole community displacement
Community level	Challenges with finding temporary and permanent housing alternatives

Figure 6.8: (6.8a) Location of manufactured housing communities across Vermont (Baker et al. 2014).[(22)] (6.8b) Social vulnerabilities experienced at the household, building and community scales in the wake of flooding events (Hamshaw and Baker 2024).[(23)]

Key Message 4: From farms to Main Street, Vermont's changing climate impacts all communities

Vermont's working landscape and community systems face mounting pressures from climate change. Mora et al. (2018) found over 400 pathways by which multiple sectors, including human health, security, food and water, infrastructure and economy, have been impacted by hazards such as flooding, heatwaves, changes in natural land cover, fires and

22 Baker, Daniel & Hamshaw, Scott & Hamshaw, Kelly. (2014). Rapid Flood Exposure Assessment of Vermont Mobile Home Parks Following Tropical Storm Irene. Natural Hazards Review. 15. 27-37. 10.1061/(ASCE)NH.1527-6996.0000112.

23 Hamshaw KA, Baker D. Manufactured housing communities and climate change: Understanding key vulnerabilities and recommendations for emergency managers. J Emerg Manag. 2024 Special Issue on Climate Change and Sustainability in Emergency Management;22(7):87-99. DOI: 10.5055/jem.0845. PMID: 38573732.

others.[24] In Vermont, our iconic dairy farms and maple sugaring industries struggle with warmer winters and heatwaves affecting everything from milk production and livestock stress to maple sap flows, damaged sugar maples, and losses in overall farm productivity. Vermont's buildings and transportation systems, originally designed for cold, temperate climates, face increased strain due to higher temperatures. Roads, bridges and railways risk damage from thermal expansion, and the Urban Heat Island effect exacerbates heat exposure in cities.

Many of our historic downtowns, built along rivers that once powered mills, now face increased risks from fluvial erosion and damage. When severe weather interrupts power supplies, it creates a domino effect—particularly dangerous for healthcare facilities trying to keep patients comfortable and safe. Local businesses are feeling the squeeze, too. Weather-damaged inventory, structural losses, and disrupted supply chains and deliveries cut into their bottom lines. Towns and state agencies spend more on snow removal while also maintaining and repairing deteriorating infrastructure impacted by freeze-thaw cycles exacerbated by climate change.

The ski and tourism industries face growing challenges as warming winters reduce the amount of natural snowfall, shortening seasons and producing an increasing reliance on expensive artificial snowmaking.

Increased rainfall and snowmelt, linked to climate change, contribute to slope instability, exacerbating the risk of landslides. Human activities, like infrastructure construction, can worsen this risk by improperly managing surface runoff or by overloading slopes. Roads, bridges, culverts and buildings on or near steep slopes, especially in areas affected historically, are vulnerable to landslide damage. Landslides can severely impact recreational spaces, such as hiking trails, and hinder transportation networks, thereby complicating emergency response efforts.

Although wildfires are currently rare in Vermont, increased temperatures, low humidities, high daily temperatures and various types of droughts have the potential to increase the incidence and exposure to wildfire risks. Severe air quality concerns arose in the summer of 2023 as the wildland fires burning in the boreal forests of northern Quebec reached Vermont. Wildland fire smoke, from the western U.S. and other parts of Canada, typically produce fewer visibility and human health challenges because it is being transported higher in the atmosphere.

24 Mora, Camilo, Daniele Spirandelli, Erik C. Franklin, John Lynham, Michael B. Kantar, Wendy Miles, Charlotte Z. Smith, et al. 2018. "Broad Threat to Humanity from Cumulative Climate Hazards Intensified by Greenhouse Gas Emissions." Nature Climate Change 8 (12): 1062–71.

Key Message 5: The integrity of Vermont's ecosystems is in peril

Expected changes to Vermont's climate that have been identified in other parts of this plan will profoundly affect the natural resources and ecosystems that we enjoy and upon which we depend. Rustad et al. (2014) reviewed literature on how climate change is changing the structure and function of the forest ecosystems in the northeast. While slow change in forest composition is normal, observed changes in temperature, precipitation and snowfall are rapidly changing our forests (Figure 6.9a, b). The tree species that grow in our forests strongly influence the way that water and essential nutrients move through ecosystems. Changes in meteorological variables also alter the habitat characteristics and food types that determine the species of insects, birds and animals that are likely to flourish in these environments. For example, birds are one of the best studied organisms in the northeast. Rustad et al. (2014) concluded that there is strong evidence for a northward expansion of bird species that were once found further south, often at the expense of valued native species (Figure 6.9c).[25] Climate change also brings the threat of nuisance species that can affect the health of forest tree species (Figure 6.9d). Hemlock woolly adelgid has already infected hemlock stands in the southern parts of the state and is moving northward. As the climate warms, other pathogens like Armillaria root rot may begin to infect tree species that are being stressed by climate change.

Potential impacts of climate change are not restricted to terrestrial ecosystems. For example, Sievert et al. (2022) identified "classes" of fish communities in the northeast and midwest on the basis of in-stream temperature and flow characteristics combined with landscape, environmental and climate variables, concluding that throughout most of Vermont, fish species were at "high" to "very high" risk of changing from one class to another, favoring warm-water tolerant species and disfavoring cold-water tolerant species (Figure 6.9e).[26] These class changes are potentially important considerations for fish biodiversity and recreation management. Finally, there are interactions between land ecosystems and water ecosystems that will be affected by climate change.

Data summarized by the Lake Champlain Basin Program show how major storm events, like the July 2023 flood, can deliver not only high runoff totals, but tremendous amounts of sediment and phosphorus as well (Figure 6.9f).[27] The July 2023 event delivered more than 100 metric tons of total phosphorus on July 11 alone and 300 metric tons of

25 Rustad, L., J. Campbell, J. S. Dukes, T. Huntington, K. F. Lambert, J. Mohan, and N. Rodenhouse. 2014. Changing Climate, Changing Forests: The Impacts of Climate Change on Forests of the Northeastern United States and Eastern Canada. Pages 50. General Technical Report NRS-99. U.S.D.A. Forest Service, Newton Square, PA.

26 Sievert, N., C. Paukert, J. Whittier, W. Daniel, D. Infante, and J. Stewart. 2022. Projected stream fish community risk to climate impacts in the Northeastern and Midwestern United States. Ecological Indicators 144:109493.

27 Lake Champlain Basin Program. 2024. State of the Lake Report 2024. Lake Champlain Basin Program, Grand Isle, VT.

phosphorus from July 10–16, which represented half of the recommended total annual load of phosphorus to Lake Champlain. Other water bodies in Vermont were affected in similar ways by this and other events. Such events hinder our ability to meet water quality targets and threaten indigenous aquatic species that we value.

FIGURE 6.9a: Projected changes in habitat for 12 tree species.

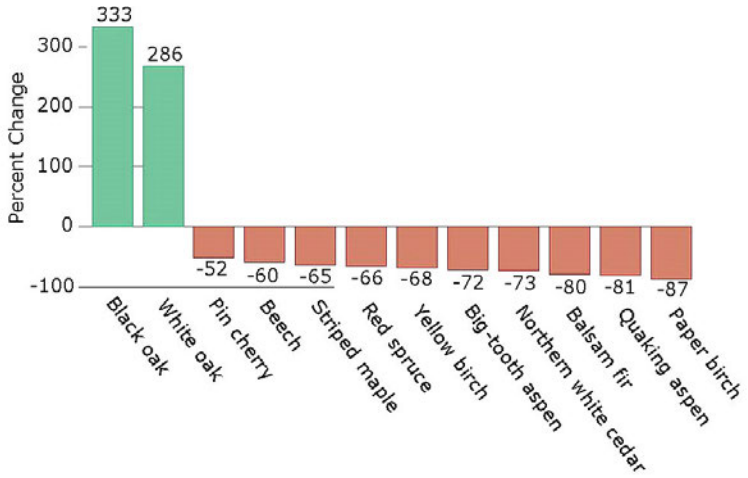


Figure 6.9a: The 12 tree species showing the largest projected changes in suitable habitat in 2100 under an average-high emissions scenario. The emission scenarios used in this and other panels in this figure are based on the Intergovernmental Panel on Climate Change (IPPC 2007) greenhouse gas emissions scenarios for New England forests 2000–2100. The emissions scenarios cited in these figures refer to older terminology but can still be interpreted as "low" and "high."

FIGURE 6.9b: Current and projected suitable habitat for New England forest types.

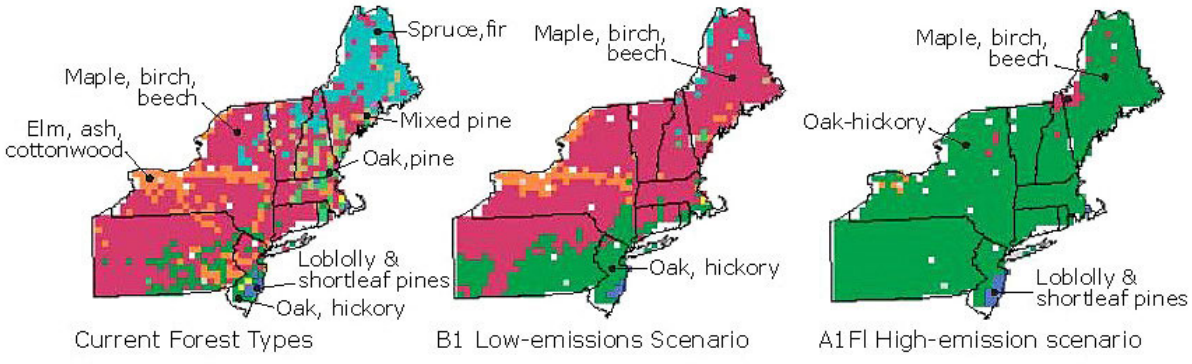


Figure 6.9b: Current and projected suitable habitat for major forest types in New England under low-and high-emissions scenarios. Under the low-emissions scenario, the conditions will favor maple-birch-beech forests, while the high-emissions scenario suggests that conditions will favor oak-hickory forests.

FIGURE 6.9c: Bird species projected to change abundance and range.

Scenario	Abundance declining	Abundance unchanged	Abundance increasing	Range declining	Range unchanged	Range increasing
Low emissions (B1)	60	22	68	33	60	57
Average-high (A2)	56	27	67	32	62	56
High emissions (A1FI)	38	48	48	15	94	41

Figure 6.9c: Number of bird species projected to change their abundance and range 2000–2100.

FIGURE 6.9d: Modeled responses of six nuisance species to climate warming.

	Range	Impact	Confidence
Hemlock woolly adelgid	+	+	high
Tent caterpillar	+ or 0	unknown	medium
Root rot	0	+	medium
Beech bark disease	+	unknown	medium
Oriental bittersweet	+	0	low
Glossy buckthorn	0	0	low

Figure 6.9d: Modeled responses of six nuisance species to climate warming where impact refers to the severity of impact within the three species range. (Figures 6.9a-d: Rustad et al.)[28]

FIGURE 6.9e: Risk of fish community change due to predicted changes in climate.

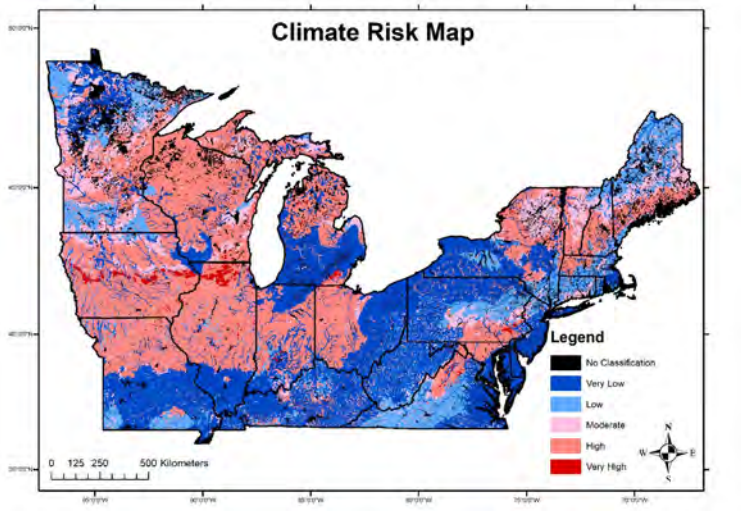


Figure 6.9e: Map showing relative risk of fish community change due to predicted changes in climate. Areas that are not classified are typically reservoirs, lakes, or wetlands for which the local catchment does not include an associated river or stream segment. (Sievert et al. 2022).[29]

28 Rustad et al. (2014)

29 Sievert et al. (2022)

FIGURE 6.9f: Cumulative river phosphorus loading to Main Lake segment of Lake Champlain.

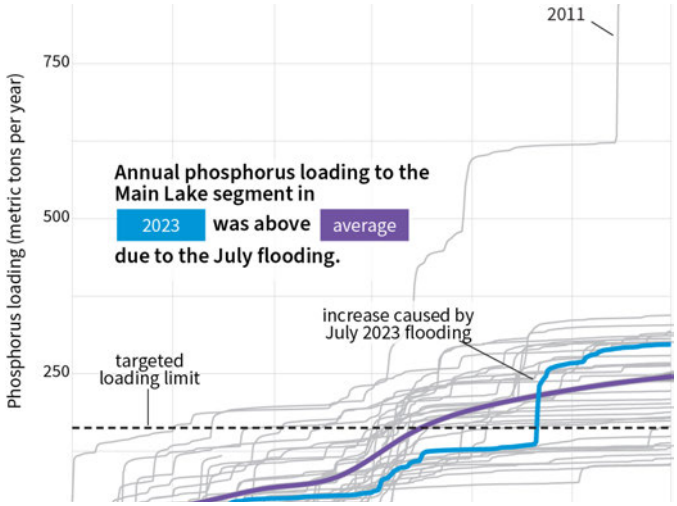


Figure 6.9f: Cumulative river phosphorus loading to the Main Lake segment of Lake Champlain, each year since 1991. Water years are shown, starting on October 1 and ending on September 30. Data sources include the Lake Champlain Long-Term Monitoring Program (Lake Champlain Basin Program, Vermont Agency of Natural Resources, State University of New York Plattsburgh) and USGS, from the Lake Champlain Basin Program (2024).

FIGURE 6.9g: July 2023 flooding by the numbers.

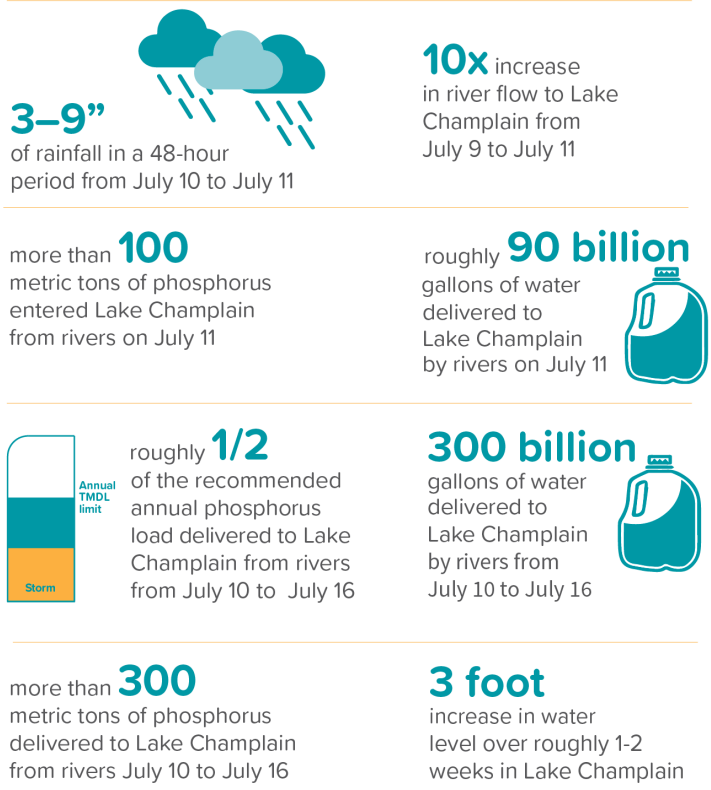


Figure 6.9g: July 2023 flooding impacts by the numbers from the Lake Champlain Basin Program (2024).

Key Message 6: There are critical knowledge gaps in the current research about Vermont's climate and climate change; opportunities also exist

Several important areas of Vermont's climate and climate change impacts remain understudied, limiting our ability to fully understand and address emerging challenges. One significant gap involves tracking and quantifying climate migration and displacement. Such monitoring and analyses should be centered on the Earth Systems Science approach of the 2024 National Academies report on this topic, in order to facilitate for a more rigorous understanding of a) the temporary and permanent movement of Vermonters as well as in-migration to Vermont as a result of climate-related hazards and impacts, b) the ability of displaced communities to adapt, and c) disparities that may exist or be exacerbated.[30] We also lack comprehensive data correlating climate change with shifts in agricultural production and its ripple effects through rural communities. In terms of public health, more research is needed to understand how declining groundwater levels may concentrate contaminants, particularly affecting Vermonters who rely on well water. There are also crucial gaps in our understanding of how gradual climate changes affect affordable housing. For instance, while we have anecdotal evidence that reduced snowpack around manufactured homes leads to moisture damage and health risks (historically, this snow provided crucial insulation), we lack systematic studies of these impacts. These knowledge gaps highlight the need for more focused research to better protect vulnerable communities and inform adaptation strategies.

Despite the climate change challenges we face, action is possible. In addition to the recommendations and pathways to reduce the state's greenhouse gas emissions profile detailed in this plan, opportunities exist to build upon existing programs and maximize co-benefits among clean water, biodiversity, and climate resilience in the state. For example, Vermont can advance flood mitigation, climate adaptation, and resilience through riparian, wetland and floodplain conservation and restoration. Priority recommendations in this plan highlight the need to adapt land management practices to increase ecosystem resilience, enhance biological diversity, improve water quality, and identify sources of funding for climate resilience adaptation practices that increase the financial capacity of land and water caretakers to achieve these goals. The plan also recommends the promotion of healthy, connected river corridors, floodplains and wetlands through expansion of wetlands, floodplains, riparian forests and/or river corridor easements that support co-benefits of increased resilience to climate change, enhanced biological diversity, and water quality benefits. These nature-based, cost-effective

30 National Academies of Sciences, Engineering, and Medicine. 2024. Climate Change and Human Migration: An Earth Systems Science Perspective: Proceedings of a Workshop. Washington, DC: The National Academies Press.

approaches increase the resilience of natural and human communities to future flooding and droughts. The effect of the floodplain wetlands in the Otter Creek watershed on maximum flood heights in Middlebury during Tropical Storm Irene in 2011 is particularly telling.[31] It is estimated that these wetlands reduced the potential damage to Middlebury by at least six times and perhaps as much as 20 times.[32] The long-term benefit of these nature-based solutions is compelling. Other initiatives like strategic dam removals, right-sizing culverts, and innovative agricultural and land-use practices can create connectivity that enhances aquatic organism passage and reduces runoff of sediment and phosphorus that negatively impacts our water bodies. We can also support funding that will help agricultural producers continue to provide a vibrant local food system while at the same time addressing our climate and water quality goals on working lands. We can support improvements to public infrastructure, including bridges, roadways, drinking water facilities, waste treatment facilities, individual septic systems, and stormwater infrastructure, to meet current codes and standards and withstand future flooding events. We can prioritize land use and sustainable development that reduces water quality impacts through consistent regulatory enforcement and with support, resources, and technical assistance for developers, farmers and woodland owners to ensure sound management, healthy soils and clean water.

Key Message 7: How is our climate projected to change in the future?

A warming and wetter climate has varying effects on different weather and climate hazards (Figure 6.10a). Projected changes in temperature through 2050 show a high degree of confidence in temperatures increasing, resulting in a higher frequency of warmer temperatures and heatwaves. In northwestern Vermont, by the end of the century, temperatures over 86°F are projected to increase by at least 27 days under the low-emissions scenario and by as much as 57 days under the high-emissions scenario (Figure 6.10b). On the other hand, the most extreme cold temperatures will likely decline in magnitude slightly as arctic warming tends to diminish the strength of wintertime arctic air masses. Overall annual precipitation will likely increase, although at a slower rate than temperature (moderate confidence). Extreme precipitation events, such as those with 2” or greater precipitation in a 24-hour period, will likely increase in frequency (moderate confidence).

31 Galford, G., A. Hoogenboom, S. Ford, J. Nash, E. Palchak, S. Pears, K. Underwood, and D. Baker. 2014. Vermont Climate Assessment: Considering Vermont’s Future in a Changing Climate. Gund Institute of Ecological Economics, University of Vermont, Burlington, VT.

32 Watson, K. B., T. Ricketts, G. Galford, S. Polasky, and J. O’Niel-Dunne. 2016. Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT. Ecological Economics 130:16-24.

FIGURE 6.10a: Vermont climate projections: hazard risks (2020–2050).

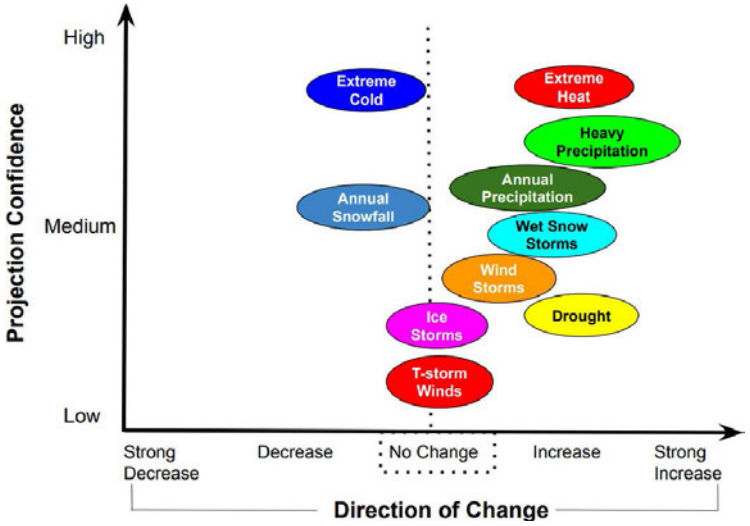
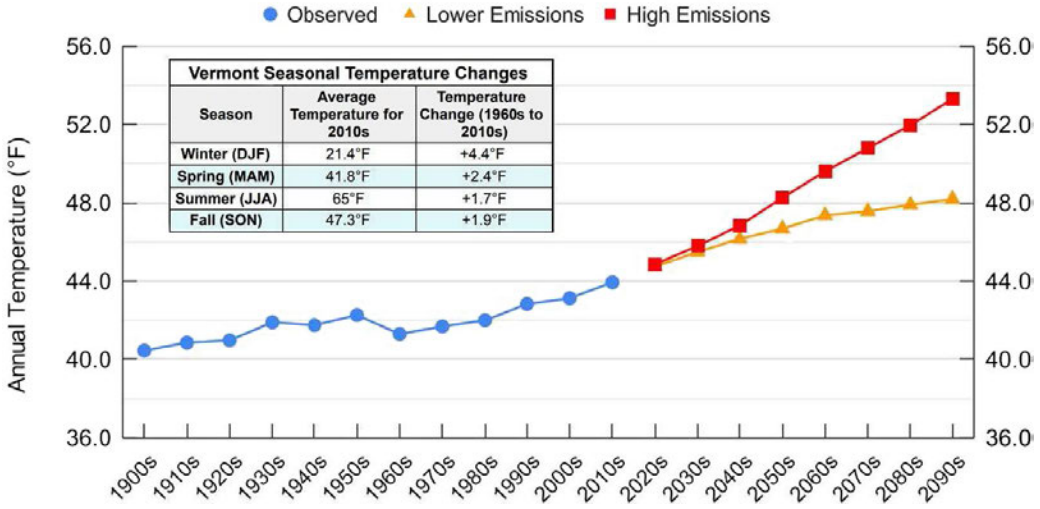


FIGURE 6.10b: Vermont temperature trend and climate projections.



Vermont Seasonal Temperature Changes

Season	Average Temperature for 2010s	Temperature Change (1960s to 2010s)
Winter (DJF)	21.4°F	+4.4°F
Spring (MAM)	41.8°F	+2.4°F
Summer (JJA)	65°F	+1.7°F
Fall (SON)	47.3°F	+1.9°F

Figure 6.10: (6.10a) Projections of natural hazards in Vermont with their corresponding confidence levels (Shafer and Cronin 2021)[33]; (6.10b) Vermont decadal temperature observations and projections under the low-emissions scenario (RCP4.5 - moderate global GHG emissions mitigation) and the high-emissions scenario (RCP8.5 - GHG emissions continue following business as usual). Inset table shows current and observed seasonal temperature changes across Vermont. Source: Both the inset table and observed temperatures graphic were created using climate division data downloaded from NOAA's National Centers for Environmental Information, Climate at a Glance tool; climate projections data (red and orange lines) were downloaded (at the county scale and aggregated to a statewide value) from NOAA's Climate Explorer tool. Further details on this figure can be found on Figure 7a of the Initial Climate Action Plan 2021.

33 Shafer, J. C., and K. Cronin, 2021: Extreme weather and climate change in Vermont: Implications for the electric grid. Vermont Electric Power Company. 47 pp.

Annual snowfall variability will likely remain high, with some wet winter seasons producing higher than average snowfall, as the climate remains cold enough to continue to support snowfall. However, the general trend is for more winter rain and reduced annual snowfall, especially in lower elevations and southern areas. Risks from power outages related to wet snowfall are expected to increase, as more winter storms will likely be closer to the freezing mark where snowfall is wet or sticky in nature (moderate confidence).

Windstorms are expected to increase in intensity, but these will likely be related to unique meteorological storm types. Tropical storms or hurricanes, if they make landfall and move inland, will likely be able to maintain strength at higher latitudes from warming ocean temperatures, therefore increasing the risk for low-frequency but catastrophic storm impacts (e.g., the Hurricane of 1938). On the other hand, gradient wind events from midlatitude storm systems across Canada or nor'easters may decline in frequency.

The projected frequency of ice storms and thunderstorms remain of low confidence with competing meteorological risk factors for each. Low-end freezing rain icing events (those with ice accretion insufficient to produce power outages) are expected to increase, as warmer winter temperatures produce more winter storms with mixed precipitation types.

Overall risks to the power distribution grid have been shown to be increasing more due to storm systems becoming more intense. A combination of current trends, literature, and two climate simulations shows that overall power outage risks are projected to increase by approximately 5%–10% through 2050, due to more frequent wet snowfall and potentially stronger windstorms.

Vermont's annual precipitation is projected to increase 1" to 2" through 2050. These rates of increase track closely to current precipitation rate changes over the last 30 to 40 years. Through 2100, the low-emissions scenario predicts approximately 4" greater annual precipitation, whereas the high-emissions scenario predicts 9" greater annual precipitation. The spatial distribution of precipitation change is relatively equal across Vermont counties. Extreme precipitation events will increase at a faster rate than annual precipitation increases, likely following current ratios of extreme events to annual precipitation rate changes.

Vermont's annual temperatures are projected to increase over 2°F through 2050 on either the low-emissions and high-emissions scenarios. These scenarios differ significantly through 2100, with the low-emissions scenario predicting 4°F of warming and the high-emissions scenario predicting 9°F of warming. The spatial distribution of warming is relatively equal across Vermont counties. With a warming climate comes a greater likelihood of higher temperatures. Extreme temperatures (as defined by a high temperature >= 90°F) are projected to double in frequency by 2050 through either the low-emissions and high-emissions scenarios. Vermont-wide average days above 90°F go from four days a year to nine days a year by 2050. By 2100, however, there is significant variability, with the low-emissions scenario reaching 15 days a year and the high-emissions scenario projecting 45 days a year.

In terms of hydrology, a high-level picture of Vermont's future in the middle of the twenty-first century has been extracted from the Fifth National Climate Assessment.[34] Figure 6.11 shows relative changes in precipitation, evapotranspiration, snow water equivalent, summer soil moisture, and runoff across the USA. The larger maps show the average expectation, while the smaller maps show the expectations for the wettest 20% of model projections (top) and the driest 20% of model projections (bottom).

34 Payton, E.A., A.O. Pinson, T. Asefa, L.E. Condon, L.-A.L. Dupigny-Giroux, B.L. Harding, J. Kiang, D.H. Lee, S.A. McAfee, J.M. Pflug, I. Rangwala, H.J. Tanana, and D.B. Wright, 2023: Ch. 4. Water. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

FIGURE 6.11a: Projected changes in average summer (June–August) soil moisture by mid-century.

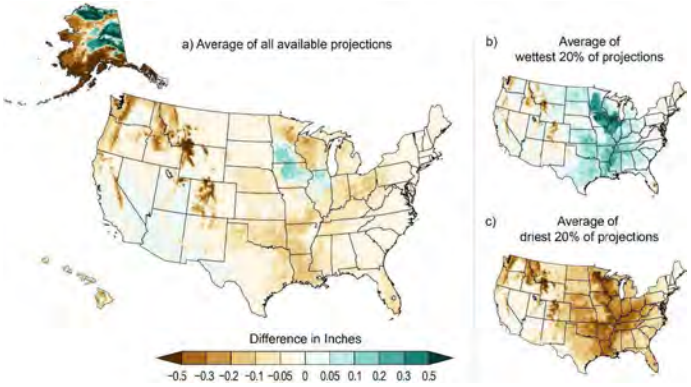


FIGURE 6.11b: Projected changes in annual precipitation by mid-century.

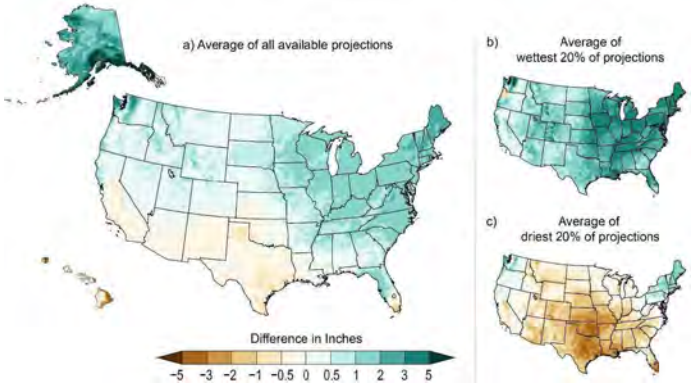


FIGURE 6.11c: Projected changes in maximum annual snow water equivalent by mid-century.

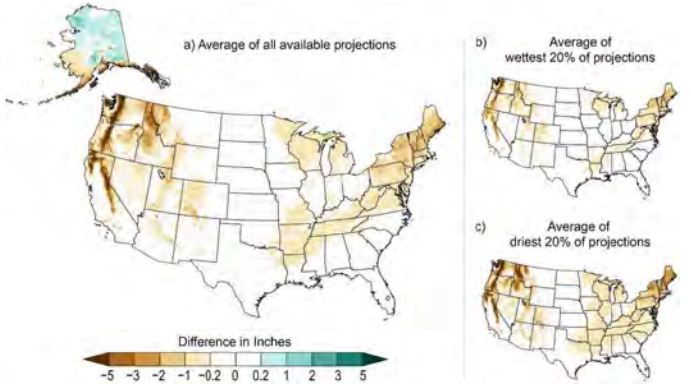


FIGURE 6.11d: Projected changes in annual actual evapotranspiration by mid-century.

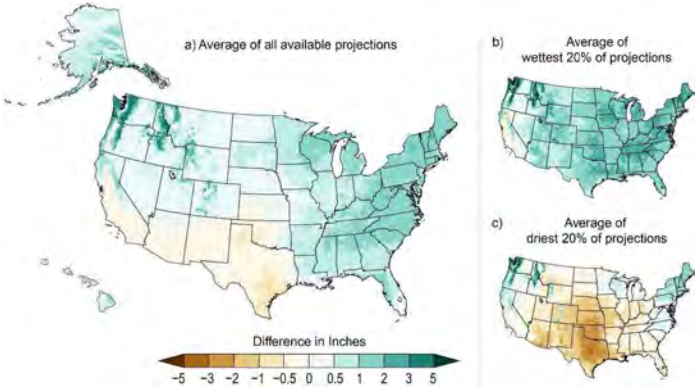
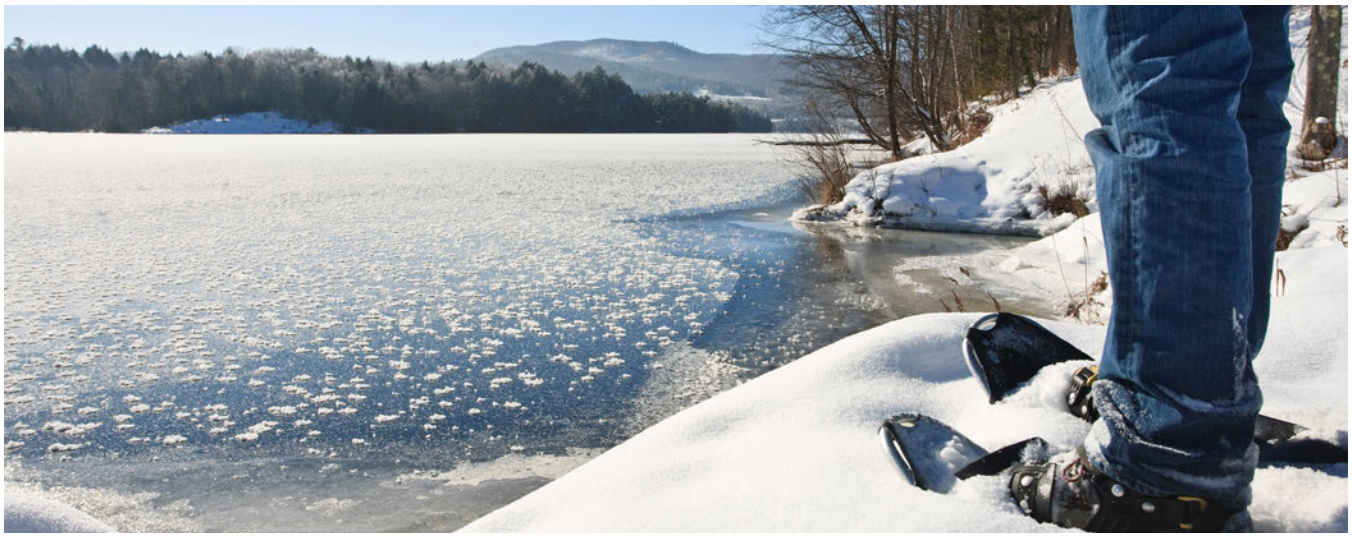


Figure 6.11: Predicted changes in key components of the U.S. water cycle between a reference period (1991–2020) and the middle of this century (2036–2065). (6.11a–d) In each figure the larger map on the left shows the average of all ensemble model runs. For comparison, the two smaller maps on the right show the predictions for the wettest 20% of projections and the driest 20% of projections (Payton et al 2023).[(35)]

35 Payton, E.A., A.O. Pinson, T. Asefa, L.E. Condon, L.-A.L. Dupigny-Giroux, B.L. Harding, J. Kiang, D.H. Lee, S.A. McAfee, J.M. Pflug, I. Rangwala, H.J. Tanana, and D.B. Wright, 2023: Ch. 4. Water. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

Focusing on Vermont, the following patterns emerge. On average we can expect 1" to 2" of additional rainfall annually. However, we can expect about 1" less total water input from snowfall. A portion of this water coming into the state will be lost back to the atmosphere by evapotranspiration. The model projections suggest that, on average, the additional loss from evapotranspiration will be about 1". The balance of rain and snowfall that does not undergo evapotranspiration will either soak into the soil or become runoff into surface water bodies. The expectation is that soil will become slightly drier (up to -0.05"). So, the sum of these water gains and losses suggests that future runoff to streams on an annual basis may not change that much, ranging from about -0.1" to about +0.1". However, as explained in other parts of this report, this very simple water balance formulation obscures crucial changes to the natural ecosystems and human communities that we value and on which we depend. For example, changes in snowfall and soil moisture content, though seemingly small, will have profound effects on the biodiversity of our forest ecosystems and productivity of our working lands. And although the expected increase in rainfall seems small, it is the erratic frequency and increasing intensity of this rainfall that will lead to threats of future flooding if left unmanaged. Floods also impact greenhouse gas emissions by increasing emissions of carbon dioxide and methane from agricultural streams, especially during periods of frequent and prolonged flooding during the growing season.[(36)]

36 Blackburn, S.R. and E.H. Stanley. 2021. Floods increase carbon dioxide and methane fluxes in agricultural streams. Freshwater Biology 66:62-77.



7. Understanding the Indirect Impacts of Climate Change on Human Health and Wellbeing in Vermont

Citation: Grass, D., Ulmer, J., Redman, A., Moore, J. "Understanding the Indirect Impacts of Climate Change on Human Health and Wellbeing in Vermont," *Vermont Climate Action Plan 2025*. Montpelier, VT, 2025.

Introduction

The desire to protect human health from the impacts of climate change was one of the central motivations for reducing emissions of planet-warming gases cited by Vermont's Global Warming Solutions Act: "[A] climate emergency threatens our communities, State, and region and poses a significant threat to human health and safety, infrastructure, biodiversity, our common environment, and our economy."[37] Deepening our understanding of how the climate emergency threatens human health can help direct the prioritization of actions as part of this plan.

In 2021, over 200 medical and health journals, led by *The Lancet* and *The New England Journal of Medicine*, released a joint statement declaring climate change the "greatest threat to global public health."[38] This threat includes direct, acute impacts on health, such as illness caused by extreme heat, wildfire smoke, and vector-borne diseases, and

37 Global Warming Solutions Act, 2020, Vermont Legislature, Act 153, Sec 2.1, Page 1.

38 Atwoli, Lukoye, Abdullah H. Baqui, Thomas Benfield, Raffaella Bosurgi, Fiona Godlee, Stephen Hancocks, Richard Horton et al. "Call for emergency action to limit global temperature increases, restore biodiversity, and protect health." The Lancet 398, no. 10304 (2021): 939-941.

also indirect, delayed and persistent effects exacerbated by chronic stress, economic hardship, and damage to housing and other critical infrastructure. To date, efforts to reduce health impacts caused by climate change in Vermont have focused primarily on direct health impacts. The long-term impacts on Vermonters' health and wellbeing from the catastrophic flooding that occurred in 2011, 2023 and 2024, especially the physical and mental health toll of the clean-up and recovery phase, have not yet been central to discussion of the climate impacts on health. The aim of this chapter is to improve our understanding of these kinds of indirect health impacts so that we can do a better job preventing, measuring and managing them in the future.

FIGURE 7.1: The number of billion-dollar weather and climate disasters occurring each year in the U.S. is increasing.

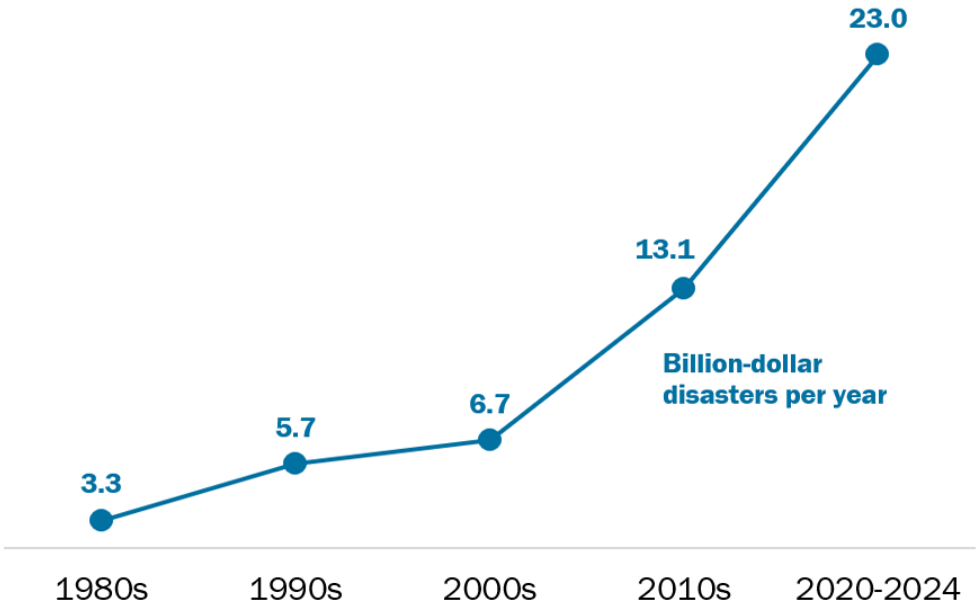
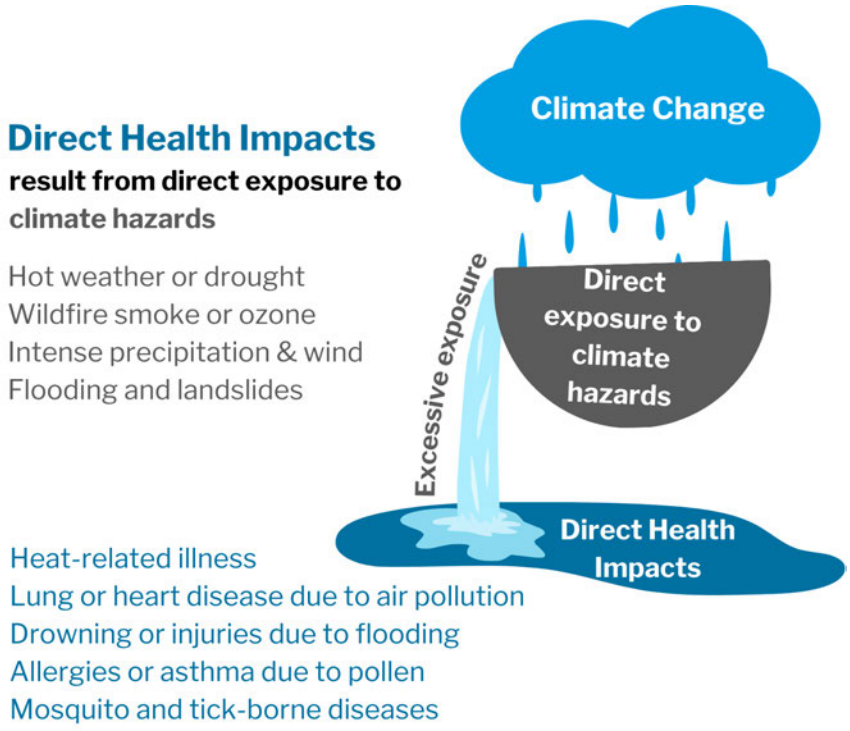


Figure 7.1: The average number of weather and climate disasters with overall damages/costs exceeding one billion dollars occurring in the United States each year, grouped by decade and adjusted for inflation (NOAA National Centers for Environmental Information (NCEI)).[39]

39 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2025).

Direct Impacts

FIGURE 7.2: Direct health impacts of climate change.



Prior summaries of the health impacts of climate change in Vermont[40], [41], [42] and nationally[43] primarily focus on the health risks directly associated with climate change. Direct impacts include illnesses, injuries or deaths that can be directly attributed to changing temperatures or weather patterns or weather disasters made more intense by climate change.

Efforts to quantifying and prevent direct health impacts[44] are essential; however, we also need to be able to identify, measure and address those health impacts associated with economic hardship, grief, stress, damaged homes and infrastructure, displacement and loss of connection that can result from flooding, landslides, drought, or incremental climate change.

40 Vermont Emergency Management. Vermont State Hazard Mitigation Plan, 2023.

41 Clement, S., Mezzacapo, M., 2021. Human Health. In Galford, G.L., Faulkner, J. et al. (Eds), The Vermont Climate Assessment 2021. Burlington, Vermont: Gund Institute for Environment at the University of Vermont. DOI: 10.18125/kowgvg

42 Vermont Department of Health. (Accessed Feb 26 2025). Health Risks of Climate Change. Climate and Health Program.

43 Hayden, M.H. et al., 2023: Ch. 15. Human health. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

44 Vermont Department of Health. (Accessed May 23 2025). Health Risks of Climate Change. Climate and Health Program.

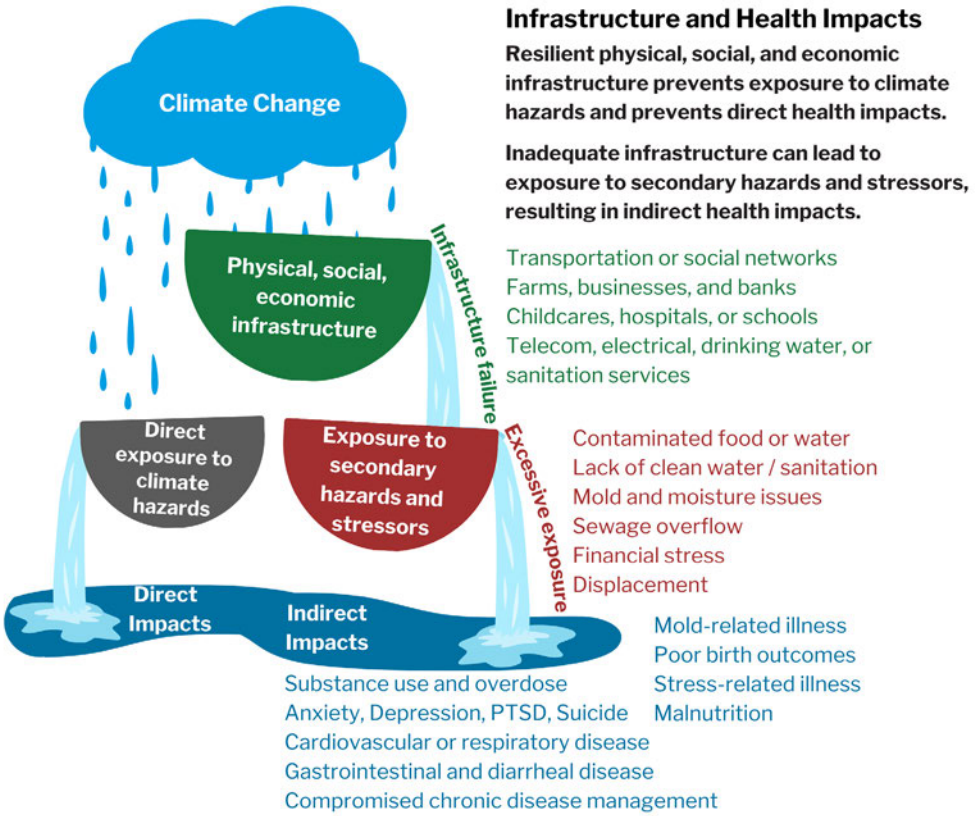
Indirect Impacts

Key Message 1: The impacts of climate on health can be sudden and direct, or more gradual and indirect, as environmental changes undermine the conditions that support our health, including our physical surroundings, economic stability, and social support systems

Climate change affects human health indirectly through its impacts on the physical, economic and social conditions that provide the foundation for human health and wellbeing. By degrading the conditions in which a person lives, climate change reduces the likelihood that an individual will be healthy. This degradation can occur gradually, such as when we restrict outdoor activities due to a lack of snow or ice or to limit tick or mosquito-borne disease risks. The conditions in which we live can also degrade suddenly, due to destruction caused by floods, landslides or wildfire. While not specific to Vermont, one study that examined the relative size and importance of indirect impacts found that the number of deaths attributable to the longer-term social and economic effects of hurricanes during the 15 years after a storm was 300 to 480 times greater than the number of deaths that occurred in the immediate aftermath of the storm.[45]

45 Young, Rachel, and Solomon Hsiang. "Mortality caused by tropical cyclones in the United States." Nature 635, no. 8037 (2024): 121-128.

FIGURE 7.3: Indirect health impacts result from climate-related damage to physical, social, and economic infrastructure, natural systems or essential services.



Indirect impacts also include opportunity costs. For example, when a family living in an area impacted by repeated extreme weather events has to pay more for homeowner's insurance, groceries, air conditioning or storm repairs,[46] they have less money available to spend on food, housing, recreation and healthcare. Climate change can have similar effect on the expenses of towns or the state as a whole.

> "Because of the floods, there are less investments happening in regular paving projects. Because of the floods, there are less investments happening in public safety. Because of the floods, there is less investment happening in water and wastewater infrastructure."
>
> *TED BRADY*
> *Executive Director, Vermont League of Cities and Towns*[47]

Funds that are required to repair roads and essential infrastructure cannot be invested in infrastructure for walkers and cyclists, public transportation, policing, firefighting,

46 Hsiang, S. et al., 2023: Ch. 19. Economics. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

47 Peter Hirschfeld, "FEMA's plodding bureaucracy exacts financial toll on Vermont towns" Vermont Public, September 23, 2024.

emergency management services, libraries, parks and recreation, and drinking water and wastewater infrastructure. Some towns' debts from road and infrastructure repair from the flooding that occurred in 2023 and 2024 exceeded their annual budgets.[48] These community-wide impacts affect property values, the tax base,[49] and the labor market.[50] Agriculture provides another example of infrastructure damage mediating health impacts: In 2023, flooding events and severe weather in Vermont caused more than $16 million in losses across 27,000 acres of farmland.[51] Apart from the economic losses and resulting stress and anguish for farmers, crop and livestock losses may affect the availability of local food options for consumers who live nearby.

Baseline Wellbeing and Health Status Modify Exposure and Resilience

Key Message 2: Compromised health or wellbeing increases the risk of exposure to climate hazards and the likelihood that those exposures will result in negative impacts such as illness, death, or the loss of values that contribute to wellbeing, like sense of identity, self-determination, influence or dignity

Poor health can affect a person's exposure to climate hazards. Someone in poor health might not be able to evacuate without assistance during a flooding event and may have more difficulty finding adequate housing if their home is uninhabitable. Someone who relies on a medical device like an oxygen concentrator or dialysis machine will be exposed to greater risk during a power outage. It may also take someone in poor health longer to recover from a climate disaster, and that exposure may, in turn, prolong their illness. Similarly, a person's baseline health can affect whether exposure to a climate hazard will result in health impacts and the severity of those impacts. For example, someone experiencing anxiety or depression may find that their symptoms worsen during a heatwave. A road closure or disruption in mail service may be life-threatening for someone dependent on medication or daily therapies such as dialysis to manage a chronic illness.

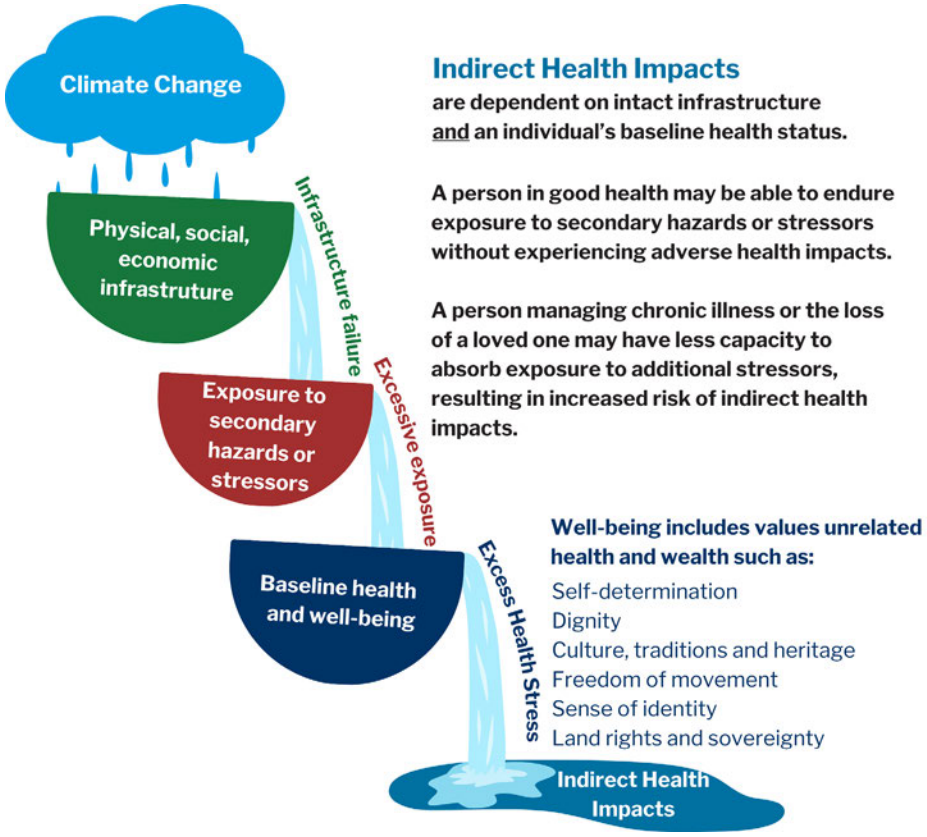
48 Kevin O'Conner, "Flooding long past, many Vermont municipalities are still swimming in red ink" VTDigger, February 27 2025.

49 Hsiang, S. et al., 2023: Ch. 19. Economics. In: Fifth National Climate Assessment. USGCRP.

50 Coulombe, Raphaelle G., and Akhil Rao. "Fires and local labor markets." Journal of Environmental Economics and Management 130 (2025): 103109.

51 Vermont Agency of Agriculture Food and Markets. (Accessed March 22 2025). 2023 Extreme Weather Impact & Recovery Report.

FIGURE 7.4: People's baseline health and wellbeing affects their resilience to harm when exposed to secondary climate hazards stressors like contaminated food or water, financial stress, or loss of their home.



Determinants of wellbeing beyond money and health can also be impacted by climate change[52] and can reinforce or undermine a person's resilience. Examples of non-economic values that influence wellbeing are listed in Figure 7.4. When values such as dignity, influence and self-determination are preserved, they can help insulate people from the stresses associated with living in an area affected by a natural disaster, like lack of access to clean water, sanitation, or having to live as a guest in a shelter or someone else's home. Alternatively, repeated exposure to daily stress increases the risks of substance use, intimate partner violence, post-traumatic stress disorder, anxiety, depression, suicidal ideation, and stress-related illness such as cardiovascular disease. First-person narratives are helpful to convey impacts on non-economic values in ways that maps of disease and injury rates cannot.

52 Tschakert, Petra, Neville R. Ellis, Christopher Anderson, Adam Kelly, and James Obeng. "One thousand ways to experience loss: A systematic analysis of climate-related intangible harm from around the world." Global Environmental Change 55 (2019): 58-72.

> "My parents got divorced. I think definitely … the flood had something to do with it because it really stressed the whole family out."
>
> *VERMONT RESIDENT*
> *three years after Tropical Storm Irene*[53]

> "It's hard for my husband to talk about. He still wears it very close. On rainy days he's looking out the window and checking the river levels. A nervous wreck. And he knows that it's not going to happen. And I have to remind him it was a freak storm."
>
> *VERMONT RESIDENT*
> *seven years after Tropical Storm Irene*[54]

> "I find that when you can't get out so much … you tend to do more things. Some people use addictions more, whatever that may be. It may be drinking, or drugging … that's increasing."
>
> *HEALTH WORKER*
> *describing the impacts of people not being able to go out on the ice*[55]

> "I have lost interest in my house … it's not home anymore … I cannot get my motivation back to do things… I think, why bother…"
>
> *FLOOD SURVIVOR*[56]

> "I was suicidal in January and February. Emotionally the worst period of my life … I feel very isolated … I'm running out of resilience to keep taking the blows and keep moving on … I carry the hurt inside."
>
> *VERMONT RESIDENT*
> *describing the impact of extended drought*[57]

53 Buschman, V., Fernandes, C., Guth, S., Mullen, A., Rosales-Underbrink, P. "Tropical Storm Irene: A Retrospective on Mental and Emotional Impacts on Vermont Communities, Three Years Later" Middlebury College Community Engaged Practicum, Fall 2014B.

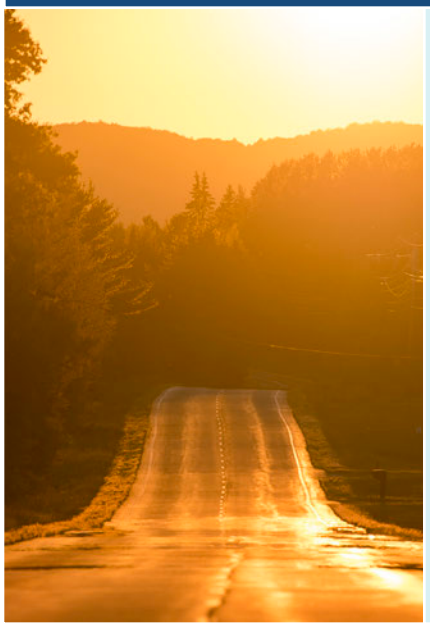
54 Carmichael, C., Danks, C., Vatovec, C. "Health Impacts of Climate Change: Perspectives from Waterbury, Vermont" Presentation at Northeast Vermont Regional Hospital, Feb 14, 2019.

55 Tschakert, Petra et al. Global Environmental Change 55 (2019): 58-72.

56 Tapsell, S.M., Tunstall, S.M., 2008. "I wish I'd never heard of Banbury": the relationship between 'place' and the health impacts from flooding. Health & Place 14, 133–154.

57 Tschakert, Petra et al. Global Environmental Change 55 (2019): 58-72.

Towns Grapple with Preparing for Heat



Vermont, a state typically known for cooler climates, is increasingly experiencing more frequent and dangerously hot weather due to climate change. Each year, approximately 90 Vermonters visit the emergency room due to heat, and at least 15 have died from excessive heat exposure since 2015, more than double the number of heat-related deaths in the previous decade. While everyone faces health risks, vulnerable populations—such as older adults and young children, outdoor workers, people with chronic health conditions and disabilities, and those who are unhoused—are particularly at risk. Towns are attempting to plan ahead to support these residents and reduce health impacts, but success varies.

Read more

Societal and Institutional Inequities

Key Message 3: Individuals or communities with the least economic, social or political resources tend to experience the greatest risks and impacts associated with climate change hazards

The impacts of climate change are most severe for segments of the population that have historically had the least social, political, and economic power and capital. These groups often live closest to the edge, whether on a literal edge like a floodplain or on the figurative edge of losing access to housing, employment, childcare, food, healthcare, and family support. As a result, groups with the smallest buffer between them and an acute hazard are most likely to experience the greatest cumulative impacts of a climate disaster and its aftermath.[58] Groups that are impacted "first and worst" by climate change may also be at the greatest risk during non-climate disasters such as infectious disease pandemics, economic recessions, or other societal disruptions. Because they are more likely to have experienced prior loss or trauma, and because of disparities in social, political, and economic capital, these groups are subject to increased exposure to chronic stress,[59] which contributes to their baseline mental and physical health burden.

58 McKee, M., Reeves, A., Clair, A. et al. Living on the edge: precariousness and why it matters for health. Arch Public Health 75, 13 (2017).

59 Geronimus A.T., "Weathering: The Extraordinary Stress of Ordinary Life in an Unjust Society", Hachette Book Group, 2023.

FIGURE 7.5: Examples of groups that may be disproportionately affected by climate change impacts on individual health and community resilience.

Examples of groups at increased risk of exposure due to physical, social or economic infrastructure

- People who work outdoors, including farmworkers
- People experiencing homelessness
- People who are incarcerated
- People living in floodplains
- People living on upper stories of buildings in urban areas (due to heat risk)
- People living at home alone with few social ties

Examples of groups at increased risk of harm due to baseline health or wellbeing

- People with disabilities
- People with poor mental health, prior trauma, or adverse childhood experiences
- People with substance use disorders
- People at greater risk due to age (e.g., the elderly, babies, and children)
- People with a chronic or pre-existing medical condition
- People on medications that increase the risk of harm in hot weather

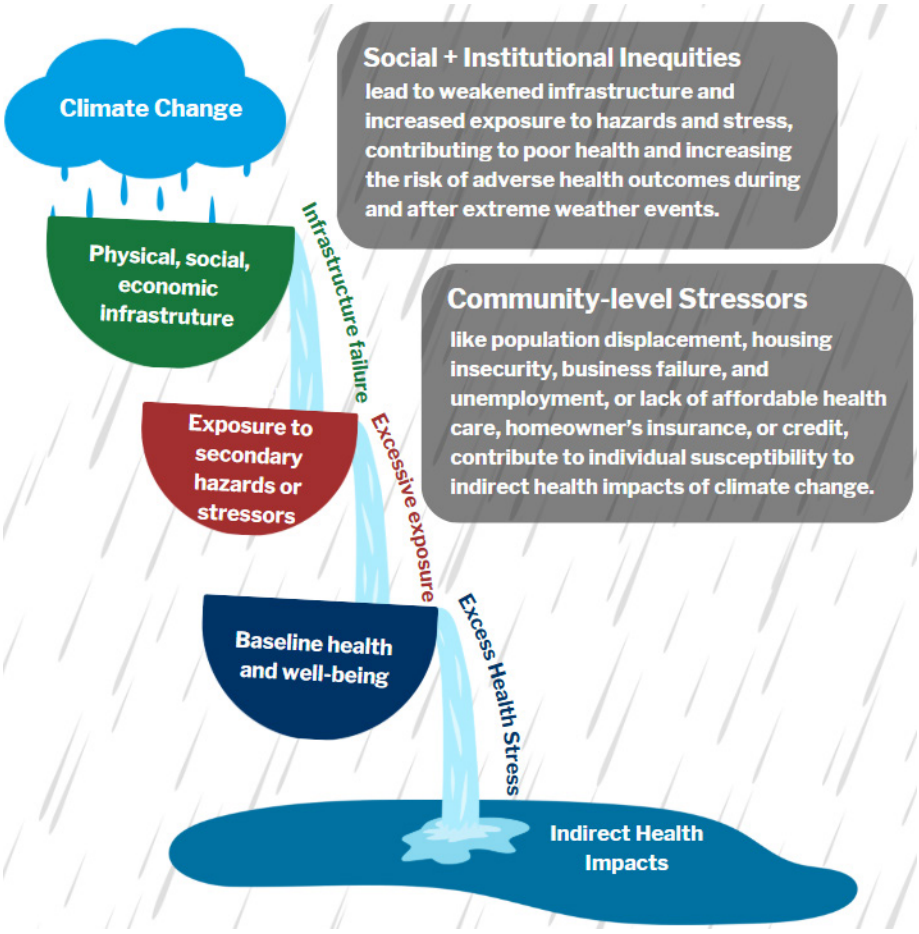
Examples of groups at increased risk due to social and institutional inequities

- People with lower income or few assets
- Black, Indigenous, and People of Color
- Veterans
- Immigrants, refugees, and asylees
- People who live in rural settings
- People with limited English proficiency
- Members of the LGTBQ+ community
- Renters

Sources of Climate-Related Stress

Key Message 4: Climate-related impacts on the health of a community, like increased cost of living, unemployment, and housing insecurity, act as chronic stressors at the individual level, undermining physical and mental wellbeing

FIGURE 7.6: Climate-related hazards and stressors add to a person's cumulative exposure to chronic stress. Repeated climate disasters exacerbate social and institutional inequities and community-level stressors, reducing individual and community resilience during subsequent emergencies.



Under normal conditions, sources of chronic stress could include job loss, losing a loved one, worrying about how to pay rent or buy food, or a divorce. In the aftermath of a disaster, chronic stress could include things like overcrowded or inadequate housing;

lack of access to clean water, heat and sanitation; discrimination or stigma; and lack of access to education and employment. The Fifth National Climate Assessment[60] provides examples of elements of community resilience that are affected by climate disruption, shown in Figure 7.6. Through their impacts on chronic stress, these indicators of community resilience (including rates of crime and domestic violence,[61] substance use,[62] and student absenteeism[63]) can impact individual physical and mental wellbeing.

Allostatic load is "wear and tear" on the body that results from (energy-consuming and potentially unhealthy) cellular, physiological, or behavioral adaptations to stress,[64] such as the thickening of arterial walls in response to chronically elevated blood pressure. Allostatic load provides a model for understanding how chronic stress can translate into pathology.

Similarly, the physical or financial stress of responding to natural disasters or climate change contributes to "wear and tear" (indirect impacts) for affected individuals and communities, in part because the time, energy and dollars expended could have been put to more productive use.

What Actions Are Being Taken to Reduce the Health Risks of Climate Change in Vermont?

By incorporating indirect impacts into our understanding of how climate impacts health, it becomes clearer how actions that aim to prevent damage to physical, social or economic infrastructure contribute to the protection of health and wellbeing. Vermont's *State Hazard Mitigation Plan*, *Vermont Resilience Implementation Strategy*, and this *Vermont Climate Action Plan 2025* all include actions that help insulate people's health from climate impacts by shoring up infrastructure and essential services. Federal, state, or non-profit programs designed to provide financial assistance to impacted individuals, farms, or other businesses can help reduce the indirect health impacts associated with financial stress. Finally, efforts that are specifically targeted to address health risks include: the Department of Mental Health's flood recovery outreach program Starting Over Strong Vermont; Farm First's flooding and disaster relief services; and the Vermont Department of Health's efforts to provide guidance and support to municipalities, schools, childcare centers, residential care facilities, and homeless shelters to develop hot weather response plans and increase hot weather preparedness.

60 Hsiang, S. et al., 2023: Ch. 19. Economics. In: Fifth National Climate Assessment. USGCRP.

61 Le Masson, V., 2022. Disasters, climate change, and violence against women and girls. In Oxford Research Encyclopedia of Natural Hazard Science.

62 Vergunst, F., Berry, H. L., Minor, K., & Chadi, N. (2023). Climate Change and Substance-Use Behaviors: A Risk-Pathways Framework. Perspectives on Psychological Science, 18(4), 936- 954.

63 United Nations Office for Disaster Risk Reduction. The invisible toll of disasters. UNDRR (2022).

64 Juster, Robert-Paul, Bruce S. McEwen, and Sonia J. Lupien. "Allostatic load biomarkers of chronic stress and impact on health and cognition." Neuroscience & Biobehavioral Reviews 35, no. 1 (2010): 2-16.

Conclusion

In order for our understanding of the health impacts of climate change to reflect Vermonters' experience with repeated climate disasters during the last 15 years, it must include both direct impacts and indirect impacts that result from damage to physical, social and economic infrastructure. Since most indirect health impacts of climate change do not result in a visit to the emergency room or admission to the hospital, they need to be accounted for in other ways, for example by monitoring how flooding events impact housing, food, and economic security.

An improved understanding of indirect health impacts, paired with the capacity to measure them, can help to ensure that climate adaptation and response actions do a better job protecting human health and wellbeing in the future.

8. Building Equity into the Climate Action Plan

Introduction

The Global Warming Solutions Act (GWSA) requires that the *Vermont Climate Action Plan 2025* (CAP) incorporate equity into each recommendation. The Just Transitions Subcommittee (JTSC) is responsible for ensuring this is carried out. Our strategy has three parts:

1. Create space for equity-centered discussions in every meeting.
2. Tackle structural challenges by enhancing the representation of Black, Indigenous, and People of Color (BIPOC), low-income, rural, and other frontline communities.
3. Promote widespread public engagement.

Despite the underrepresentation and power imbalance of the Climate Council and its subcommittees, efforts are underway to diversify membership. The Climate Council is dedicated to collaborating with everyone living in Vermont to ensure that equity is woven into every step of the CAP.

How Do We Define a Just Transition?

A "just transition" refers to the shift from a carbon-heavy economy to a low-carbon, sustainable one, while ensuring that vulnerable communities, particularly minorities and frontline populations, receive support throughout this transformation. This approach emphasizes fairness and equity by addressing the unequal effects of climate change on

marginalized groups. It highlights the importance of inclusive decision-making, enabling these communities to play an active role in shaping the policies that impact their lives. By focusing on equity, a just transition seeks to guarantee that everyone has the necessary resources and opportunities to succeed in the new green economy.

Equality Versus Equity

Equality and equity are terms that are often confused, but they have important differences that are crucial to grasp. Equality means providing everyone with the same resources and opportunities, regardless of their circumstances or needs. While it promotes uniformity, it does not account for the unique challenges some individuals or groups may face in achieving the same outcomes. On the other hand, equity takes into account the varying circumstances, needs and challenges faced by individuals and groups. It goes beyond treating everyone the same, advocating instead for the fair allocation of resources, opportunities, and support tailored to help each person or group. By addressing systemic barriers and inequalities, equity aims to create a level playing field where everyone has the tools and opportunities needed to achieve shared goals.

FIGURE 8.1: Equality Versus Equity.

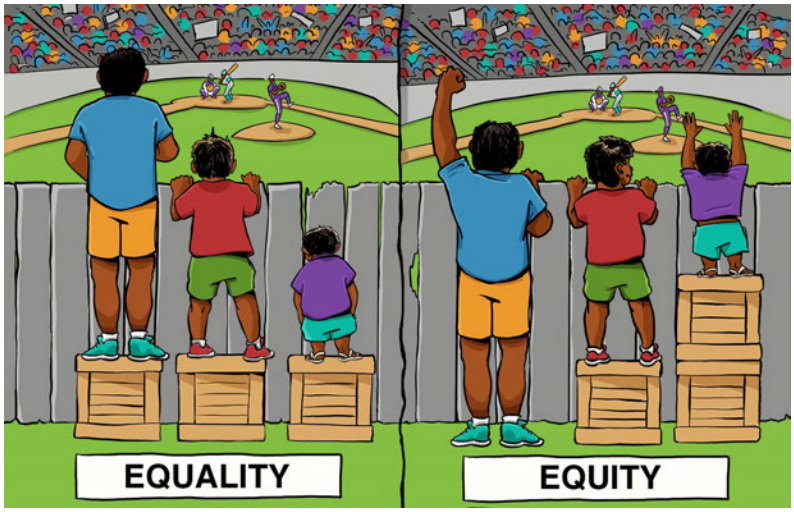


Figure 8.1: Equality provides everyone with the same resources, whereas equity provides resources specific to a person or community's needs. (Interaction Institute for Social Change | Artist: Angus Maguire)

Which approach is more effective? We highlight the significance of focusing on equity rather than equality. Equity understands the unique backgrounds and challenges that people face, ensuring that everyone receives the specific support they need to meet shared objectives. By adopting an equity-focused approach, we pave the way for a more inclusive and fair journey toward our collective goals.

Who Are Vermont's Frontline and Impacted Communities?

Many residents of Vermont are significantly impacted by the growing threats of climate change. These effects are particularly severe for certain groups, referred to as "frontline and impacted communities." These communities are especially susceptible to climate risks, including extreme weather events like heatwaves, flooding, droughts and storms, as well as long-term dangers such as rising sea levels, wildfires, and the decline of ecosystems and biodiversity. They also face additional challenges like disruptions in agriculture, water shortages, health risks, economic instability, and social unrest. Furthermore, frontline and impacted communities often endure higher levels of oppression, greater exposure to pollution, and the risk of job losses as the economy shifts in response to climate change. With limited resources, political influence, and safety nets, these communities are often less prepared to deal with or recover from the impacts of climate change. Acknowledging these vulnerabilities, our guiding principles emphasize the importance of including frontline and impacted communities in the creation of climate action strategies, ensuring their perspectives are integral to the decision-making process and that resources are distributed to meet their specific needs and challenges. The list below highlights particular communities in Vermont that are most at risk.

Specific Frontline and Impacted Communities

- rural communities
- youth
- senior citizens
- non-native English speakers
- women
- unhoused and housing-insecure people
- low-income earners
- LGBTQIAP+ individuals
- recent graduates of the foster care system
- People of Color, Black, African American, Brown, Latinx, Asian, Pacific Islander, and Indigenous communities and Native Americans
- outdoor workers
- incarcerated or formerly incarcerated populations
- renters and subsidized housing tenants
- chronically ill and hospitalized people
- single-parent households
- individuals with disabilities
- small business owners
- immigrants, asylees and refugees
- unemployed and underemployed people
- people impacted by natural disasters

Then and Now

The Just Transitions Subcommittee's work during the 2021 *Initial Vermont Climate Action Plan* focused on developing the Guiding Principles for a Just Transition and accompanying assessment tool (Appendix 4). The JTSC simultaneously worked on engaging the public in the planning process.

Contracted organizations supported public engagement during the summer and fall of 2021, resulting in a final report in October 2021. Another consultant, Kiah Morris, met with other subcommittees and the Climate Council to help them apply the Guiding Principles to evaluate their recommendations for equity considerations. Additionally, liaisons from Just Transitions and other Council subcommittees were present to uplift equity considerations in real time as those subcommittees were deliberating suggestions for the CAP.

Table 8.1: Building Equity into the Plan

Then: Initial Climate Action Plan (2021)	Now: Revised Climate Action Plan (2025)
The Just Transitions Subcommittee (JTSC) drafted the Guiding Principles for a Just Transition, formally adopted by the Climate Council in August 2021. There were only four months to incorporate the Principles into the plan. That was not enough time to use the principles proactively to develop and prioritize recommendations.	The Just Transitions Subcommittee (JTSC) heard from other subcommittees that using the Guiding Principles while developing recommendations felt daunting. In response, the JTSC created a simplified graphic explaining which questions to ask at each step of the planning process. It showed when and how to consider public input.
Members of other subcommittees were unclear on how and when to apply the Guiding Principles. Liaisons from Just Transitions were available to support the other subcommittees.	In addition to the Guiding Principles simplified graphic, five JTSC members volunteered as liaisons to the other subcommittees. The liaisons attended those subcommittees' meetings to help them to apply the Guiding Principles throughout the drafting process, rather than at the end.
The quick timeline limited public engagement. Agency of Natural Resources staff had to move quickly to contract outreach support, which did not allow time for deliberation and input from the Just Transitions Subcommittee.	Public engagement occurred before and throughout the planning process at key junctures. Public input was better communicated to subcommittees and the Council through quarterly reports and other means. Engagement activities were vastly broadened to lift up voices of frontline and impacted communities. These improvements were possible because of a new staff position in the Climate Action Office (CAO) and additional capacity via the Consensus Building Institute (CBI); these did not exist during the 2021 Climate Action Plan process.

Then: Initial Climate Action Plan (2021)	Now: Revised Climate Action Plan (2025)
There was not a streamlined process in place to ensure that public input was reviewed and discussed by subcommittees and the Council before decisions were made.	In fall 2024, the JTSC created public comment recommendations and incorporated public comment into subcommittee work. A revised version was then adopted by the Council in early 2025 for its own work.
The CAO did not have a designated staff person to support JTSC, though CBI provided support in most meetings. A staff member from Department of Public Service and another from Department of Environmental Conservation supported JTSC.	In addition to the two support staff, CAO Communications and the Community Engagement Coordinator supported JTSC. CBI also provided facilitation support to JTSC for two key meetings.

Challenges 2024–2025

Challenges Faced by the Just Transitions Subcommittee

Time:

- There was not adequate time for JTSC members to re-introduce the Guiding Principles and other tools to the drafting subcommittees and help them become fully comfortable with the materials.
- More time is needed for new JTSC members to become oriented to the CAP update process and their role in it, and for the JTSC to build meaningful relationships with the other subcommittees.
- The time commitment for subcommittee members is high, and the current compensation system (per diem) doesn't adequately reflect that. The low per diem may preclude people from marginalized and frontline communities from participating as subcommittee members.
- The time commitment for JTSC liaisons to attend the other subcommittees' meetings was high. Some liaisons did not have the capacity to engage as much as other liaisons.

Capacity:

- There has not been enough capacity and time allocated for equity training for Climate Council and subcommittee members. Daytime meetings are inaccessible for subcommittee members who work during the day and cannot leave their jobs to attend virtual meetings. This has limited JTSC liaison participation in other subcommittees' meetings.

- Without adequate compensation in relation to time and energy commitments, who can join these conversations and efforts is severely limited to those who are already able to meet their needs and offer additional time without being paid sufficiently.
- Limited capacity impeded the Council and its subcommittees' ability to engage with those impacted by climate events, especially catastrophic flooding, since the initial plan was adopted.

Broad Scope of Recommendations:

- Many recommendations in the CAP are broad. Thus, they could be implemented either equitably or inequitably, depending on decisions made by implementors (usually the Legislature, executive branch, or a combination of the two). This can make conversations about incorporating equity into the CAP complicated and confusing for everyone involved.

Suggested Solutions to Overcome Challenges

- Recruit new subcommittee members earlier in the process.
- Present Guiding Principles and related tools to the drafting subcommittees early, with support from liaisons throughout the entire process.
- Increase the per diem amount.
- Better define the role and time commitment of JTSC liaisons.
- JTSC should play a role in recommending how to center equity in the implementation of the plan's recommendations (not just in the planning work itself). The JTSC should also evaluate the equity impacts of the draft pathways, strategies, and actions and make recommendations to the drafting subcommittees.
- Offer equity training for all Council and subcommittee members early in the planning process.
- Work with Vermont Agency of Human Services and local recovery groups to directly engage with disaster-impacted communities about their climate adaptation and resilience priorities.

Youth: An Impacted Community

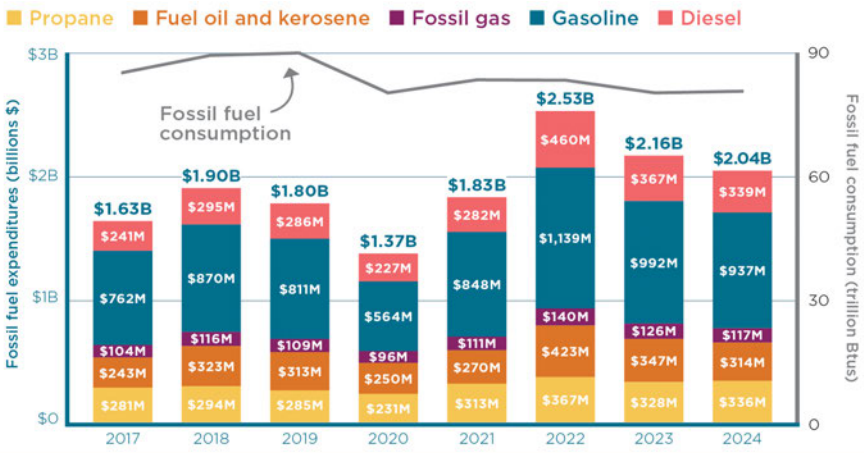
By Aleks Cirovic, Dahlia Cohn, and Senja Erikson
(Youth representatives to the Council and subcommittees)

Young people face systemic barriers that limit their ability to make decisions, yet their involvement in climate action is essential for a just and sustainable future. By including youth in the process of a just transition and in creating the *Vermont Climate Action Plan 2025* (CAP), we empower them to contribute innovative solutions, build leadership skills, and drive meaningful change. Investing in young voices ensures that climate policies are inclusive, equitable, and representative, creating a resilient future for all.

9. The Vermont Climate Economy: Energy, Resilience, and Opportunities Related to Climate Action

This chapter describes the economic impact of Vermonters' energy choices. These choices include the purchase of fuels, energy utilizing appliances and equipment, and other related investments. Beyond the direct impacts of the costs, the circulation of the money spent represents a significant portion of the Vermont economy.

FIGURE 9.1: Fossil fuel price volatility has led to large cost swings for Vermont, despite relatively flat consumption.[65]



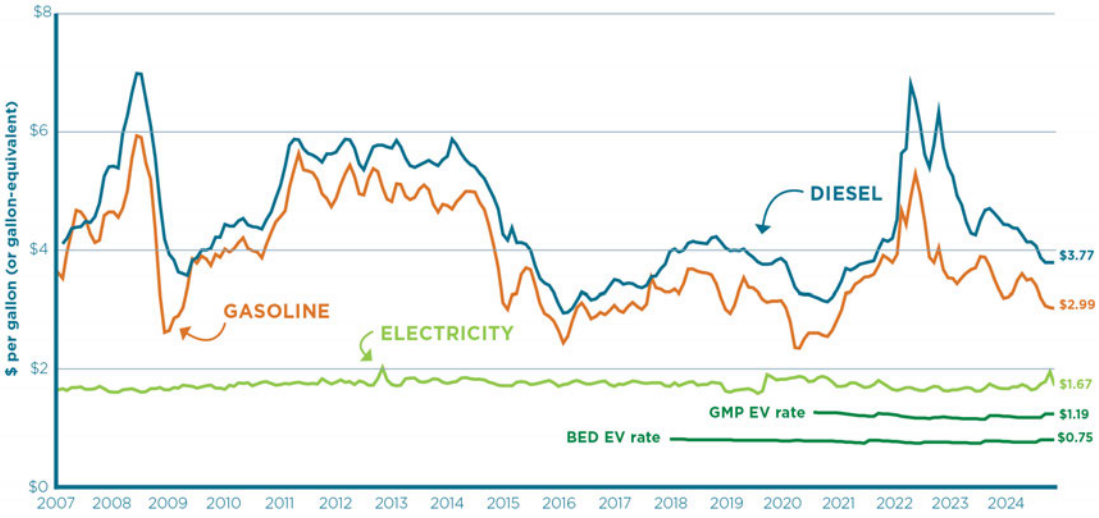
Sources: Gasoline and diesel sales volumes from Vermont Department of Taxes via the Joint Fiscal Office; fuel oil, kerosene, and propane sales volumes from Vermont Department of Taxes; fossil gas sales volumes and prices from VGS; other fuel prices from Vermont Department of Public Service and EIA. **Note:** This estimate only includes Vermont sales of gasoline, diesel, propane, fuel oil and kerosene, and fossil gas. It does not include sales of aviation gasoline or jet fuel from the transportation sector or of fossil fuel-based electricity generation (less than 10% of Vermont's electricity portfolio).

65 Energy Action Network, Annual Progress Report for Vermont 2025. (Energy Action Network, 2025), 3.

Figure 9.1 shows that Vermont continues to spend billions of dollars for the purchase of fossil fuels. Over $2 billion per year was spent on fossil fuels for transportation and heating during each of the past three years. While there are some changes in overall fossil fuel volumes used, we are not yet seeing the scale of reductions necessary to meet the greenhouse gas emissions reduction requirements established in the Global Warming Solutions Act (GWSA).

As shown in Figure 9.2, fossil fuel prices since the Initial Plan was adopted in 2021 continue to show large fluctuations. Prices dropped during the Covid-19 pandemic but spiked in 2022 to the point where fuel oil and diesel prices reached more than $5 per gallon.

FIGURE 9.2: Cost comparison of different transportation fuels over time in Vermont (adjusted for inflation, December 2024 dollars).[66]



Sources: VT electricity, gasoline, and diesel prices: EIA, 2025; Off-peak EV rates: Green Mountain Power and Burlington Electric Department, 2025. **Notes:** Data through December 2024. Prices shown are in December 2024 dollars, using the U.S. Bureau of Labor Statistics Consumer Price Index. The electricity prices shown in light green are average statewide residential rates.

Additional Investment

Beyond the purchase of energy and fuels, each year Vermonters, businesses, and property owners also buy cars, appliances, and other equipment that uses energy. Many of the ways to reduce our use of fossil fuels involve the replacement of inefficient, polluting equipment with more efficient and less polluting electric or renewably fueled equipment. In some cases, the purchase of more efficient equipment and appliances leads to lower lifetime costs but also requires additional upfront cost, both of which are important in considering the overall economic impact of a cleaner energy future.

Table 9.1 provides a picture of estimated average annual spending in Vermont on the purchase and replacement of heating, cooling and cooking appliances, many of which have traditionally been powered by fossil fuel.

66 Energy Action Network.

TABLE 9.1: Estimated Average Annual Spending in Vermont on the Purchase and Replacement of Heating, Cooling and Cooking Appliances

Annual Energy Equipment Choices in Vermont	# of Units	Cost per Unit	Total Cost	Reference for Unit Numbers	Reference for Unit Costs
Heating system replacements	11,300	$5,700	$64.4 million	Zero Emission Heating Standard Study[67] by Energy Action Network (EAN)	Blend for boiler and furnace[68]
Heating systems for new construction	1,680 residential	$20,000	$33.6 million	Zero Emission Heating Standard Study (EAN)	Above plus estimate for distribution system
Heat pumps to supplement existing systems	11,000	$9,700	$107 million	Zero Emission Heating Standard Study (EAN)	Blend of costs from NV5 Potential Study Appendices
Wood stoves to supplement existing systems	2,000	$3,000	$6 million	2020 Vermont Single Family Existing Homes Baseline Study[69]	Review of retail prices
Window unit air conditioners	15,000	$400	$6 million	2020 Vermont Single Family Existing Homes Baseline Study	Review of retail prices
Hot water heating replacements[70]	23,500	$1,500	$35.3 million	Zero Emission Heating Standard Study (EAN)	PSD Tech Ref Manual for HPWH; review for others
Hot water heating for new construction	1,680 residential	$2,000	$3.4 million	Zero Emission Heating Standard Study (EAN)	PSD Tech Ref Manual for HPWH; review for others
Cooking appliance replacement	15,000	$1,000	$15 million	Estimate based on average replacement time of 20 years	Review of retail prices
Cooking appliance for new construction	1,680 residential	$1,500	$2.5 million	Zero Emission Heating Standard Study (EAN)	Retail price plus installation

In total, these annual purchases amount to more than $250 million. These numbers provide important context for the design of incentive programs meant to encourage the replacement of fossil-fueled appliances, both when such equipment reaches the end of its useful life as well as to promote replacement of a working appliance.

67 Energy Action Network. Assessing zero-emission heating equipment standards for Vermont: Analysis of emissions, energy use, and energy costs. February 2025.

68 "How Much Does a New Furnace Cost?" Angi, last modified July 22, 2025.

69 This study reported an increase in room air conditioning penetration, which represents about 6,000 homes per year, and the replacement of existing air conditioners represents about 9,000 per year.

70 A mix of resistance, combustion, and heat pump (HPWH).

FIGURE 9.3: Vermont thermal measures: Historical uptake and Climate Action Plan pathways.[71]

There is appropriate interest in considering the investments necessary to transition to a lower greenhouse gas–emitting future. For thermal energy needs, the electrification of heating systems requires the purchase of heat pump systems that often cost more up front than the oil, propane, or natural gas combustion devices they are replacing; additionally, switching may necessitate changes to the existing ductwork and electrical system to accommodate the heat pump. However, these up-front costs can be balanced by multiple years of reduced expenditures on heating fuels, depending on the fuel being replaced and the utility territory they are located in. This hurdle of higher up-front costs to realize lower annual and lifetime costs points to the important role of grants and incentives (especially for Vermonters with lower- and middle-incomes) and financing programs (especially for middle- and upper-income Vermonters).

In addition to appliance purchase costs, Vermonters have been gradually carrying out weatherization actions to improve the quality and efficiency of existing homes and buildings. Historically, this has occurred at a level of about 2,000 homes per year, though that number has often increased when additional federal funding has been available, as in recent years.[72] Weatherization costs are a combination of materials purchased and the labor for installation.

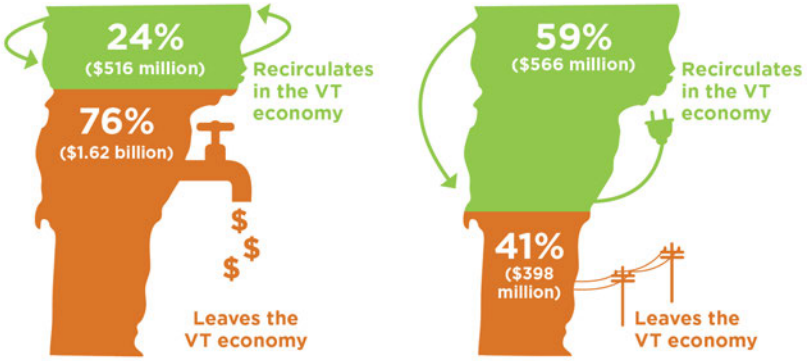
71 Energy Action Network, Annual Progress Report for Vermont 2024. (Energy Action Network, 2024), 27.

72 Based in part on Annual Reports from the Office of Economic Opportunity and supplemented by estimates on subsidized weatherization from Efficiency Vermont.

A different and more dramatic investment is represented in the purchase of vehicles in Vermont. In fiscal year 2024, Vermonters purchased new and used vehicles with an annual net cost of about $2.4 billion.[73] In addition to the purchase price and fuel costs described earlier, Vermonters spend money for repairs, registration and insurance. To get an overall number, the total vehicle miles traveled in Vermont (7.15 billion miles in 2023)[74] can be applied to a fleet average of $0.80 per mile,[75] meaning Vermonters spend more than $5.7 billion on vehicle-based transportation needs.

In total, it is estimated that Vermonters annually spend more than $1 billion on home heat and appliances, of which about 80% is represented by fuel costs, and more than $5.7 billion on vehicle-based transportation needs, of which about 20% is represented by fuel costs. Fossil fuel purchases result in a large flow of dollars to out-of-state entities (on average, 75%)[76] because no fossil fuel production takes place in Vermont.

FIGURE 9.4: Vermont average annual fossil fuel spending versus Vermont average annual electricity spending.[77]



Sources: Fossil fuel spending: VT Department of Taxes, 2025; VGS, 2025; EIA, 2025; Dollar recirculation share: Ken Jones, EAN Senior Fellow for Economic Analysis, 2025. **Note:** Data shown are an average of 2021-2024. This graph includes spending on thermal and transportation fuels only.

Sources: Electricity spending: Vermont Department of Public Service and VT electric utilities. Dollar recirculation share: Ken Jones, EAN Senior Fellow for Economic Analysis, 2025. **Note:** Data shown are an average of 2021-2024. The methodology for the dollar recirculation share was updated in January 2025 to account for out-of-state transmission costs.

To put these large numbers into context, Vermont's GDP totaled more than $35 billion in 2023. There is no simple calculation of Vermont's energy GDP. The calculation would include the in-state portion of fuel (electricity, fossil and renewable) amounting to about $1 billion and the in-state portion of capital expenditures for cars, trucks, HVAC equipment and building construction, which may add another $1 billion. The remaining billions of out-of-state expenditures for fuel and capital purchases must be paid for by the export of Vermont goods and services.

73 This calculation is based on the collection of the vehicle Purchase and Use Tax. For both new and used car purchases, the tax is based on the difference between the purchase price and the trade-in value of the car being replaced (when appropriate). This means that the tax represents the increase in the vehicle stock value in the state.

74 Vermont Agency of Transportation. Vermont Mileage and Vehicle Miles of Travel (VMT) Report: Calendar 2023.

75 "Average Cost of Owning and Operating an Automobile." Bureau of Transportation Statistics, last modified March 2025.

76 Energy Action Network. Annual Progress Report on Emissions, Energy, Equity, and the Economy (page 7). 2024.

77 Energy Action Network, Annual Progress Report for Vermont 2025. (Energy Action Network, 2025), 7.

In addition to the cost of the fuel itself, another portion of fuel purchase costs is in Vermont employment. Because fuel purchases have not changed significantly since the Initial Plan in 2021, the employment numbers for those involved in fossil fuel delivery have largely remain unchanged. There remain about 3,500 people employed at gas stations and convenience stores and 1,100 involved in fuel oil and propane deliveries. On top of these numbers, there are several hundred people employed in the wholesale movement of fossil fuels. Costs beyond employment include those related to transportation and business operations. Beyond fossil fuel delivery, there is also employment related to the installation and maintenance of fossil fuel–based equipment not reflected in the job numbers above.

The Clean Energy Economy

As with other sectors of the economy, the expenditures by Vermonters are reflected in economic activity that results in local employment and, for investors, a return on their capital. The "clean energy economy" includes the development of renewable energy supplies, design and installation of efficiency technologies, and the several support sectors that result in retail sales and service.

Each year, the Department of Public Service produces a report that focuses on the employment associated with the clean energy economy. The most recent report reflects conditions through the year 2024.[78] At that time, more than 18,000 people were employed in the clean energy sector, which represents about 6% of the Vermont workforce.

The largest subsectors include solar installations, weatherization, installation of heating systems, and production of woody biomass. It is also important to recognize that some of this employment includes workers carrying out functions in the non–clean energy economy; the full-time equivalent in the clean energy sector is closer to 13,500 people.

Beyond the thermal and transportation sectors, Vermont has focused on the efficient use of electricity for more than 25 years. These electric efficiency investments have helped avoid the need for new electricity supplies and distribution and transmission investments.

Efficiency Vermont, overseen by the Public Utility Commission, uses funds from ratepayers to support cost-effective investments in electric efficiency. In 2023, Efficiency Vermont invested more than $40 million in "electric resource acquisition" spending. These are direct investments in businesses and residential properties to reduce electricity use. In 2023, the electricity reductions amounted to more than 72,000 Megawatt hours (MWh). These savings accumulate over time, and in their 2023 annual report, Efficiency Vermont reports that the lifetime savings from the past three years of investments is more than 3 million MWh.[79] At current rates, this amounts to more than $480 million in customer savings.

78 Vermont Department of Public Service, Clean Energy Development Fund. 2024 Vermont Clean Energy Industry Report.

79 Efficiency Vermont. Annual Report 2023, p. 34. December 23, 2024.

One set of strategies worthy of note is an increase in the use of liquid and gaseous biofuels. Liquid biofuel feedstocks include waste fats, oil and grease, which can be sourced locally, but larger volume liquid biofuels rely on seed oil crops that are largely grown in more intensively cropped parts of the U.S. and Canada.

Renewable natural gas can be derived from animal manure waste, which has multiple benefits when compared to management that allows for methane release to the air. Renewable natural gas is also created in the anaerobic treatment of wastewater and other food wastes. To the extent that these activities take place in Vermont, it displaces the purchase of natural gas from the Canadian pipeline.

Forest resources have also long been used to provide heat. Modern wood heating appliances are more efficient in their use of wood. Cord wood and wood chips primarily come from in-state sources. Wood pellets, while produced in Vermont, currently largely come from out-of-state suppliers.

Current Costs of Climate-Related Damages

Chapter 15, Scientific Underpinning of Emissions Reductions, includes information on the updated calculation for the social costs of greenhouse gases that assigns a dollar amount to each ton of greenhouse gas emitted. Those calculations are based on global impacts and report the incremental damage from each ton emitted. A different way to look at economic damages is to consider the actual costs in Vermont that have risen from climate-related impacts on economic activity. It is possible to look at trends in damages and, utilizing advances in attribution science, estimate how much greater damages have been due to climate destabilization.

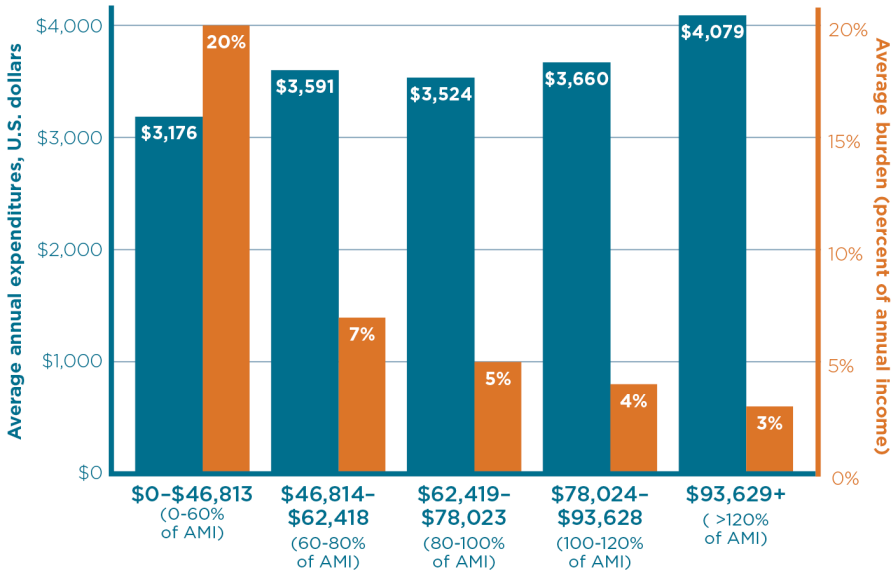
The most obvious examples of climate-related damages in Vermont are the increasing frequency and severity of flooding events. From 2011 to 2024, Vermont tied for the fifth highest number of climate-related disaster declarations of any state in the U.S., and had the fourth highest per capita climate disaster costs, as measured by FEMA and HUD assistance dollars.[80] Unfortunately, FEMA and other federal government payments represent only a fraction of the total costs that Vermonters face in repairing the damages from climate-related events. Insurance payments are in addition to FEMA payments and the continuing trend of increasing insurance premiums reflects the increasing payments that are necessary in addressing climate-related damages. Furthermore, insurance companies that work in multiple states must also address climate-related damages that are resulting from increases in hurricane and wildfire events taking place outside of Vermont. In this way, Vermont pays a portion of the costs of the climate-related damages resulting from out-of-state occurrences.

80 "Atlas of Accountability: County-level Disaster Declarations and Congressional Districts (2011-2024)." Rebuild by Design, last modified December 31, 2024.

Recognizing the Important Aspect of Equity in the Energy Economy

It is typical and yet somewhat misleading to talk about the Vermont economy as the dollar total of income and expenditures. Unfortunately, such a presentation, including in this section, misses the important fact of the distribution of costs and income to different portions of the Vermont population.

FIGURE 9.5: Vermont combined average household heating and electricity fuel costs and burden by income level, 2019–2023.[81]



Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-year Public Use Microdata Samples.
Notes: Income categories are based on 2019-2023 median household income in Vermont of $78,024. Energy burden refers to the share of annual household income spent on energy. Costs include fuel only and are not inclusive of equipment and maintenance costs.

Understanding that the over $2 billion spent on fossil fuels means that some households are spending 20% or more of their overall income on those purchases is critical in the design of strategies to move us to a lower carbon future. Energy burdens above 6% are considered to be high and above 10% are considered severe.[82]

A corollary to the direct expenditures for energy purchases is the very different cost of capital when households need to borrow to make purchases for their home or transportation. Any program that increases household debt has a much greater negative impact on a low-income household than on a middle- or upper-income household.

81 Energy Action Network, Annual Progress Report for Vermont 2025. (Energy Action Network, 2025), 6.

82 American Council for an Energy Efficient Economy. National and Regional Energy Burdens. September 2020.

Resilience and Adaptation

This *Vermont Climate Action Plan 2025* includes the consideration of resilience and adaptation as a necessary direction for Vermont to pursue in the context of rapidly changing climate conditions.

Vermonters have made and will, to an increasing extent, need to make investments to reduce the economic danger from future climate-related events such as floods, drought, and high temperature events. As with mitigation, these activities will require investments, and such investments will yield local economic activity as well as a reduction in future costs. Concurrent with the development of the CAP, the Agency of Natural Resources led the development of the Resilience Implementation Strategy that sought to catalog existing programs and identify critical gaps within the resilience and adaptation work supported by state government. As a next step, the Vermont State Treasurer will be examining possible approaches to expand funding for this work.[83] In addition to state-led work, there are also considerable resilience and adaptation efforts underway at the regional and local levels. A visit to the Flood Ready Vermont website provides a snapshot of the planning activities underway in each of Vermont's municipalities. As resilience and adaptation efforts are growing rapidly at all levels, developing a more fulsome understanding of the economics of resilience and adaptation will require additional research and data collection.

83 "Resilience Implementation Strategy," State of Vermont, last modified September 2025.

10. Progress Assessment and Implementation

In addition to preparing this 2025 update to Vermont's Climate Action Plan, the Climate Council, as supported by the Climate Action Office, continues to track progress of efforts to implement the *Initial Vermont Climate Action Plan* and the additional requirements of the GWSA. Substantive progress has been made in a number of the focus areas identified in the Initial Plan—efforts that were accelerated by unprecedented federal funding that has been available to Vermont over the last several years to invest in existing and new programs. As a result, spending on climate action has steadily increased since the adoption of the Initial Plan. There are challenges ahead, however, that will change that picture.

Federal Funding

Under the current federal administration, Vermont has already (in 2025) experienced and anticipated further reductions in federal investments. Funding through the American Recovery Plan Act has always been slated to wind down in late 2026, but federal funds from laws like the Inflation Reduction Act and the Bipartisan Infrastructure Law (also known as the Inflation Investment and Jobs Act) appear increasingly vulnerable to rollback and recission. There is also growing risk of the loss of sustained federal funding for critical programs like the Climate and Health Program at the Vermont Department of Health. In addition, the tariffs implemented by the current administration have created uncertainty and raised the cost of many of the materials and equipment needed in the transition to electric vehicles and home-heating systems.

State Funding

Over the past four years, state funding has been used to advance key initiatives from the Initial Plan—from flood preparedness and recovery to the Green Savings Smart program that supports low-income Vermonters accessing energy-related grant funds. New funding sources will be necessary if we want to continue to sustain the current pace and scale of climate action, to say nothing of achieving the pace and scale needed to fulfill the obligations created by the Global Warming Solutions Act.

Progress Made Since the Initial Climate Action Plan

Since the *Initial Vermont Climate Action Plan* was adopted, several administrative and legislative actions have been taken. The Climate Action Office detailed progress across all the pathways, strategies, and actions as the Council began its work to update the CAP in the spring of 2024 (see Appendix 3: 2021 Climate Action Plan Progress). These efforts include programmatic initiatives to build landscape-level resilience and reduce climate pollution as well as several detailed technical studies necessary to better understand the mechanics and the costs of different possible approaches to achieving required emissions reductions. Specific progress and data related to the emission reduction requirements can be found in Chapter 15, Scientific Underpinning of Emissions Reductions.

While it is clear that real progress is being made, such an unprecedented rise and equally precipitous fall in federal funding reveals the imperative for Vermont to prioritize and quantify the benefits and costs of the respective initiatives that comprise the CAP.

Effective, equitable implementation will require the development of an implementation plan that strives to reconcile the initial public and private capital outlays for materials and new equipment with the long-term climate benefits and value that come from beneficial electrification and creating more resilient communities—while knowing that there are many competing demands for finite public and private dollars.

Adopting Advanced Clean Cars II

Of note, the Initial Plan and GWSA required the Agency of Natural Resources (ANR) to adopt by December 2022 California's Advanced Clean Cars II (ACC II) Regulations (amending Vermont's existing Low and Zero Emission Vehicle Regulations), Advanced Clean Trucks Regulations, the Heavy-Duty Low NOx Omnibus, and the Phase 2 Greenhouse Gas Rule for Trucks and Trailers. These rules set and amend standards for auto manufacturers and reduce greenhouse gas and criteria air pollutant emissions from passenger cars, light-duty trucks, and medium- and heavy-duty vehicles, along with engines that are delivered for sale or placed in service in Vermont. They also require auto manufacturers to deliver more lower-emitting and electric vehicles to Vermont. This work was initiated and conducted pursuant to the GWSA and in accordance with the procedures for administrative rulemaking in the Vermont Administrative Procedure Act (APA).

Given the scope of these rules and the tight timeframe in which ANR was required to act, this was a significant undertaking that drew from resources and staff not only within ANR and other state agencies, but also from regional organizations and partnerships that have supported work in this space for decades. The GWSA requires a series of reports, rule record sharing, and public engagement in addition to the requirements of the APA, and ANR engaged with the Climate Council, the Legislature, stakeholders, and the public to fulfill these requirements.

To adopt the Advanced Clean Cars II rules, ANR led a robust public engagement process to meet the enhanced outreach requirements of the GWSA. ANR hosted multiple meetings in areas and communities that have the most significant exposure to the impacts of climate change, including disadvantaged, low-income, and rural communities and areas. In-person meetings were held in Manchester, Newport, Bellows Falls, Barre, and Burlington. Two virtual meetings were held, including one that focused specifically on the medium- and heavy-duty vehicle rules. ANR received 236 written comments in favor of the rules and 27 written comments opposed. Over 300 individuals and entities signed on to written comments, which were responded to via a responsiveness summary that was filed with the Final Proposed Rule. On November 17, 2022, the Legislative Committee on Administrative Rules approved the rules and ANR filed the adopted rule with the Secretary of State on December 1, 2022, meeting the requirements of the GWSA. The rule amendments were effective on December 16, 2022.

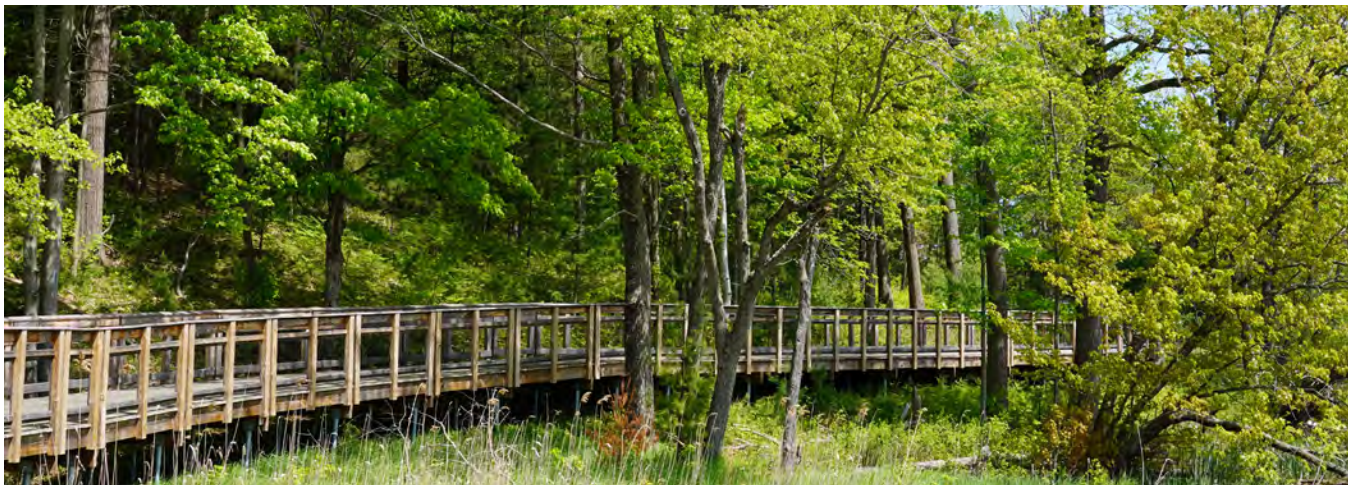
In early June of 2025, however, Congress passed Congressional Review Act resolutions to nullify three Environmental Protection Agency waivers granted to California that underpin these rules; President Trump has since signed the resolutions. While certain to face legal challenges, this action effectively repealed California's authority to enforce these stricter emissions standards, which Vermont had also adopted. Given the uncertainty caused by this specific congressional action coupled with many of the other challenges noted above, enforcement of these rules has been paused by Executive Order of the Governor, calling into question whether the emissions reduction benefits that had been anticipated from these rules can be achieved under their original timeline.

These rules were anticipated to have the greatest impact on climate pollution of any of the initiatives that have been advanced from the Initial Plan, so if they are delayed or rolled back, Vermont will be further challenged to meet its emissions reduction targets in the transportation sector.

Beyond the Clean Car and Clean Truck regulations, legislative action has helped advance several other important recommendations in the Initial Plan. These initiatives largely now sit with Executive Branch agencies charged with their implementation. The complete list of legislative actions that have advanced with relationship to the Initial Plan can be seen in Table 10.1.

TABLE 10.1: Legislative Actions Advanced Since the Initial Climate Action Plan

Bill	Year	Summary
Act 121, Flood Safety Act	2024	Establishes a minimum state floodplain standard; expands regulation of development in river corridors; improves dam safety; and enhances wetland restoration to improve our collective flood preparedness, climate resilience, and water quality.
Act 143, Flood Response Act	2024	Creates the Community Resilience and Disaster Mitigation Fund to assist municipalities with infrastructure projects; creates stronger coordination of first responders; includes public works employees in planning and benefits; requires more comprehensive local and regional emergency planning; updates and clarifies stormwater utility statutes; improves emergency communications translation and interpretation services; supports the state's swift water rescue operations; and provides additional support to all communities that were flooded in 2023.
Act 122, Climate Superfund Act	2024	Authorizes the state to recover financial damages from fossil fuel companies for the impacts of climate change to Vermont, and funds recovered support climate adaptation projects.
Act 179, Renewable Energy Standard	2024	Requires Vermont's electric distribution utilities to source 100% of their power from renewable sources by 2030 for large utilities and by 2035 for smaller, municipal utilities.
Act 181, Act 250 Reform and Housing	2024	Comprehensive reform of Act 250 jurisdiction, criteria and administration supports expanded housing opportunities, smart growth and new protections for forest blocks, habitat connections, and other critical resource areas.
Act 148, 2025 Transportation Program	2024	Contains numerous statutory amendments and funding authorizations related to transportation; requires VTrans and ANR to study the impacts and benefits of Vermont joining a cap-and-invest program.
Act 142, Public Utilities Commission Miscellaneous Changes (includes tweaks to the Clean Heat Standard)	2024	Makes technical clarifications to certain fees related to energy storage facilities; expands the jurisdiction of the PUC; requires a report focused on low- and middle-income households; and establishes new Energy Savings Account requirements.



11. From Context to Action

As this plan document transitions from the foundational elements to the specific recommendations that will guide climate action over the next four years, it is important to recognize the groundwork that has been laid. The Global Warming Solutions Act (GWSA) has set forth targets for greenhouse gas (GHG) emissions reductions as well as objectives to advance resilience and adaptation strategies in both our communities and natural environment.

The Vermont Climate Council, established under the GWSA, has been tasked with the challenge of not only identifying and evaluating strategies to meet these targets but also ensuring that Vermont's communities, infrastructure and economy are prepared to adapt to the ongoing and future impacts of climate change. The Council's work is guided by foundational criteria in the Initial Plan: impact, cost-effectiveness, co-benefits, equity, and technical feasibility. Further information of the prioritization framework can be accessed in the *Initial Vermont Climate Action Plan*. The foundational criteria are essential in evaluating and prioritizing actions that will be most effective in achieving the GWSA's goals.

The GWSA provides the framework for reducing GHG emissions and enhancing resilience, and the following chapters of this 2025 update to the CAP will outline the pathways, strategies and actions necessary to meet these objectives. The following context is intended to set up the reader to understand both the structure of the plan and the criteria used to evaluate the recommendations.

Vermont Climate Action Plan Requirements

On September 22, 2020, the Vermont Legislature passed Act 153, the Vermont Global Warming Solutions Act (GWSA) that created the Climate Council and set forth specific GHG reduction requirements for the state to achieve.

The CAP shall include specific initiatives, programs, and strategies that will:

- Reduce GHG emissions from the transportation, building, regulated utility, industrial, commercial, and agricultural sectors.
- Encourage smart growth and related strategies.
- Achieve long-term sequestration and storage of carbon and promote best management practices to achieve climate mitigation, adaption, and resilience on natural working lands.
- Achieve net zero emissions by 2050 across all sectors.
- Reduce energy burdens for rural and marginalized communities.
- Limit the use of chemicals, substances, or products that contribute to climate change.
- Build and encourage climate adaptation and resilience of Vermont communities and natural systems.

In addition, the specific initiatives, strategies and programs identified in the CAP must further the following objectives:

- Prioritize the most cost-effective, technologically feasible, and equitable GHG emissions reduction pathways, adaptation and preparedness.
- Ensure that all regions of the state benefit from GHG emissions reductions.
- Provide for GHG emissions reductions that reflect the relative contribution of each source of emissions.
- Minimize negative impacts on marginalized and rural communities and individuals with low and middle incomes.
- Support economic sectors and regions of the state that face the greatest barriers to emissions reductions (rural and economically distressed regions and industries).
- Support industries, technology, and training that will allow workers and businesses in the state to benefit from GHG reduction solutions.
- Support the use of natural solutions (including working lands) to reduce GHGs, sequester carbon and increase resilience.
- Maximize the state's involvement in interstate and regional initiatives and programs designed to reduce regional GHG emissions and build upon state, national, and international partnerships and programs.

Using This Plan

The CAP outlines the path forward for Vermont to take meaningful climate action and is organized around four key areas:

1. Cross-Sector Mitigation: Reducing planet-warming emissions
2. Agriculture and Ecosystems: Building resilience and adaptation in Vermont's natural and working lands
3. Rural Resilience and Adaptation: Building resilience and adaptation in Vermont's communities and built environment
4. Cross-Cutting Solutions: Education, workforce, funding and financing

For each area, the CAP identifies a set of pathways, strategies and actions that strive to meet the intent of the objectives for that area. Recommendations are outlined in three categories: Pathways, Strategies and Actions. Each category serves a distinct function in the overall recommendation.

Pathway: A pathway is a high-level means of achieving GHG emissions reductions or adaptation, resilience and sequestration goals.

Strategy: Under each pathway, a suite of strategies has been developed. These strategies are a statement of measurable activity—a benchmark—to be reached in pursuit of the pathway.

Action: Actions have been identified as the "operational" tasks that the state, regional organizations, municipalities, non-governmental organizations and Vermonters will undertake to meet the pathways and strategies.

Foundational Criteria

To meet both the requirements and objectives laid out in the GWSA, the Council utilized foundational criteria from the Initial Plan: impact, cost-effectiveness, co-benefits, equity, and technical feasibility. These criteria speak directly to the priorities put forward in the GWSA while building upon the specific work to develop this *Vermont Climate Action Plan 2025* to inform high priority actions. More detailed information on the foundational criteria utilized can be accessed in the *Initial Vermont Climate Action Plan.*

TABLE 11.1: Foundational Criteria.

	Mitigation	Resilience
Impact	Impact is the consideration of actions' contribution to achieving 2025, 2030, and 2050 emissions reduction requirements. The gross GHG emissions reductions required by 2025 are 1.26 MMTCO2e below our most recent (2018) levels. Reductions of 3.46 MMTCO2e are required by 2030.	The assessment of impact for adaptation, resilience, and sequestration actions takes into consideration both the scale at which a particular action occurs and the effects (both short and long term) of that action.
Cost-Effectiveness	Cost-effectiveness refers to the lifetime net cost per ton of GHG emissions avoided (acknowledging that some mitigation measures do not generate net costs and save money). Cost-effectiveness is also understood to account for lifetime or dynamic costs, not merely upfront or static costs.	Cost-effectiveness for actions seeking to build resilience, further adaptation, and enhance sequestration and carbon storage refers to the relative lifetime net cost of the action compared to the desired outcome or impact. This definition only deals with the true cost to Vermonters and does not speak to the cost of avoided damages, which we know is very important.
Co-benefits	Comprehensive climate policy will advance actions that work to mitigate climate pollution while also building resilience, adaptation, and storing and sequestering carbon. Actions must also seek to advance broader societal benefits such as public health, equity (specific focus on impacted communities), economic prosperity, biodiversity conservation, workforce opportunities, and other benefits that improve the quality of life in Vermont broadly.	
Technical Feasibility	The degree to which the required technologies are developed and reasonably available. Since this is called out in the GWSA, it is important to simply answer yes or no to ensure the action is implementable.	

The release of this updated CAP is a step forward in the Council's ongoing work to inform climate action in Vermont. The following chapters outline recommendations that can be utilized by legislators, state agencies, and communities to fulfill the charge of the GWSA.

12. Priority Actions

We present a significant and broad set of recommendations intended to guide climate action over the next four years. At the heart of our efforts is a commitment not only to reduce emissions, but also to ensure Vermont remains a vibrant, healthy place for current and future generations.

In all, this 2025 update to the CAP identifies more than 250 recommended actions (see Appendix 2). To focus the state's efforts, we highlight 52 priority actions as well as a shortlist of the top 10 priority actions. The 52 prioritized actions are comprehensive, providing important recommendations for how Vermont communities can become more resilient and reduce climate pollution while recognizing the changing context for this work.

Context for the 2025 Plan Update

A period of unprecedented federal investment in climate action is abruptly coming to an end. We must now change our understanding about how we support Vermont's climate action and consider who will have the financial and operational capacity to do this work. The end of federal investment will affect Vermont's efforts to reduce emissions as well as its disaster recovery and resilience initiatives.

The federal government is also pulling back on key policies, such as support for electric vehicles and renewable energy. Even before this challenging context, Vermont faced a heavy lift to achieve its 2030 emissions reduction requirement under the GWSA and has struggled to fully recover from recent disasters. Reduced federal funding, coupled with the limited financial capacity of Vermonters and their municipalities, is requiring the state to carefully decide how to raise funds and prioritize investments in climate action.

Despite this difficult moment, the reality of the climate hazards facing the state and our urgent need for action drives us to take responsibility for Vermont's own contribution to

the climate crisis. This plan identifies a series of meaningful actions Vermont can take to reduce emissions and become more resilient.

This plan emphasizes actions that:

- **Reduce climate pollution** – Make homes more energy efficient and help Vermonters, particularly those living on low and middle incomes, to switch to price-stable and affordable sources of heat and transportation.
- **Create resilience** – Make investments in resilience, preparedness, and community development that will help Vermonters recover more quickly from disasters and save money and lives as Vermont faces future climate hazards.
- **Build the workforce** – Invest in building the workforce needed to implement these actions, including support for education and skills training, new technologies, and business opportunities.
- **Fund the work** – Identify sustainable, long-term funding to support climate action and meet the requirements of the GWSA.

Given the current federal landscape surrounding energy efficiency, clean energy, hazard mitigation, and other climate action, we recognize an increased responsibility for state-level action and the necessity for collaboration across states. Important progress can be achieved through partnerships with other states, such as Vermont's continued involvement with the U.S. Climate Alliance and evaluating possible participation in multi-state programs such as the Western Climate Initiative. As we lean into new state and multi-state action, we believe we can and should advance solutions that reduce costs and deliver benefits, especially for households with lower and middle incomes. In sum, the actions in this plan represent opportunities to make positive changes in a challenging context.

Criteria for Action

The Council offers the following criteria as especially important when designing policy and implementing climate action:

- Minimize financial hardship of Vermonters living on low and middle incomes through the intentional design, prioritization, and pacing of programs, and ensure those in need receive timely financial support.
- Balance investment in emissions reductions and adaptation measures to strengthen resilience against current climate impacts.
- Ensure adequate capacity for state agencies to advance the actions (e.g., new staff, funding, technology).
- Identify revenue sources that are compatible with climate actions (e.g., raising the cost of electricity is not compatible with the adoption of climate-friendly electric heating and transportation options).

- Ensure necessary supporting technologies are being funded and implemented (e.g., residential electric panel upgrades, expanded availability of electric vehicle charging infrastructure).
- Support and develop enough trained workers to implement the actions.
- Take into account the costs of not acting, including Vermonters' continued dependence on price-volatile fossil fuels for home heat and transportation and the cost of rebuilding after all-but-certain future climate disasters.

Sequence of Actions

This updated CAP includes actions that will reduce emissions now. It also contains critical steps we need to take on more complex efforts that will serve Vermont in the medium and long terms. Similarly, the plan urges the Legislature and administration to find funding sources that can be immediately put towards climate action while concurrently taking steps to secure sustainable, long-term funding for climate action.

10 Highest Priority Actions

This shortlist was created in direct response to public input. Actions are not listed in priority order; rather, they are equally important as a collective suite of actions. These 10 highest priority actions identify immediate steps needed to reduce climate pollution and make Vermont more resilient to climate-related hazards:

Make Vermont more resilient

- Expand and maintain a permanent Flood Resilient Communities Fund

  ► **See Rural Resilience and Adaptation #3**

- Invest in municipal infrastructure to support compact development

  ► **See Rural Resilience and Adaptation #11**

Support climate-informed land use

- Increase funding and adapt existing Vermont programs that achieve climate goals on farms and in forests

  ► **See Agriculture and Ecosystems #1**

- Promote equitable landscape connectivity and conservation for 30x30 and 50x50 goals (Act 59)

  ► **See Agriculture and Ecosystems #13**

Reduce climate pollution

- Weatherize homes, focusing on low- and middle-income households

  ► See Emissions Reductions #7

- Take preparatory steps now and join a cap-and-invest program as soon as a viable option is available

  ► See Emissions Reductions #1

- Support utility programs that ensure the electric grid supports customer electrification and resilience

  ► See Emissions Reductions #4 and Emissions Reductions #6

- Reduce GHG emissions from vehicles and buildings through electrification

  ► See Emissions Reductions #2 and Emissions Reductions #9

Identify funding and also support the needed workforce

- Identify revenue sources to immediately support these priority actions

  ► See Cross-Cutting Issues #7

- Implement the U.S. Climate Alliance's Climate-Ready Workforce Initiative and related actions

  ► See Cross-Cutting Issues #4

Emission Reductions: Transportation, buildings and thermal, electricity

1. **Take the following steps to join a cap-and-invest program.**
   - Develop a framework for the reporting of GHG emissions data from fuel suppliers and other significant emitters of climate pollution. ANR will work expeditiously to put a reporting framework in place and recommend to the Legislature by December 15, 2025, statutory changes and funding needed to support streamlined reporting requirements and a stepped implementation plan.
   - Determine the most appropriate and feasible mechanism(s) for addressing affordability concerns related to the implementation of a cap-and-invest program.
     - Ensure that a significant portion of cap-and-invest revenues are used to provide direct payments or rebates in as close to real time as possible to Vermonters with low and middle incomes, to prevent cost-of-living increases for those households from the program. Another significant portion of revenues should be used to provide direct incentives to support low- and middle-income households in reducing pollution and saving money via increased energy efficiency and adoption of no-carbon or low-carbon technologies.

- ANR, in collaboration with the Department of Public Service, the Vermont Agency of Transportation, and the Vermont Climate Council, will advance a study that will make specific technical recommendations around achieving affordability, including potential limits on allowance prices (a price ceiling).

- Monitor cap-and-invest programs and continue to track updated economic analysis to understand the costs and benefits on implementing the program in Vermont, and join the best available program, such as Western Climate Initiative or New York Cap-and-Invest, based on the above analysis.

  The Council views a cap-and-invest program as an overarching policy to provide predictable and substantial emissions reductions in Vermont over time. However, alongside such a program, additional policies will be needed to achieve targeted reductions, deliver benefits to lower-income Vermonters, and achieve the scale of emissions reductions required by the GWSA. In the thermal sector, this plan recommends important investments in weatherization and lower-emissions heating systems, which can provide near-term emissions reductions. The Council also acknowledges the need to explore and implement other complementary policies to accelerate the transition to non-fossil heating fuels. Options include a thermal energy benefit charge and thermal sector performance standards, such as a modified clean heat standard, equipment standards, and fuel standards.

2. Reduce GHG emissions from vehicles.

- Continue to monitor and maintain Vermont's adoption of the California Advanced Clean Cars II (ACC II) and Advanced Clean Trucks regulations, including adopting rule amendments adopted by California Air Resources Board (CARB) that provide increased compliance flexibility.

- Urge the Vermont Attorney General to join and participate in any litigation defending California and states' authority under the Clean Air Act's Section 177.

- Support vehicle electrification, ensuring long-term, consistent funding for EV incentives to low- and middle-income car purchasers, which aligns with estimates provided for the Vermont Agency of Transportation's February 2024 Clean Transportation Incentive Programs report, as well as guidance from the February 2025 Legislative Report on Vermont Clean Transportation Incentive Programs.

- Support vehicle electrification investment for the equitable deployment of fast charging and Level 2 charging options to levels needed to meet the modeling done in the Pathways 2.0 Report and as estimated in the Agency of Transportation's January 2025 Statewide Level 3 Report, Map, and Funding.

3. Invest in public, active, shared, and multimodal transportation, such as transit, micro transit, biking and walking.

- Use the VTrans July 2024 Vermont Smart Growth, Vehicle Miles Traveled (VMT), and GHG Research Project Report and the November 2023 Carbon Reduction

Strategy and associated GHG Sketch Tool to guide investments that reduce the need for single-occupancy vehicles (also known as reducing vehicle miles traveled), which has important co-benefits such as cost savings to individuals and families, access to jobs, and health and environmental benefits.

- Leverage the Downtown Transportation Fund in a manner that most effectively accelerates this policy.

4. **Support cost-effective load management, grid hardening, and optimization (through advanced metering, storage, targeted siting of generation, rate design, and distributed energy resource management systems statewide) to enable customer programs and avoid or delay more expensive physical upgrades.**
   - Continue Public Utility Commission (PUC) oversight of utility load management programs, investments, and rate designs, and consideration of regulatory approval improvements for efficient generation and infrastructure siting.

5. **Review and implement as appropriate recommendations from Act 179 study[84] regarding evolution of community-level renewable energy programs, especially for low-income customers.**
   - With community and customer input, utilities continue, or consider, creating procurement and customer enrollment programs to support community-based renewable energy projects. Primary considerations for any such program should be cost-containment actions, funding avenues that are not electric-customer supported, and how approval for community-based project siting occurs.

6. **Support existing programs and expand as needed to ensure the electric grid supports customer electrification necessary to meet Global Warming Solutions Act goals, including service drops, transformers, smart panels, EV chargers, storage, and more.** Highlight importance of cost-effectiveness and equity in design, implementation, and affordable funding.
   - Continue Public Utility Commission oversight of utility programs (e.g.,Tier III); consider expanding credit in Tier II for these purposes; seek state or federal sourced funding where possible; strive for deployment across utility territories with ability to participate for all customers, including rural and low-income customers.

7. **Sustain and expand funding for comprehensive weatherization focused on low- and middle-income households.** Through legislation or administrative action, ensure that the current scope of weatherization being conducted is sustained, while aggressively working to ensure that 79,000 additional homes are comprehensively weatherized as soon as practicable, with a priority on low- and middle-income households.

84 Act 179 of 2024 Report. This report was prepared by the Department of Public Service as required in Act 179, An Act Relating to the Renewable Energy Standard

- The weatherization work should recognize energy efficiency broadly. It should include: traditional energy efficiency measures; electrical, health, and safety measures needed to comply with codes; and needed infrastructure upgrades such as wiring and service panels to enable electric vehicle charging, the adoption of heat pumps for space and water heating, and other strategic electrification opportunities.
- Current programs (funding and workforce) are able to weatherize approximately 4,000 homes per year at an average cost of $11,000 per unit. Much of the recent funding has come from federal sources, which are unlikely to be renewed.
- It is essential that Vermont take steps to maintain and accelerate its current pace of weatherization in order to complete the additional 79,000 units as soon as practicable.

8. **Through legislation or administrative action, ensure additional commercial, industrial, municipal, and non-residential buildings, as modeled to be necessary, are comprehensively weatherized by 2030, and secure the funding needed to achieve the target.**
   - Including "weatherization ready" project needs
   - With priority for supporting/expanding existing programs (i.e., the Municipal Energy Resilience Program, Municipal Technical Assistance Program, Building Communities, etc.)

9. **Secure funding for electrification of space and water heating for low- and middle-income households.**
   - Develop programs for implementation regarding 200-amp service and related building upgrades, coordinated with weatherization, efficiency, and equipment incentive programs (EV chargers, heat pumps, storage, etc.), and ensure that any potentially related statewide program (such as Clean Heat Standard, if adopted, or enhanced weatherization efforts) includes building electrical upgrades in their design and funding models in order to enable decarbonization.

10. **Conduct a study that considers the technological options and market feasibility for emission-based equipment standards for various types of heating.** The purpose is to better understand the feasibility and considerations of Vermont adopting a thermal equipment emissions standard(s), either for oxides of nitrogen or, more broadly, for GHGs.
    - The Legislature needs to fund the study.
    - The Agency of Natural Resources needs to file a report with the Vermont Climate Council by June 30, 2027.
    - The study shall consider:
      - adoption by other states

    - the means by which equipment standards can influence market activity
    - the most equitable approaches
    - how to secure the greatest emissions reductions
  - The study is contingent on securing funding.

11. **Analyze options for a performance-based Clean Fuels Standard that implements a declining carbon intensity (CI) score eligibility requirement for residential, commercial, and industrial (RCI) fuels and can be implemented gradually alongside complementary policies that would be necessary.** As a potential alternative, analyze instituting a minimum percentage clean fuel blending requirement for all residential, commercial, and industrial liquid and gaseous fuels, utilizing an approved list of eligible clean fuels.

12. **Utilities and their regulators should adopt standards and programs to support thermal energy networks, waste heat recovery, and community-scale geothermal.**

Cross-Cutting Pathways: Education, workforce development, finance and funding

1. **Amend the Vermont State Board of Education's Education Quality Standards to incorporate environmental and climate change education at all grade levels.**

2. **Compile an open source, accessible, and interdisciplinary climate change curriculum for Vermont educators that builds off existing resources and programs to enable teaching across subject areas.**

3. **Maintain funding for programs to educate Vermonters about their energy choices and funding options to increase energy efficiency in residential homes, including the Green Savings Smart Program, which supports energy coaches at Community Action Agencies.**

4. **Implement the Climate-Ready Workforce Initiative to grow career pathways in climate change and clean energy fields, support new and existing workers, retain recent graduates, ensure job quality and safety, strengthen workforce diversity, and train workers in service of the collective U.S. Climate Alliance goal of 1 million new registered apprentices across 24 states by 2035.**
   - Increase the number of registered apprenticeships that can be supported in the state by Vermont State University, the Department of Labor, and other registered apprenticeship programs, especially in plumbing/HVAC, electrical, and weatherization.

- Support training from middle school through adult education and service-learning programs for a wide variety of audiences, including through the weatherization training center and the many existing training programs.
- Target outreach, training, support, and service-learning systems for existing Vermont residents to enter and stay in careers that support climate action, including farming and forestry, conservation, clean energy, weatherization, outdoor recreation, and resilience and adaptation careers.
- Invest in instructors and physical infrastructure to increase the number of students who can be supported in the Career and Tech Ed system in the state, including electrical, plumbing, and building trades programs, as well as agriculture, forestry and other sectors mentioned above.

5. **Support programs for people to start and build their own businesses in the trades, including business development and climate change career programs.**

6. **Monitor the impacts of decarbonization on the workforce and create programs to support impacted workers by tracking leading indicators.**

7. **Interim funding for priority climate actions.** Until new and significant sources of revenue are in place to fully implement the recommended priority actions in this plan, the State of Vermont should identify, authorize, and appropriate revenue from existing or new sources that will immediately support the creation or expansion of certain priority actions. This funding should be used to: (a) Establish or grow programs proven in Vermont, or demonstrated in other jurisdictions, to be cost-effective strategies for achieving climate benefits, while optimizing other public policy co-benefits; and (b) Increase investment in building state agency capacity to design and implement the priority action recommendations.

   The source of revenue should be a bridge to having adequate revenue from other programs, such as a cap-and-invest system, be structured to mitigate impacts on Vermonters facing financial hardships, and not burden those economic sectors and programs that are essential to a transition to a low-carbon and climate-adapted landscape and economy.

8. **Support the implementation of the Climate Superfund Act (Act 122),** including by funding the work at the Agency of Natural Resources and Vermont State Treasurer's Office and any other work deemed necessary to support its implementation, helping to provide essential revenue to invest in resilience and adaptation measures.

9. **Building off recent climate infrastructure financing efforts, the Vermont State Treasurer's Office, in consultation with the Climate Action Office and Climate Council, should explore opportunities to further leverage public and private capital to make needed clean energy, resilience and adaptation investments.** This effort should focus on reducing hurdles facing Vermonters in accessing and affording

cleaner and more energy efficient technologies, weatherization, and necessary infrastructure and resilience investments. It should seek to build off existing structures and institutions (such as credit unions and banks) to leverage programs, partners and capital as well as explore other potentially useful strategies (such as on-bill utility financing, bonding and insurance markets).

Rural Resilience and Adaptation: Community capacity and planning, infrastructure and built environment, public health

1. **Increase state capacity to manage funding programs and provide technical assistance for the development and implementation of climate resilience plans, with a focus on maximizing the efficacy of Local Hazard Mitigation Plans and augmenting existing programs with the Municipal Planning Grant program, the Municipal Climate Planning Framework and Guide, and the Municipal Climate Toolkit.**

2. **Establish permanent, dedicated funding for Regional Planning Commissions to hire and retain staff for climate resilience and natural resources planning work, hazard mitigation application development, and management of hazard mitigation grants on behalf of municipalities or other eligible grant recipients as well as cover overhead costs related to completing Local Hazard Mitigation Plans.**

3. **Secure sustainable, long-term funding to expand and maintain a permanent Flood Resilient Communities Fund (also known as Community Resilience and Disaster Mitigation Fund) for the design and implementation of local and regional climate change adaptation projects and community resilience.** Funding may be used as the local match for federally funded hazard mitigation programs as well as hazard mitigation activities not eligible under FEMA.

4. **Expand the Business Emergency Gap Assistance Program (BEGAP) to provide financial support and one-on-one coaching to businesses and non-profits before a disaster, in addition to providing funding to businesses that are impacted by climate disasters and disruptions. Link and coordinate efforts with organizations and networks providing similar support to businesses.**

5. **Integrate regional housing targets and ongoing mapping, including Flood Insurance Rate Map updates, river corridors, and landslide hazards; identify areas that are suitable for new, climate-safe housing; and increase funding mechanisms where communities are investing in development-ready infrastructure.**

6. **The State of Vermont, through the Public Utility Commission and Public Service Department, should complete the PUC resilience planning investigation underway**,

which is analyzing whether and how to define, value, measure, and set targets for grid resilience. Utilities should continue to integrate resilience planning into their operations.

7. **Expand upon the Municipal Vulnerability Indicator tool to create a Municipal Vulnerability Index that can be used by state agencies and others as a resource to assist in prioritizing infrastructure resilience investments across the state based on specific vulnerabilities or combinations of vulnerabilities.** Ensure it includes currently missing data such as historical utility outage data, to the extent available, and the Agency of Natural Resources' Environmental Justice mapping tool, when complete.

8. **Develop a framework that creates a plan to identify prioritized state investments in resilience projects. The framework should be attentive to fiscal constraints, similar to the State Transportation Improvement Program, and build upon the Resilience Implementation Strategy, the State Hazard Mitigation Planning process, and Hazard Mitigation Project Review process.** The purpose of this action is to have a standing list of projects, vetted through an interagency prioritization and public engagement process, that could be implemented as funding is available.

9. **Create a transportation flood resilience funding program to design and construct transportation projects identified as high-priority locations via use of the most relevant risk and vulnerability assessment tools.**

10. **Replace or harden electric and communication infrastructure with the most appropriate resilient alternative when cost effective.** For example, for aging or unreliable lines, utilities should continue to evaluate improving resilience by relocating lines underground or through other options, where demonstrated to be feasible and cost effective to electric customers.

    Planning frameworks, valuation tools, and metrics resulting from the Resilience Investigation (Case No. 25-0339-PET) being conducted by the Public Utility Commission should be used to inform this evaluation.

11. **Increase investment in municipalities to harden, improve, expand and build new drinking water, wastewater, stormwater and other infrastructure to support compact development, especially growing away from climate hazards such as flooding, and ensure the long-term operation and maintenance of these assets.**

12. **Continue to implement and monitor for progress and outcomes Act 181**,[(85)] which is the statutory framework for updating and implementing many State and local land use policies (such as designation program reform and Act 250 updates).

85 Act 181, An act relating to community resilience and biodiversity protection through land use. Vermont State Legislature. 2024.

13. **Provide increased capacity to strengthen messaging and awareness of local and state emergency preparedness, response, and recovery structures.**

14. **Provide funding and technical assistance to municipalities and local partner organizations to support adaptation and preparedness planning in communities, with specific focus on disproportionately affected and vulnerable populations.** Include the identification, adaptation, and equipping of facilities to serve as community resilience hubs that serve as places for learning, collaboration, resource access, and refuge in response to climate-related hazards and other community needs.

15. **Provide funding for equipment, supplies and services that improve resilience and reduce the health impact of climate-related hazards for income-qualifying households needing extra assistance.** The intent is to provide financial support for resilience needs in a similar way to existing financial support for energy efficiency (e.g., through heat pump and EV rebates). Resilience equipment and strategies should address health risks related to flooding, power outages, extreme temperatures, hazardous air quality, humidity, vector-borne diseases, and other climate-related hazards, and could include:
    - Supplies and equipment to improve heat resilience, such as trees and other vegetative shade, window treatments (shade and thermal barriers), efficient air conditioning (heat pumps) fans, and dehumidifiers
    - Equipment to improve indoor air quality, such as air purifiers and mechanical ventilation (e.g., ERVs)
    - Backup power equipment
    - Window screens
    - Services such as water intrusion and moisture mitigation and management, private drinking water testing and treatment, and others.

16. **Provide state-contracted community mental health service partners with more capacity to address anxiety, depression, distress and trauma caused by climate change and climate-related disasters.**

Agriculture and Ecosystems: Reducing and sequestering emissions, supporting adaptation, climate-resilient land

1. **Increase funding for, enhance, and adapt existing State of Vermont programs that support GHG emissions reductions, soil carbon sequestration, and/or climate adaptation and resilience on working lands, including through manure management.** Coordinate with applicable agencies to defend and accelerate the

implementation of federally funded climate mitigation and resilience practices in Vermont.

- Enhance and adapt programs to better incorporate nature-based solutions as well as Traditional Ecological Knowledge and Indigenous Knowledge.
- State programs include, but are not limited to:
  - Agency of Agriculture, Food and Markets: Agriculture-Clean Water Initiative Performance (Ag-CWIP), Best Management Practice (BMP), Forestry Acceptable Management Practices (AMP), Capital Equipment Assistance Program (CEAP), Conservation Reserve Enhancement Program (CREP), Farm Agronomic Practice (FAP), Grassed Waterway and Filter Strip (GWFS), Pasture and Surface Water Fencing (PSWF), Vermont Pay for Phosphorus (VPFP), Vermont Farmer Ecosystem Stewardship Program (VFESP)
  - land acquisition
  - river corridor easements
  - wetland conservation
  - County Forester Program
  - the recommendations in the ANR report *Maintaining and Creating Resilient Forests in Vermont* (2015)

2. **Utilize best practices to quantify carbon sequestration and emissions reductions from agriculture and forestry.**

3. **Fund and implement Payment for Ecosystem Services (PES) programs to encourage landowners and land and water caretakers[86] to implement practices that improve soil health, improve crop and forest resilience, increase carbon storage, increase stormwater storage capacity, and reduce runoff.** Fund existing agricultural PES programs and expand to include or develop new programs for forestry.

   Note: Payment for Ecosystem Services programs recognize and reward land and water caretakers for practices that enhance ecological function and community wellbeing, rooted in both traditional stewardship values and modern land management. These programs do not include carbon markets or trading.

4. **Leverage the power of peer learning to advance climate resilience by funding a Request for Proposal (RFP) that provides funds to support Vermont Natural Resource Conservation Districts, farmer organizations, and non-profit organizations with the specific objective of allowing them to reach other farmers and foresters and do peer-to-peer education about improved soil and manure management strategies that enhance climate resilience.**

86 The Agriculture and Ecosystems Subcommittee used the word “caretakers” to refer to any individual who makes decisions around the land and water. This could include land and water managers and stewards as well as landowners.

5. **Create a dedicated climate impact emergency recovery fund for farms and forestry operations or related infrastructure (or ensure the agriculture and forestry sectors are given specific considerations in existing recovery funds), support leverage of federal funds and expansion of programs to support the adaptive capacity and restoration of farms and forests, and promote insurance for farm and forest landowners and businesses to ensure that they can equitably and viably recover from climate-induced disasters.**
    - The fund should be simple to access, deploy sufficient funds quickly following a disaster, be sustained over time with predictable and consistent funding, and be flexible, equitable, and proportional to meet the diverse needs of the farming and forestry community.

6. **Dedicate robust funding for farm and forest supply chain resilience and state food security, including significant investment in storage, processing and distribution infrastructure.** Prioritize investments in farm, food, and forestry businesses, cooperatives and non-profits, as well as Indigenous and community projects, that have climate resilience, adaptation and mitigation goals.
    - Funding should include:
        - a substantial increase in base funding for the Working Lands Enterprise Initiative, the Agriculture Development Grant program, Crop Cash Plus, and Farm Share
        - dedicated appropriations for distribution and food hub operations and infrastructure, and appropriations for research, development, and support for siting and permitting process improvements that recognize the vital conservation benefits of market expansion opportunities for local wood products processing and manufacturing in Vermont

7. **Improve funding opportunities and create equitable access for Black, Indigenous, and People of Color (BIPOC) farm, food, and forest organizations and businesses by developing multi-year unrestricted BIPOC-centered grants and loan programs.** This includes uplifting and resourcing the work of the Abenaki and other Indigenous Peoples in the state, Land Access and Opportunity Board, and other BIPOC communities and organizations in Vermont.

8. **Promote and incentivize the use of agricultural and sustainably harvested wood-based construction materials (subject to existing certification criteria or procurement standards to be developed) over less climate-friendly options, such as imported wood from locations lacking required sustainable harvest requirements and/or non-wood materials with high carbon footprints (such as steel and concrete).**
    - This could include using state procurement standards to require that publicly funded building projects, or those subsidized through low-interest loans or tax benefits, use chain-of-custody certified wood products (mass timber, cellulose insulation, advanced wood heating, and others) and prioritize building materials

(such as sustainably harvested wood) that align with climate goals and ecological values, while reducing reliance on high-carbon, non-renewable materials like steel and concrete.

- Continue to research and develop the lifecycle accounting of these products for the greatest impact.

9. **State agencies should utilize financial incentives, siting policies, and regulations to incentivize, support, and preferentially site renewable energy capacity on buildings and parking lots (by installing solar roofs), in compact settlement areas (including renewable energy and charging facilities in rental housing), and in previously disturbed or developed areas, where feasible.**
   - Avoid conversion of ecologically sensitive areas, forests, and prime agricultural soils.

10. **State agencies should promote nature-based climate solutions, Traditional Ecological Knowledge and Indigenous Knowledge by considering how to gauge their effectiveness**[87] and incorporate them into assessments, planning efforts, prioritization frameworks, and funding programs to address climate change impacts.

11. **State land management agencies should continue to adapt their management of lands using nature-based climate solutions to address climate impacts, increase ecosystem resilience, enhance biological diversity, and improve water quality.** State land management agencies should also enhance technical assistance and resilience funds to support the financial capacity of other land and water caretakers to achieve these goals.

12. **State agencies and the Legislature should identify gaps and opportunities to expand and improve current programs that promote healthy, connected river corridors, floodplains, and wetlands that prioritize restoration and conservation, and that incentivize water storage in headwaters and natural areas, all to promote flood resilience and biodiversity through expansion of wetland, floodplain, riparian forest and river corridor easements that better compensate land and water caretakers for restoring, managing and conserving these natural water storage areas.** Also use opportunities presented by Act 121,[88] an act relating to the regulation of wetlands, river corridor development, and dam safety.

13. **State agencies should work with partners, and the Legislature should fund the state agencies as necessary, to promote strategic and equitable statewide landscape connectivity and the conservation of priority forest blocks, farmland, and other actively and passively managed lands through planning and implementation toward 30x30 goals and 50x50 goals in alignment with Act 59 of 2023, an act relating to community resilience and biodiversity protection.**

87 The Council received a specific recommendation on how to gauge the effectiveness of nature-based solutions in a written comment from the Transnational Environmental Law Clinic.

88 Act 121, Flood Safety Act. Vermont Legislature. 2024.

This work should use the best available data and mapping, including Vermont Conservation Design, while braiding in Traditional Ecological Knowledge and Indigenous Knowledge.

- Conservation planning and implementation should meet the targets set forth in Vermont Conservation Design. These goals include managing forests to achieve a target of 3%–5% young forest and allow at least 9% of Vermont's forest to become (or be maintained as) old forest, specifically targeting 15% of the matrix forest within the highest priority forest blocks—including National Forests—to achieve the old growth condition and ensure the protection of sacred sites or other historically or culturally important areas as determined by the Vermont Division for Historic Preservation.

- At the same time, protecting farmland and managed forests from development through land conservation and protection programs is essential to ensure these land uses continue to provide climate mitigation, adaptation, and resilience benefits. Existing state land-use protection programs, such as the Vermont Farmland Conservation Program and forest conservation easements, should be enhanced to improve farmland access and the protection of agricultural soils and working forests.

14. **Enhance education, outreach, research, and technical assistance programming to encourage farmers, foresters, and other land and water caretakers to adopt strategies that increase climate mitigation, adaptation and resilience.** State agencies should work with and support efforts to fund partners and higher education, such as University of Vermont Extension and Natural Resource Conservation Districts.

    - These efforts should be incorporated into current programs, braiding Traditional Ecological Knowledge and Indigenous Knowledge and recognizing the value these bring to better understanding and taking care of the land. Initiatives should be designed to represent diverse perspectives while addressing a diversity of audiences and age groups. Simplify and assist with application processes for funding and support programs.

15. **Fund and undertake as soon as possible the study previously requested by the Vermont Climate Council on the use of woody biomass for utility-scale electric energy facilities.**[89] In addition, use the guidance previously provided by the Council to the Vermont Public Utility Commission (PUC) regarding biomass.

    - Read the Council's biomass addendum.

89 This study is not aimed at smaller-scale biomass such as advanced wood heat and agricultural waste methane generation.

13. Education, Workforce Development, Finance and Funding

Cross-Cutting Pathways is an area of climate action that provides a comprehensive approach by supporting emissions reductions as well as resilience and adaptation efforts. Through the development of the *Initial Vermont Climate Action Plan*, several cross-cutting pathways were identified as integral to climate action in Vermont. These pathways included Environmental Justice, State Government, Community and Partner Capacity, Building Codes, Transportation, Workforce Development, Education, and Compact Settlement. Since the adoption of the Initial Plan, there has been a completion of cross-cutting recommendations and acknowledgment from the Climate Council that some of the pathways would be best served by subcommittees with expertise in the particular pathway. For instance, the Environmental Justice pathway, which recommended the creation of an environmental justice policy, was addressed by the passage of Vermont's Environmental Justice Law (Act 154) in 2022. Additionally, the establishment of the Climate Action Office made progress toward what was envisioned by the State Government, Community, and Partner Capacity pathway. Furthermore, Building Code and Transportation pathways were moved to Cross-Sector Mitigation, as expertise on building codes and transportation reside in the Cross-Sector Mitigation Subcommittee.

As a result, the update of Cross-Cutting Pathways in the CAP focused on the following three key cross-cutting pathways: Workforce Development, Education, and Compact Settlement. These pathways were identified as necessary for climate action across various sectors. To support this work, representatives from Cross-Sector Mitigation, Rural Resilience and Adaptation, and Agriculture and Ecosystems subcommittees

worked to refine these pathways and build upon actionable recommendations in the update of the CAP. This collaborative effort involved public meetings to gather feedback and finalize recommendations, ensuring that actions under Cross-Cutting Pathways are comprehensive and forward- looking.

Following the development of the updated Compact Settlement actions and public input, the Council determined that it would be most effective for Compact Settlement to be integrated within the Rural Resilience and Adaptation section of the updated CAP.

Additionally, the Council added a Finance and Funding Pathway to Cross-Cutting Pathways. The Finance and Funding Pathway speaks to the need to leverage public and private capital to facilitate clean energy, resilience and adaptation investments, focusing on reducing barriers for Vermonters in accessing and affording cleaner technologies and necessary infrastructure.

Education

The Education Pathway encompasses strategies aimed at equipping Vermonters with the knowledge and skills necessary to take climate action. The update to the Education Pathway emphasizes the importance of creating accessible and equitable research, partnerships and education. Among these, a key priority is to offer technical assistance to Vermonters about energy choices and available funding to increase energy efficiency in their homes. For example, the Green Savings Smart Program, administered by Vermont's Community Action Agencies, plays a key role in ensuring that residents have the information and resources needed to make informed energy decisions about efficiency improvements they can make, ultimately contributing to reduced energy consumption and emissions. Additionally, there is a focus on creating an accessible climate curriculum for educators, which would be interdisciplinary, open source, and accessible, building on existing resources. Furthermore, incorporating environmental and climate change education at all grade levels is recommended to ensure that climate education becomes a fundamental part of the educational experience. Lastly, supporting educational programs that strengthen the workforce pipeline, with a focus on postsecondary educational models like apprenticeships and stackable credentials in fields such as construction, energy, agriculture, and renewable energy, is essential.

Additional Education Pathways that were not identified as priorities but are critical components to advancing education in the CAP include developing accessible educational materials that communicate climate science and local impacts and promoting equitable language use across state agencies. The collective priorities outlined in the Education Pathway support Vermonters with the foundational knowledge to build a just energy transition and implement the Global Warming Solutions Act.

Workforce Development

The current capacity of Vermont's workforce will constrain efforts to achieve climate goals. The Workforce Development Pathway is critical to equip Vermont's workforce to meet the demands of a climate-resilient economy and enhance workforce capacity. One key priority is increasing access to equipment and supporting contractors in making investments that boost their operational capacity. Another priority focuses on targeting outreach and training for existing Vermont residents to enter and remain in climate careers, such as those in farm and forestry, clean energy, and resilience sectors. By supporting Vermont workers to join these trades and providing resources for readiness and retention, this action seeks to expand and maintain a climate-ready workforce. Additionally, creating clear career pathways for young adults to enter into climate-related fields is essential. Actionable steps include increasing the number of students supported in Career and Tech Ed programs and expanding registered apprenticeships, particularly in plumbing, HVAC, electrical, agriculture and forestry, and weatherization.

Supporting programs for individuals to start and build their own businesses in the climate field is also a priority, with initiatives advancing through partnerships with organizations with workforce development programs and adult-learning community-based organizations. These efforts collectively aim to build a robust workforce capable of driving climate action and supporting Vermont's transition to a sustainable and equitable future.

Finance and Funding

The Finance and Funding Pathway, a new addition to the CAP's Cross-Cutting Pathways, is designed to strengthen the financial mechanisms supporting clean energy, resilience and adaptation investments in Vermont. In order to immediately start to fund key CAP recommendations, such as weatherization and resilience strategies, it is important to identify revenue sources—new or existing—that can be used to immediately support this work. State funding for clean water can serve as a model. In 2017, then–Treasurer Beth Pearce issued a report establishing an annual target for funding necessary investments in clean water; she also recognized that it would likely take several years to put a long-term funding solution in place and so identified two years of "bridge funding" that was used to accelerate efforts in the near term. The Council is recommending a similar approach to accelerate climate action, recognizing that joining a cap-and-invest program will take several years. Putting in place bridge funding also provides time for essential efforts to design and structure a cap-and-invest program in a manner that intentionally mitigates impacts on Vermonters facing financial hardship. It is important that any source of bridge funding has a nexus with climate action and supports the transition toward less carbon-intensive fuels (i.e., the revenue source should not involve taxing renewable energy or electric vehicles).

Another critical component in the Finance and Funding Pathway builds on recent climate infrastructure financing efforts. The Vermont State Treasurer, in collaboration with the

Climate Action Office and Climate Council, is exploring opportunities to further leverage both public and private capital. A key priority is to address and reduce the financial barriers Vermonters face in accessing and affording cleaner, more energy-efficient technologies, weatherization, and essential infrastructure improvements. While many climate investments may have meaningful upfront costs, they can often save Vermonters money in the medium and long terms. This pathway recommends using existing structures and institutions, such as credit unions and banks, to maximize the impact of programs, partners and capital. Additionally, to support this pathway, the Council recommends exploring innovative strategies such as on-bill utility financing, bonding, and insurance markets to broaden financial accessibility. Key stakeholders in this effort may include the Vermont Housing Finance Agency, the Vermont Bond Bank, economic development associations, distribution and efficiency utilities, credit unions, and pivotal state entities like the Public Utility Commission, among others. Through these collaborative efforts, the Finance and Funding Pathway provides direction to ensure that financial resources are effectively mobilized and coordinated to support climate action moving forward.

Conclusion

The update to the CAP's Cross-Cutting Pathways—Education, Workforce Development, and Finance and Funding—are pivotal in advancing Vermont's climate goals. Each pathway addresses critical aspects of climate action, from access to low-cost capital and educational initiatives to strengthening the workforce needed for a climate-resilient economy. The Finance and Funding Pathway focuses on coordinating financial investments in clean energy, resilience and adaption, while the Education Pathway emphasizes equipping Vermonters with the knowledge and skills necessary to engage in climate action. Workforce Development ensures that Vermont's labor force is both prepared and of sufficient size to meet the demands of a sustainable future, with targeted training and career pathways in clean energy and climate change–related fields. Together, these pathways provide an important foundation for the specific actions identified in Chapters 16 through 21 of this updated CAP.

14. Reducing the Emissions That Drive Climate Change

Two Drivers of Our Work: Climate urgency and economic affordability

During the past two years, as the Climate Council developed this CAP update, we witnessed—and in many cases personally lived through—a series of climate disasters in Vermont, across the U.S., and globally, reminding us again and again that the human and natural consequences of climate pollution are relentless and will continue to worsen.

As UN Secretary-General Antonio Guterres stated at the end of 2024, "This is climate breakdown—in real time. We must exit this road to ruin—and we have no time to lose."(90)

And Vermonters are still reeling from the high costs of climate disruption following disastrous flooding events across the state in the summers of 2023 and 2024.

In enacting the GWSA the General Assembly recognized, alongside many other states, cities, and nations, that every government needs to accept a measure of responsibility to reduce harmful climate emissions. This has been an enacted goal in Vermont since 2005, and a legal obligation since 2020, and has guided the Council in the preparation of this CAP.

A second main driver of the mitigation actions in this CAP is a concern for affordability. We must reduce emissions, but we must also consider the economic impacts and benefits of our solutions with policies and approaches that maximize cost savings to Vermonters and the Vermont economy.

90 United Nations/Guterres New Year Message, December 30, 2024.

As we considered the costs of climate action, we have also considered the high costs to Vermonters of inaction. Vermont's fossil fuel bill has averaged over $2.2 billion per year over the last four years, in the same range as the state's budget for K-12 education.[91] Since 2021, the first full year after the GWSA was passed, Vermonters have paid nearly $9 billion to import fossil fuels, mostly for transportation and heat. About 75% of that money has left the state's economy.[92]

The policies in this CAP are aimed at reducing Vermont's high annual fossil fuel bills by financing greater efficiency in homes, vehicles and businesses. We emphasize that the transition process should proceed at a pace that is achievable, that grows over time, and that delivers long-term cost savings to rural and lower-income Vermonters, while moderating even short-term cost effects.

Getting the Structure Right: Why one or more high-level policy drivers are needed in the transportation and thermal sectors

There is a well-known principle in public policy known as the "tyranny of the status quo," describing how the beneficiaries of existing public policies and embedded market patterns make it difficult to enact structural reforms.[93] Vermont's continuing dependence on fossil fuels is an example of this problem.

Vermonters can rightly take pride in our historic initiatives to reduce energy burdens and fossil fuel emissions. But progress has been piecemeal and too slow. To meet the commitments made in the Paris Agreement and Vermont law, and to substantially reduce fossil fuel bills, high-level policy drivers are needed.

Across the globe, the most successful large-scale energy transitions have been driven by two types of policies: performance standards and quantitative pollution caps. We recommend that the Legislature and administration continue to examine these options to reduce emissions while creating a reliable revenue source to help Vermonters transition away from fossil fuels.

Vermont has plenty of positive examples that such drivers can succeed over time. Think of the decades of experience we have with wastewater cleanup, energy efficiency obligations, and renewable electricity.

91 Energy Action Network. Fuel Sales in Vermont: What the Latest Data Mean for the State Economy, Vermont Consumers, and GHG Emissions Reduction Commitments. April 2025.

92 In 2022 alone, nearly $2 billion of the approximately $2.6 billion in total fossil fuel spending in Vermont left the state economy. In 2023, $1.7 billion spent on fossil fuel left the state. Annual Progress Report for Vermont 2023 and Annual Progress Report for Vermont 2024, Energy Action Network.

93 See Milton Friedman and Rose D. Friedman, Tyranny of the Status Quo (New York: Harcourt Brace Jovanovich, 1984). Although Milton Friedman was a leading conservative economist, the book argues that the power of the status quo tends to block reforms whether viewed as moving in a "liberal" or "conservative" direction.

We do not recommend adopting performance standards or carbon caps at any cost or regardless of impacts on consumers. Instead, we recommend approaches that can double as consumer-protection initiatives, helping Vermonters with lower and middle incomes to save money and come out ahead. This aligns well with the just transition principles of the GWSA. For example, a cap-and-invest program can provide direct financial relief or rebates to low- and middle-income households, while also supporting investments in low-emitting vehicles and heating systems.

Lowering Climate Pollution: A suite of recommended actions

While needed to drive change over time, an overarching policy is unlikely to succeed as a stand-alone initiative. It needs to build upon and help coordinate a suite of supporting policies.

To reduce climate pollution in a complex society, there is no single “silver bullet” solution. But even within the category called “silver buckshot” there is a huge range in scale among different sectors, markets and opportunities.

In Vermont the two largest emitting sectors by far are transportation (39% of Vermont’s emissions) and buildings (31%), so recommendations focus on reducing emissions and costs there.

Industrial processes (8%) and waste management (3%) are smaller-emitting sectors but are covered as well. Agricultural emissions (16%) are addressed elsewhere.

Electric generation (3% of in-state emissions) contributes a small fraction of Vermont’s climate pollution. We recommend continued progress on renewable electricity. We also recommend prioritizing strategies that build on our clean power portfolio, recognizing that electrification is crucial to lowering fossil emissions from vehicles and heating. We recommend actions in the power sector that will accelerate electric solutions generally.

The suite of recommendations in the 2025 update necessarily focuses on actions that should be taken by state agencies, including the agencies of Natural Resources and Transportation, the Department of Public Service and the Public Utility Commission. Some, but not all, of these recommendations would require legislative action.

The task of the Climate Council, according to the GWSA, is to recommend actions by which Vermont could do its share to avoid the worst consequences of climate disruption and, instead, create more adaptive, resilient communities. We recommend doing so through strategies that are realistic, affordable and equitable. We conclude that the mitigation goals of the GWSA can be met with a program of investments in buildings, vehicles, heating and other strategies that would also save Vermonters billions of dollars in fossil fuel costs in coming decades.

15. Scientific Underpinning of Emissions Reductions

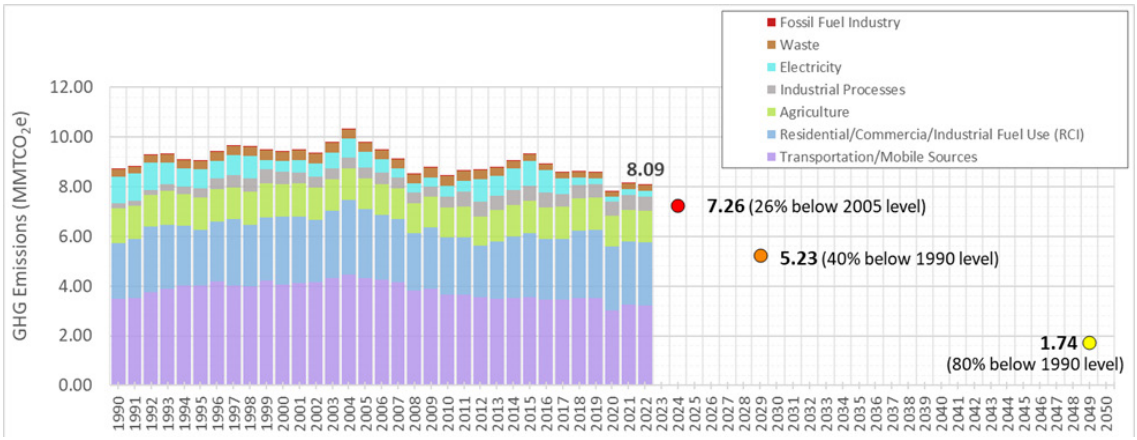
In drafting this update to the CAP, the Agency of Natural Resources produced or commissioned the following reports and technical studies, prioritized by the Climate Council, that sought to clarify and improve our understanding of key components of climate action.

Greenhouse Gas Inventory Review and Forecast

The *Vermont Greenhouse Gas Emissions Inventory and Forecast*[94] (GHG Inventory) is published annually by the Agency of Natural Resources, as required by Vermont statute 10 V.S.A. § 582 and following guidelines for GHG accounting from the Intergovernmental Panel on Climate Change and Environmental Protection Agency. The GHG Inventory establishes 1990 and 2005 baseline GHG levels for Vermont and tracks changes in GHG emissions through time. The GHG Inventory is the primary means of determining progress toward Global Warming Solutions Act (GWSA) statewide emissions reduction obligations. It is important to note that, historically, there has been a three-year lag in emissions inventory reporting, primarily due to delays in calculating agriculture sector emissions (i.e., the GHG Inventory covering 1990–2022 emissions was published in 2025).

94 Vermont Agency of Natural Resources. Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2022. July 2025.

FIGURE 15.1: Vermont Greenhouse Gas Inventory historical emissions and future requirements.[95]



Vermont's annual statewide GHG emissions from 1990 through 2022 are shown by sector in Figure 15.1 as reported in the GHG Inventory. The dots indicate the maximum statewide emissions, consistent with the GWSA requirements, to be achieved by January 1 of 2025, 2030, and 2050.

Beginning in 2024, a supporting companion document was published with the annual GHG Inventory, detailing the methodologies and data used to inform the Inventory. This methodology document also discusses data and methods for supplemental analysis related to Land Use, Land-Use Change and Forestry (LULUCF) sources and sinks, providing links to relevant reports. The Science and Data Subcommittee of the Climate Council is responsible for reviewing and providing feedback on any updates to the inventory methodology. To ensure that Vermont fulfills its legal obligations, it is important that our tracking methods continue to be as transparent and accurate as possible.

Vermont Pathways/LEAP

In support of the 2020 *Vermont Comprehensive Energy Plan* and the 2021 *Initial Vermont Climate Action Plan,* the State of Vermont commissioned development of the Vermont Pathways model in the Stockholm Environment Institute's Low Emission Analysis Platform (LEAP). In contrast to the GHG Inventory which presents historical emissions, the Vermont Pathways model utilizes existing data and projections of activity across a wide range of economic sectors to forecast emissions of GHGs and other pollutants. It includes representations of numerous GHG reduction measures, including data related to their installation and operational costs and their energy use. The model includes a baseline case (often referred to as "business as usual") that projects future emissions based on the ongoing effects of current policies as well as scenarios developed from

95 Vermont Agency of Natural Resources. Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2022. July 2025, updated August 2025, p. 7.

that baseline designed to explore the changes in emissions and costs of implementation of different approaches to reduce emissions. The model also provides annual and total estimates of key indicators, (e.g., number of weatherization projects completed, number of electric vehicles in service, and number of heat pumps installed) necessary to achieve the emissions target for a given scenario.

Vermont Pathways 2.0 was the version supporting the 2021 Climate Action Plan. Since then, the model has been significantly updated twice. In 2023, it was updated to version 3.27 in support of the Analysis of Buildings/Thermal Energy Sector Emissions Reduction Policies for Vermont (discussed below), and in 2025 it was updated to version 4.69 in support of the CAP update.

This 2025 update includes a comprehensive update of the baseline scenario assumptions for all the sectors represented in the model, which mirror the sectors accounted for in the GHG Inventory. The model results presented below were provided to the Agency of Natural Resources just as this CAP was being published and have not been reviewed by the Climate Council.

The updated baseline incorporates two changes from the previous version worth noting. First, the calibration factors for each sector were updated so that modeled emissions aligned with reported emissions from the 2024 GHG Inventory.

Second, implementation of the Advanced Clean Cars II and Advanced Clean Trucks regulations was removed from the baseline scenario due to uncertainty regarding the waiver granted to California, and by extension to other states, to allow those regulations to become effective. As a result, emissions are 0.887 million metric tons carbon dioxide equivalent (MMT CO_2e) / 13.4% higher in 2029 and 0.420 MMT CO_2e / 8.8% higher in 2049 as compared to the previous version of the baseline scenario.

The update also includes four mitigation scenarios. These scenarios implemented the 26 mitigation measures[(96)] represented in the model on different schedules in order to explore the potential effects on emissions reduction trajectories and net costs or savings. These scenarios and their emissions reductions relative to 1990 emissions, along with the GWSA target reductions and the revised baseline reductions, are presented in Table 15.1.

96 Mitigation measures are: increased behind-the-meter solar PV, B100 in heavy-duty vehicles, manure management, wastewater methane abatement, ozone-depleting substances substitution, semiconductor manufacturing measures, enhanced agricultural soil sequestration, reduced enteric fermentation, commercial building advanced wood heat, fossil water heating phase-out by 2040, fossil cooking phase-out by 2040, district heating projects, commercial building heat pumps, managed EV charging, residential building heat pumps, E15 ethanol blending in gasoline, vehicle-to-grid technology, B20 biodiesel, B100 heating fuel, sustainable aviation fuel, B100 for industrial processes, renewable natural gas for industry, biogas, light duty internal combustion motor vehicle sales phase-out by 2035, vehicle miles traveled reductions, weatherization at scale.

TABLE 15.1: Greenhouse Gas Emissions Percent Reductions Compared to 1990.[97]

Scenario	2029	2034	2049
GWSA requirement	40%	N/A	80%
Baseline	14%	26%	41%
Scenario 1: All mitigation measures implemented over the entire modeling period (2024–2050)	29%	53%	78%
Scenario 2: Societally cost-effective measures[98] implemented over the modeling period, with non-cost-effective measures implemented 2039–2050	25%	44%	72%
Scenario 3: Implementation of societally cost-effective measures through 2050	28%	49%	69%
Scenario 4: Societally cost-effective measures plus weatherization implemented over the entire modeling period, with the remainder of the non-cost-effective measures implemented 2039–2050	25%	44%	72%

The results of the scenario analysis illustrate the challenge with achieving the 2030 requirement currently established in state statute. Scenarios 2, 3, and 4 also present the progress anticipated by 2035 to provide context for the impact of implementation over time.

Although Scenario 1 fully implements all 26 of the mitigation measures represented in the model in all sectors, as noted above, the emissions reductions achieved are less than the GWSA emissions reduction requirements for both 2030 and 2050. To achieve a 40% reduction by 2030 would have required increasing the assumed measure adoption/implementation rates for one or more mitigation measures. Tables showing the level of implementation of selected measures are presented later in this section. This scenario results in cumulative savings of $6.06 billion in 2050 as compared to the baseline scenario, with the primary benefit being savings from avoided fuel costs. This scenario becomes net cost beneficial in 2031. In 2030 it is $9 million more costly than the baseline.

Scenario 2 delays implementation of measures that are not cost-effective until 2039. This results in a 44% reduction by 2035 with cumulative savings of $2.65 billion as compared to the baseline. Cost savings as compared to baseline in 2050 are $7.52 billion, approximately 25% more than Scenario 1.

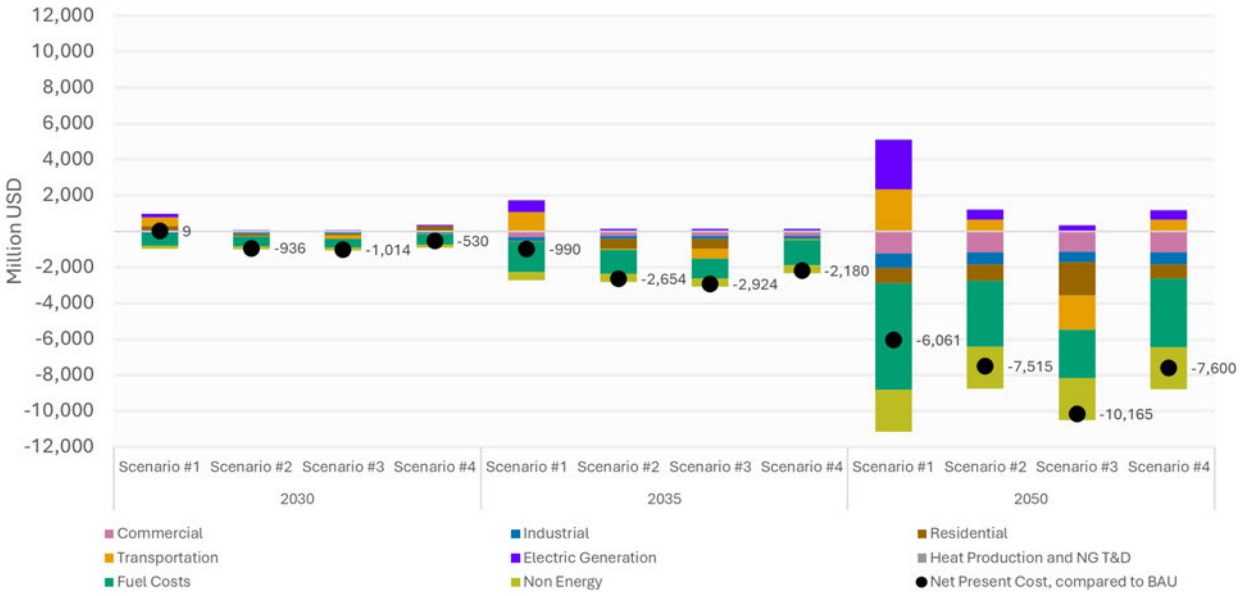
97 Updated by Vermont Pathways 4.69, July 2025.

98 Social cost includes measure implementation costs, operational costs or savings as compared to baseline, and the social cost of avoided GHGs. Societally cost-effective mitigation measures are increased behind-the-meter solar PV, B100 in heavy-duty vehicles (implemented 2034–2050), B100 heating fuel, B100 for industrial processes, B20 biodiesel, sustainable aviation fuel, E15 ethanol, manure management, wastewater methane abatement, ozone-depleting substances substitution, semiconductor manufacturing measures, enhanced agricultural soil sequestration, reduced enteric fermentation, commercial building advanced wood heat, fossil water heating phase-out by 2040, fossil cooking phase-out by 2040, district heating projects, commercial building heat pumps, managed EV charging, residential building heat pumps.

Scenario 3 implements only societally cost-effective measures over the entire modeling period. As expected, this results in the greatest net savings of all scenarios: $1.01 billion by 2030, $2.92 billion by 2035, and $10.17 billion by 2050. This scenario does not achieve a 40% reduction until 2032 and does not achieve the 80% reduction by 2050 target.

Scenario 4 adds weatherization retrofits to the list of cost-effective measures being implemented over the entire modeling period. This scenario results in nearly identical emissions reductions as compared to Scenario 2 in all years. Including weatherization projects throughout the modeling period results in cumulative net savings by 2035 of $2.18 billion, approximately $474 million less than Scenario 2. However, the effect of early weatherization projects results in cumulative net savings by 2050 of $7.6 billion, $85 million greater than Scenario 2.

FIGURE 15.2: Costs/savings of scenarios versus baseline, including social costs of GHGs.[99]



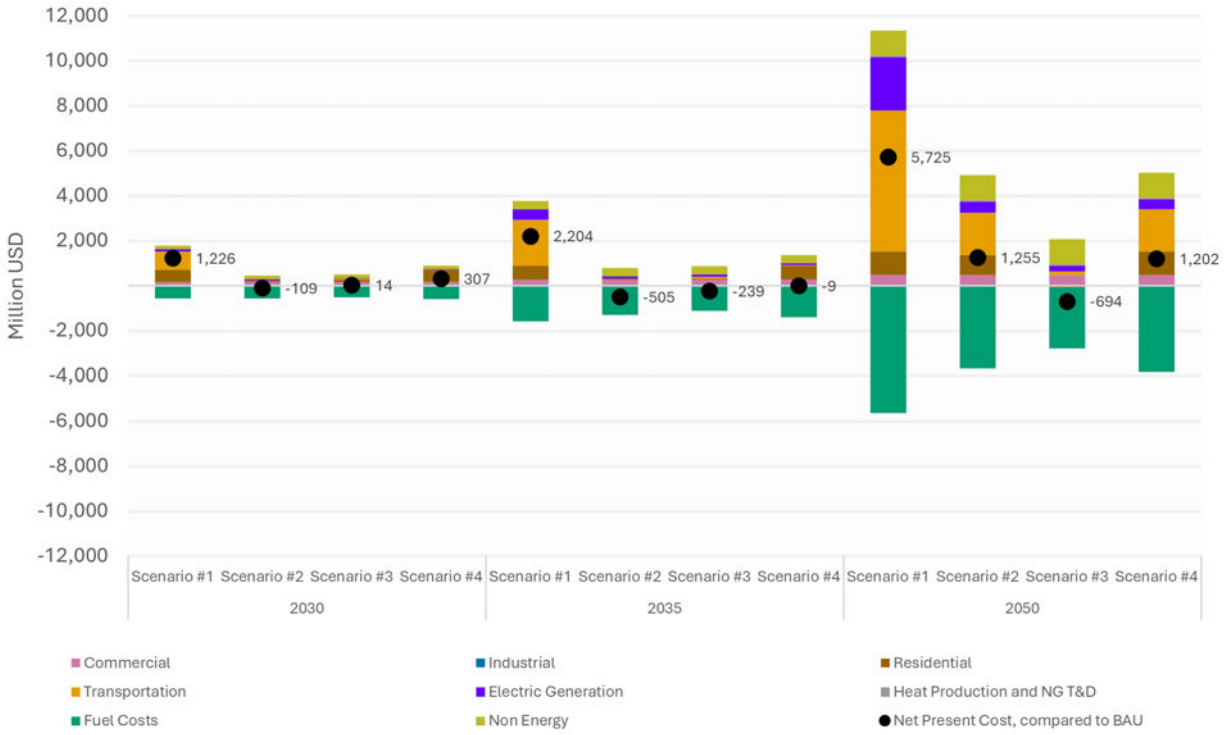
Note that the costs/savings results from the model are inclusive of the social cost of GHGs, which is described in more detail below. Among the costs that the social cost of GHGs estimates are the increased costs due to negative health outcomes related to pollutant emissions, but those costs are not specific to Vermont. In addition, several measures (e.g., weatherization, EVs) produce health benefits to Vermonters that are not related to GHG emissions. Those benefits were not included in the benefit-cost analysis. However, a health benefits study performed in support of a prospective regional transportation sector cap-and-invest program in the northeast U.S. concluded that positive health outcomes would likely result from decreased combustion emissions from motor vehicles and an increase in non-motorized transport modes.[100]

99 Updated by Vermont Pathways 4.69, July 2025.

100 Fallon Lambert, K. et al, "Air Quality, Health and Equity Impact Assessment of the Transportation Climate Initiative", American Geophysical Union, Fall Meeting December 2020.

Given that the social cost of GHGs estimates the avoided costs of emissions that accrue to society worldwide over decades, the cumulative net cost analysis was performed minus that adjustment in an effort to present a rough estimate of the costs/savings at the state scale of the various mitigation scenarios. The analysis likely overestimates costs to some extent as there are benefits embedded in the social cost of GHGs that do accrue to Vermonters, but development of state-level cost of GHG emissions values was beyond the scope of this modeling effort. As expected, net costs increase in all scenarios as compared to the analysis with the social cost of GHGs included. Scenario 3 (cost-effective measures) results in net benefits from 2030 onward with $1.66 billion in net benefits by 2050. Scenario 2 (delayed implementation) is net beneficial by 2030 and 2035 but has cumulative net cost of $1.26 billion by 2050. Scenario 4 has a net cost of $307 million by 2030, is net beneficial with $9 million in net savings by 2035, and has a cumulative net cost of $1.2 billion by 2050. Scenario 1 shows net costs over the entire modeling period, with a cumulative net cost of $5.73 billion by 2050—over four times the average net cost of Scenario 2 and Scenario 4 ($1.23 billion).

FIGURE 15.3: Costs/savings of scenarios versus baseline, excluding social costs of GHGs.[101]



Indicators from the two sectors (see Table 15.2 to Table 15.5) that make up the majority of the state's emissions—transportation and residential/commercial/industrial heating—illustrate the level of adoption of mitigation measures necessary to achieve the emissions reductions noted above.

101 Updated by Vermont Pathways 4.69, July 2025.

TABLE 15.2: EV/PHEVs.[102]

	Number of Vehicles				Percent of Fleet			
	2025	**2029**	**2034**	**2050**	**2025**	**2029**	**2034**	**2050**
Baseline	21,870	66,543	153,342	281,920	4.0%	12.2%	29.3%	64.0%
Scenario 1	22,633	79,075	187,724	418,759	4.1%	14.5%	35.9%	95.0%
Scenario 2	21,870	66,543	153,342	339,341	4.0%	12.2%	29.3%	77%

TABLE 15.3: Heavy-Duty EV/PHEVs.[102]

	Number of Vehicles				Percent of Fleet			
	2025	**2029**	**2034**	**2050**	**2025**	**2029**	**2034**	**2050**
Baseline	510	784	1,957	4,246	1.0%	1.4%	3.3%	6.7%
Scenario 1	793	4,727	15,044	51,343	1.5%	8.3%	25.1%	80.1%
Scenario 2	525	834	2,050	20,878	1.0%	1.5%	3.4%	32.9%

TABLE 15.4: Residential Weatherization Retrofits.[102]

	Average Annual Retrofits				Cumulative Retrofits			
	2025	**2026–2029**	**2030–2034**	**2045–2049**	**2025**	**2029**	**2034**	**2049**
Baseline and Scenario 3	5,845	3,969	2,254	2,199	5,845	21,722	32,992	65,719
Scenarios 1 and 4	11,613	11,613	7,262	6,174	11,613	58,064	94,373	186,987
Scenario 2	2,345	2,345	2,345	20,591	2,345	11,726	23,452	166,243

TABLE 15.5: Heat Pump Installations.[102]

	Average Annual Housing Units Switching to Heat Pumps				Cumulative Retrofits			
	2025	**2026–2029**	**2030–2034**	**2045–2049**	**2025**	**2029**	**2034**	**2049**
Baseline	5,003	1,118	4,927	2,362	5,003	9,474	34,108	96,430
Scenario 1	6,018	1,859	5,973	3,147	6,018	13,452	43,317	117,502
Scenario 2	5,251	1,086	5,558	3,759	5,251	9,594	37,384	117,049
Scenario 3	5,538	1,218	5,552	3,242	5,538	10,409	38,168	113,721

102 Updated by Vermont Pathways 4.69, July 2025.

Marginal Abatement Cost Analysis

This report,[103] released in 2022, provided additional analysis and information on the emissions abatement potential and costs for each of the mitigation measures represented in the original version of the Vermont Pathways model. The analysis examined two timeframes. The first scenario implemented the measures only through 2030 but accounted for savings realized through 2050. The second implemented the measures through 2050 and accounted for savings and costs through 2050. The results showed a wide range of both emissions reduction potential for each measure and their cost. Three measures, all in the residential sector (fossil cooking phase-out, fossil water heating phase-out, and heat pump space heating) had savings in the range of $140 to $400 per metric ton reduction in both scenarios. Two transportation measures (internal combustion sales phase-out by 2035 and E15 motor fuel) had costs ranging from $0.32 to $50.04 per metric ton reduction in both scenarios. Four measures across three sectors (transportation, residential, industrial) had costs ranging from $132 to $972 per metric ton reduction. Two residential sector measures (weatherization at scale and advanced wood heating) had significant savings in the 2030 scenario but significant costs in the 2050 scenario, due in part to decreasing opportunities for savings for measures implemented after 2030 due to ongoing decarbonization of energy.

Analysis of Buildings / Thermal Energy Sector Emissions Reduction Policies for Vermont

In 2023 the Agency of Natural Resources (ANR) released a study[104] of a suite of policies for reduction of GHG emissions in the buildings/thermal energy sector. The study utilized the Vermont Pathways model and several external spreadsheet workbooks to explore the efficacy and comparative cost of three overarching policy options (expansion of existing programs in the buildings/thermal energy sector, a clean heat standard, and a cap-and-invest program) under two different emissions trajectory scenarios (40% reduction in emissions from 1990 level by 2030, and the same reduction by 2035). It also examined a bundle of regulatory measures that would achieve the 40% reduction in emissions by 2030. The study made several findings, including:

- Achieving reductions was made easier due to availability of federal and state funding; however, additional policies and programs were required to meet emissions reduction targets.
- Many of the emissions reduction measures considered would reduce energy costs for consumers that are able to implement them.
- The cost of fossil fuels would need to increase to recover program costs.

103 Energy Futures Group. Marginal Abatement Cost Curves: Examining the Mitigation Potential and Cost per Tonne of Emissions Reductions of Measures in the Vermont Pathways Analysis. September 2022.

104 Energy Futures Group, Stockholm Environment Institute, The Cadmus Group. The Analysis of Buildings / Thermal Energy Sector Emissions Reduction Policies for Vermont. November 2023.

Transportation Carbon Reduction Strategy

In 2023 the Vermont Department of Transportation (VTrans) released its *Carbon Reduction Strategy*,[105] analyzing a collection of mitigation measures in the transportation sector to understand how current programs affect GHG emissions and to assess future policy options and investment strategies toward the reduction of transportation emissions. The baseline forecast from this analysis indicated transportation sector emissions in carbon dioxide equivalents would be 0.4 million metric tons over the transportation sector's target emissions to achieve a 40% reduction from 1990 levels by 2030, and 0.1 million metric tons over the 80% reduction by 2050. The majority of transportation emissions are from, and are forecast to continue to be from, motor vehicles (cars and trucks) operating on Vermont's roadways. The study concluded that achieving transportation sector emissions reductions consistent with the Global Warming Solutions Act targets requires measures beyond the simple expansion of current programs and projects. Development and implementation of additional innovative policies and programs is necessary to move toward more rapid decarbonization.

Life Cycle Emissions Study

Act 18 of 2023, the Affordable Heat Act, amended statute 10 V.S.A. §582 (greenhouse gas inventories; registry) to require an annual supplemental accounting of upstream and lifecycle GHG emissions from liquid, gaseous, solid geologic and biogenic fuels combusted in Vermont. Subsequently, the ANR commissioned an analysis of the lifecycle emissions from sources of energy, both electricity and thermal, used in Vermont. The study, *Vermont Energy Sector Life Cycle Assessment*,[106] was delivered in April 2024 and updated June 2025. The analysis combined emissions from the existing *Vermont Greenhouse Gas Emissions Inventory and Forecast* for the energy sector with the upstream emissions occurring due to use of energy in the state to determine total Vermont energy sector lifecycle emissions for the time series 1990–2020. It concluded that the percentage of total energy sector emissions from upstream sources ranges from 17% to 21%.

Upstream emissions from petroleum products were consistently the highest contributor to the transport and residential/commercial/industrial sectors.

Clean Heat Standard Assessment of Thermal Sector Carbon Reduction Potential in Vermont (CHS Potential Study)

The Affordable Heat Act (Act 18 of 2023) required the Department of Public Service to undertake a study to assess and quantify the technical, economic, and maximum achievable potential for GHG emissions reductions in the building thermal energy sector.

105 Vermont Agency of Transportation, Cambridge Systematics. Vermont Transportation Carbon Reduction Strategy. November 2023.

106 Eastern Research Group, Vermont Agency of Natural Resources. Vermont Energy Sector Life Cycle Assessment (1990 – 2022). June 2025.

In September 2024, the department's contractor, NV5, delivered its report[107] which analyzed those three scenarios and a fourth scenario that prioritized implementation of cost-efficient lifecycle emissions reductions to meet the sector reductions specified in Act 18. The study developed a mix of mitigation measures that achieved the 2030 and 2050 building thermal sector proportional share of the reductions required in Vermont's Global Warming Solutions Act. This scenario relied heavily on a rapid transition to biofuels in the short term to achieve the 2030 reductions, coupled with a steadily increasing number of buildings switching to heat pumps to achieve the 2050 target. The estimated cumulative societal net benefits of this scenario were $124 million through 2029 and $2.14 billion through 2049. The majority of the benefits are generated by avoided social, economic and environmental damages and avoided fossil fuel (fuel oil and propane) consumption, while the majority of the costs are due to incremental costs of mitigation measures (e.g., costs associated with heat pump installation) and increased consumption of biofuels and renewable fuels.

The report also included an analysis of the Vermont workforce's ability to deliver clean heat measures. While the results vary by measure, in general the state's clean energy workforce will require expansion through 2049, with the most significant need being for single-family home weatherization workers.

Cap-and-Invest Study

In early 2025 VTrans released a study,[108] developed cooperatively with ANR, analyzing the effect of Vermont's participation in a multi-jurisdictional cap-and-invest program covering the state's transportation sector and potentially the thermal energy sector. The two candidate programs considered were the linked California and Quebec programs (the Western Climate Initiative or WCI) and the prospective New York Climate Initiative (NYCI). The study concluded that Vermont's participation in either of these programs would support additional progress toward meeting the state's emissions reduction targets. However, due to the time required to develop and promulgate regulations, develop other program support measures, and ultimately link with another program, a cap-and-invest program would not enable Vermont to reduce emissions to the level required by the GWSA by 2030. As directed by statute, the Treasurer's Office reviewed this study. The Treasurer's Office recommended Vermont not consider joining WCI at this time, given concerns about work needed to insulate low- and middle-income Vermonters from the resulting increased fuel costs, but rather wait for and analyze the details of the NYCI when they become available.

107 Vermont Public Service Department. Thermal Sector Carbon Reduction Potential Study. September 2024.

108 Cambridge Systematics. Assessment of a Cap-and-Invest Program for Vermont. January 2025.

Social Cost of Greenhouse Gases

Background

As part of the *Initial Vermont Climate Action Plan* (CAP) adopted by the Climate Council in December of 2021, estimates of the Social Cost of Carbon and of other GHGs were recommended for use in Vermont.[109] At the time the Initial Plan was adopted, the federal government was in the midst of a comprehensive update to Social Cost of Greenhouse Gases (SC-GHG) estimates to reflect the latest science.

The SC-GHG puts a dollar value on the harm caused by releasing one ton of GHGs into the air. The SC-GHG estimates the value of all future climate impacts (both negative and positive)—like farm productivity, health effects, flood damage and other forms of extreme weather, energy disruptions, conflicts, migration, and ecosystem harm—on society worldwide.

However, current estimates miss some impacts because of data gaps and modeling limits. When certain damages can't currently be quantified, they're essentially counted as zero. This means the real cost of climate pollution is likely higher than is currently reflected in the SC-GHG. The SC-GHG gives policymakers a way to compare the economic benefits of cutting emissions against the costs of climate action, though the true benefits are probably underestimated.

Adopted Recommendation

Based on the Environmental Protection Agency's updated Social Cost of Greenhouse Gases (SC-GHG) estimates developed in response to the National Academies of Sciences, Engineering, and Medicine (NASEM)'s recommendation to incorporate the latest science in estimates of SC-GHG values, and consistent with the 2021 Initial Plan recommendation to "update the Social Cost of Carbon and discount rate on a regular basis, taking into account new research," the Science and Data Subcommittee unanimously advanced, and the Climate Council unanimously adopted, the following recommendations:

- Vermont should utilize the EPA's updated SC-GHG estimates as provided in the *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* from November 2023, for benefit cost analysis of activities that impact GHG emissions and for GHG emissions-related rules adopted or amended pursuant to 10 V.S.A. chapter 24 and the Climate Action Plan.

The EPA's *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* from November 2023 shares SC-GHG estimates calculated with 1.5%, 2%, and 2.5% discount rates, with 2% selected as the central discount rate. For clarity, we recommend a central discount rate of 2%, as used by the EPA and

109 See Initial Vermont Climate Action Plan, pg. 52-55. Vermont Climate Council. December 2021.

recommended by a leading panel of economists in the United States.[110] While the estimated social cost per ton of emissions varies by GHG and the year it is emitted, for reference, the 2023 EPA report establishes an estimated social cost of $190 per ton of carbon dioxide emitted in 2020 when utilizing a 2% near-term discount rate.[111], [112]

The Science and Data Subcommittee of the Vermont Climate Council will continue to track the latest and most relevant scientific literature regarding the social cost of GHG estimates, including any updates released by the federal Interagency Working Group on the Social Cost of Greenhouse Gases or its successors that are in line with NASEM recommendations. What Vermont uses for SC-GHG should continue to be based on NASEM recommendations and the best available science.

110 Rennert, K., Errickson, F., Prest, B.C. et al. Comprehensive evidence implies a higher social cost of CO2. Nature 610, 687–692 (2022).

111 Environmental Protection Agency. Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances pg. 4. November 2023.

112 Note: for comparison, among the Social Cost of Carbon values adopted as part of the Initial Vermont Climate Action Plan (2021), the estimated social cost of carbon dioxide emitted in 2020 when utilizing a 2% near-term discount rate was $121 per ton.

16. Transportation Pathways for Mitigation

Challenges and Opportunities in the Transportation Sector

The Implications of Fossil Dependence in a Rural State

Transportation—the movement of people and goods—is essential to the state's economy and Vermonters' quality of life. Due to the state's rural character and low population density, Vermonters depend primarily on personal vehicles—as opposed to public transit—to get them where they need to go. Over 97% of those vehicles rely on fossil gasoline and diesel fuels. This combination of factors makes transportation Vermont's largest source of climate pollution, now 39% of our GHGs.[113] It is also a significant reason why Vermont emits more GHGs per capita than any other state in New England.[114] Transforming the state's transportation system with cleaner vehicles and multiple transportation options to support getting where people need to go is essential to meeting the emissions reduction requirements of the Global Warming Solutions Act (GWSA). In addition, cleaner, more multi-modal transportation options can have significant public health benefits (and cost savings) by reducing exposure to the air pollutants caused by gasoline and diesel burning and by expanding active modes of transportation.[115]

113 Vermont Agency of Natural Resources. Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2022. July 2025.

114 Energy Action Network. Assessing Vermont's climate responsibility: A comparative analysis of per capita emissions. March 2025.

115 Vermont Department of Health. Improving Health Through Transportation. December 2019.

Vermont families and businesses spend more than $1 billion per year on fossil fuels for transportation, representing about 45% of Vermont's total annual fuel bill.[116] Electric vehicles (EVs) are inherently more energy-efficient than conventional combustion vehicles, so as more Vermonters transition to EVs, we expect to see reduced transportation emissions and transportation fuel and maintenance costs for EV drivers.[117] Policies to accelerate that transition are key elements in this CAP.

Lower-income Vermonters spend a greater proportion of their incomes on energy than upper income families. Transportation costs—primarily through owning, operating and maintaining a vehicle—make up about 45% of total energy expenditures for the average Vermont household. And because energy expenditures constitute a greater percentage of the household budget of lower-income Vermonters, this reality places a disproportionate economic burden on these households.[118] Transportation recommendations in this CAP also aim to improve energy equity through thoughtful program design, incentives or new and expanded programs.[119]

Research also highlights that vehicle ownership is a significant requirement for job access and retention for lower-income Vermonters.[120] Research found that "possession of a driver's license and a car was a stronger predictor of leaving public assistance than even a high school diploma," which speaks to the importance of vehicle access and ownership as an important justice issue.[121]

While the operating costs of electric vehicles are lower on an annual basis, the often higher upfront cost of electric vehicles presents a barrier to getting EVs into the hands of households that can benefit most from the long-term cost savings. The relatively high cost of EVs and the limited number of pre-owned EVs available for purchase in Vermont means that EV uptake among lower-income households has been lower than among more affluent households.

Finding a continued source of funding for upfront incentives is essential to expanding the uptake of EVs among energy-burdened households in the state.

116 Energy Action Network. Fossil Fuel Sales in Vermont. April 2025.

117 At current average electricity rates in Vermont, electric vehicles can be fueled at approximately half the cost of gasoline vehicles, EAN 2024 Annual Progress Report. The size of the EV cost advantage will vary depending on changes in the price of electricity relative to the prices of gasoline and diesel fuel. Policies that limit avoidable increases in the price of electricity are an important factor in promoting electric vehicles and beneficial electrification generally.

118 Efficiency Vermont. 2023 Vermont Energy Burden Report. August 2023.

119 Vermont Department of Public Service. 2021 Annual Energy Report A summary of progress made toward the goals of Vermont's Comprehensive Energy Plan. January 2021.

120 Vermont Agency of Human Services, Department for Children and Families. Evaluation of Reach Up. January 2020.

121 Sierra Club Wisconsin Chapter. Arrive Together: Transportation Access and Equity in Wisconsin. October 2018.

Transportation Strategies to Lower Costs and Reduce Climate Pollution

The GWSA requires us to take a comprehensive look at the pathways needed to reduce climate pollution, fuel costs and energy burdens. In the transportation sector as in the other sectors covered in the CAP, there is no single "silver bullet" policy to meet these goals. Achieving these goals will require short-term actions to sustain funding as well as serious consideration of trade-offs inherent in each policy decision. This CAP covers the sector broadly by recommending four key pathways:

1. Adopt a **cap-and-invest program,** including the transportation sector, to achieve GWSA obligations and create a sustainable revenue source for carbon- and cost-reducing transportation programs. We emphasize that provisions to ensure equity in the design of the cap and in the distribution of benefits are essential elements of the cap-and-invest program that the CAP recommends.
2. Reduce GHGs through **performance standards for vehicles.**
3. Lower the **carbon intensity of fuels.**
4. Reduce **dependence on private vehicles** through smart land-use strategies and multi-modal transportation programs.

Together, these strategies will not only improve health outcomes and save Vermonters money but also set the state on a course to reduce transportation-related carbon pollution and more equitably shift to a cleaner, more accessible transportation system.

Pathway 1: Join a multi-jurisdictional cap-and-invest program covering transportation fuels and emissions

Vermont has made progress in transportation sector regulatory policy since *the Initial Vermont Climate Action Plan* was adopted, particularly with the adoption of California's Advanced Clean Cars II and Advanced Clean Trucks standards (see Pathway 2 below). However, these new vehicle performance standards (which would apply, by definition, only to new vehicles purchased in Vermont or another participating state) are not yet in effect. There is also a possibility that these rules will be delayed or their implementation barred by policy changes at the federal level. In sum, the clean cars programs are important but insufficient on their own to meet the GWSA's emissions reduction requirements.

To make needed progress, Vermont must advance a primary regulatory or policy tool to reduce emissions—equitably and with certainty—in line with the obligations of the GWSA. The Climate Council has identified preparing for and joining a carbon cap-and-invest program, such as the Western Climate Initiative (WCI) or the New York Cap-and-Invest

Initiative (NYCI), as the preferred approach to meeting the GHG emissions obligations in the GWSA.[122] Vermont has successfully participated in a similar cap-and-invest program for the power sector, the Regional Greenhouse Gas Initiative (RGGI), since 2009.

At the same time, there is recognition that additional policies will be needed to accelerate the pace of low-emissions vehicle sales, to enhance public transportation options, to deploy electric vehicle charging points and to provide transportation assistance to lower-income Vermonters. As this CAP is being written, we do not know the details of the NYCI program. However, we do know that participating in a cap-and-invest program could be a powerful means of reducing climate pollution, lowering overall transportation costs, and supporting more equitable transportation options.

As re-affirmed by the Vermont Climate Council in November 2022, it remains clear that:

> *The only currently known policy options for which there is strong evidence from other states, provinces and countries of the ability to confidently deliver the scale and pace of emissions reductions that are required of the transportation sector by the GWSA are one or a combination of: a) a cap and invest/cap and reduce policy covering transportation fuels and/or b) a performance standard/performance-based regulatory approach covering transportation fuels.*[123]

In this CAP, the Council continues to support this conclusion. The Council, however, also points to two reports since this 2022 statement that help provide more guidance on the ability of a cap-and-invest initiative to deliver the scale and pace of emissions reductions envisioned under the GWSA. One report is a technical study presented in early 2025.[124] In addition, the Office of the State Treasurer issued a report responding to the technical work.[125]

That is why, in this pathway, we recommend taking both administrative and legislative steps to monitor cap-and-invest options and undertake the necessary steps for Vermont to join a program, including: establishing the necessary reporting system within the Agency of Natural Resources (ANR) so that sales data and emissions rate baselines can be set; designing tools to address affordability concerns; and readying the State of Vermont to receive and deploy potential program proceeds. These steps and others will support Vermont in joining a multi-state cap-and-invest program and should begin as soon as possible.

122 The Western Climate Initiative stated in spring 2025 that it was not currently accepting new members, and New York has yet to implement its initiative. As of the writing of this plan, there is not an immediate opportunity for Vermont to join a multi-state cap-and-invest program. However, this plan calls for taking the steps needed to join such a multi-state initiative in the future. The Council also recommends taking complementary actions to reduce emissions.

123 Vermont Climate Council. Initial Climate Action Plan Addendum 19: Transportation. November 2022.

124 Cambridge Systematics. Assessment of a Cap-and-Invest Program for Vermont. January 2025.

125 Office of the Vermont State Treasurer. Report Pursuant to Act 148 of 2024: Recommendations to the General Assembly Regarding Viable Approaches to a Cap-and-Invest Program. February 2025.

Pathway 2: Continue to participate in and defend emissions performance standards for vehicles

As recommended in the Initial Plan in 2021, Vermont moved forward with the adoption of the next phase of our state's long-standing participation in California's clean vehicle programs. In 2022, Vermont adopted both the Advanced Clean Cars (ACC) II program and the Advanced Clean Trucks (ACT) regulation. ACC II promotes the electrification of light-duty cars, requiring automakers to deliver a gradually increasing percentage of zero-emission vehicles into the Vermont market, eventually putting the state's car and light truck sales on a pathway toward 100% new electric vehicle sales by 2035. The ACT rule requires manufacturers to produce and sell an increasing percentage of zero-emission trucks and buses annually through 2035. Both programs, but ACC II in particular, are foundational to achieving the targets of the GWSA and ensuring cleaner, more affordable vehicles are delivered to Vermont.

In recent actions, the federal government and other actors have sought to repeal California's (and thus Vermont's) authority to implement ACC II. Because implementing these rules is essential to achieving needed emissions reductions in Vermont, this CAP recommends a set of administrative actions to defend the ANR's authority to adopt ACC II, including working with other states on this and related regulations. We also recommend that the Attorney General join and participate in any litigation defending California's authority under the Clean Air Act.

Pathway 3: Continue transportation electrification by supporting the availability, accessibility, and affordability of EVs and reliable EV charging options

The beneficial electrification of transportation is an essential component of Vermont's clean energy future. We recommend a suite of policies and programs to advance the use of EVs in Vermont broadly and to make EVs affordable for lower-income Vermonters in particular.

Recommendations include ensuring long-term consistent funding for EV incentives to low- and middle-income vehicle purchasers, and the equitable deployment of fast-charging and Level 2 charging stations, in line with the Vermont Agency of Transportation's Electric Vehicle Infrastructure Deployment Plan.[126]

Since the Initial Plan, Vermont has leveraged an unparalleled influx of federal funds to support investments in cleaner transportation. This has included significant investments in electric vehicle incentive programs and EV charging infrastructure, helping to support

126 Vermont Agency of Transportation. Electric Vehicle Infrastructure Deployment Plan. August 2023.

thousands of Vermonters in reducing pollution and saving money by switching to electric vehicles, with nearly 18,000 EVs registered in Vermont as of January 2025.[127] Federal and state funds have also enabled significant investments in climate and equity-focused programs, like Mileage Smart and Replace Your Ride. Restarting and expanding electric vehicle point-of-sale purchase or lease financial incentives is important in that this can be a significant consideration as car owners are deciding which vehicle to purchase, knowing that the vehicle—whether fossil-fueled or an EV—may be on the road for a decade or more.

Charging Forward to Electrify Transportation

Electrifying Vermont's transportation takes more than the cars themselves. To feel ready to take the leap to an electric vehicle (EV), a robust and reliable network of chargers is crucial. While most charging will occur at people's homes, Vermonters and visitors alike need to feel confident that they can charge their vehicle while on the road. Several State of Vermont programs have invested over $11.5 million since 2014 to support easier access to charging across Vermont's 14 counties. These investments have positioned Vermont as a leader in per capita public EV charging stations, with 203 public stations per 100,000 people.

Read more

Many new and used electric vehicles are now available for purchase. They are more energy efficient than gas powered vehicles and cost far less per mile than a gas-powered vehicle to own and operate over time.[128] This means that rural Vermont drivers can see significant savings. A recent study estimated that a typical rural driver can save approximately $1,500 per year by switching from a conventional gasoline car to a comparable electric vehicle, made even more significant over the life of the vehicle.[129]

This section and the related recommendations of the CAP focus on electrification of vehicles. However, aviation sector fuel switching is also actively advancing. Electric aviation has the potential to measurably reduce transportation sector emissions. Electric

127 Drive Electric Vermont. EV Registration Updates. July 2025.

128 Energy Action Network. Annual Progress Report on Emissions, Energy, Equity, and the Economy (pages 5, 22). 2024.

129 Union of Concerned Scientists. Rural Communities Could Benefit Most from Electric Vehicles. November 2020.

aircraft are currently being manufactured and tested in South Burlington by BETA Technologies, which has collaborated with VTrans to install two aircraft chargers at two state airport facilities. Reduced reliance on road vehicles for the movement of cargo and passengers in the years to come has the potential to save both emissions and time.

Pathway 4: Invest in public, active, and shared transportation and support smart growth development patterns

This 2025 CAP update, like the Initial Plan in 2021, recommends a range of programs and policies that can reduce emissions, improve public health, and provide improved mobility options to Vermonters.

Avoiding car trips, reducing car trip lengths, and replacing car trips with clean and energy-efficient transit, biking and walking options, carpool and rideshare programs, and other non–single occupancy vehicle strategies have economic, equity and public health benefits—while also delivering emissions reductions. These policies are important for a host of reasons, even though they are unlikely to deliver the scale of GHG reductions that the GWSA requires and that the other three pathways in this section would accomplish—especially in the near term. Some of these options (e.g., carpooling and remote work options) can be implemented in the near term while some (e.g., building a bike path) may take a few years. On the other hand, building out planned "smart growth" community centers will take decades to meaningfully affect climate emissions.

Decarbonizing Transportation

Reductions in climate pollution from Vermont's transportation sector, the state's largest contributor to greenhouse gas emissions, are being achieved through two key strategies—electrifying vehicles and bolstering public transit. This acknowledges the challenges of a low-density, rural state while aiming for significant environmental and social benefits.

Read more

17. Buildings and Thermal Pathways for Mitigation

Heating Reforms Can Make Housing More Affordable and Less Polluting

The infrastructure of Vermont consists not just of public facilities like roads and bridges, but is predominantly made up of buildings. The heating and cooling requirements of those buildings impose substantial energy costs and produce nearly a third of the state's GHG emissions.[130] This chapter tackles thermal cost and emissions problems through three main strategies: improving the thermal integrity of buildings, lowering the carbon intensity of heating fuels, and improving the performance of equipment we use for space and water heating.

Importing fossil fuels to heat our buildings is a significant drain on Vermont's economy. In 2024, Vermont families and businesses spent $767 million on fossil fuels for heat, the vast majority of which left the state's economy.[131] Dependence on fossil fuels also exposes Vermont families and businesses to global fuel-price volatility; between 2021 and 2022, for example, the cost of heating fuels jumped from $694 million to $930 million, a 34% increase. The cost of heat disproportionately burdens lower-income Vermonters with high energy-related expenses relative to their incomes.

130 Vermont Agency of Natural Resources. Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2022. July 2025.

131 Energy Action Network. Annual Progress Report 2023. pg. 7. The following year $1.7 billion spent on fossil fuel left the state. Energy Action Network. Annual Progress Report 2024. p.7.

Vermont's thermal challenge is in part due to the age of the housing stock, which is dominated by homes built before 1975, before more modern building codes began to address energy issues. Indeed, over a quarter of Vermont homes were built before 1939.[132] Energy use in homes dominates the thermal sector, but commercial and industrial buildings produced roughly 14% of the state's GHG emissions in recent years.[133] Vermonters rely on a variety of resources to heat water and buildings. Heat in Vermont comes predominantly from fossil fuels (72%) with smaller fractions from wood heat (24%), electricity (3%), and some alternative fuels.

Replacing carbon intensive fossil-fueled heat with lower-carbon alternatives can greatly lower costs over time and contribute to Vermont meeting its climate commitments. It will also support Vermont's economy because more of the money Vermonters spend on heating will stay in the state.[134] Moreover, by focusing on the most burdened households and businesses, Vermont can pair up clean fuel options and weatherization programs to deliver low-carbon building solutions to those who need them the most.

Affordability and the Ability to Pay

While the policy recommendations discussed in this chapter would lower the state's total cost of heat and total climate emissions, they must be designed and applied to address two financial challenges.

Affordability

Vermonters routinely spend over $750 million each year on fossil heating fuels, a cost that contributes to the state's housing affordability challenge. Vermont's annual fuel bills are obviously expensive. While many climate-friendly options will lower costs over time, some of the solutions require significant investments to be made. Weatherizing homes and transitioning away from fossil heat requires investments in buildings, heat pumps, pellet stoves and the like. The challenge is often one of timing: How to finance investments now in order to lower energy bills over time? The economic analyses that have been done to date show long-term savings from reduced fossil fuel bills but vary considerably in their assumptions about the cost of clean heat measures and resulting shorter-term cost impacts.[135] For this reason, we recommend including clear cost caps or price caps in the design of the thermal policies included in this CAP.

132 Vermont Housing Finance Agency. VHFA Housing Needs Assessment p. 2. June 2024.

133 Vermont Agency of Natural Resources. Vermont Greenhouse Gas Emissions Inventory and Forecast 1990-2017. May 2021

134 Energy Action Network. Annual Progress Report 2024. p.7. Fossil fuel spending: Vermont Department of Taxes, 2024; VGS, 2024. Dollar recirculation share: Ken Jones, EAN Senior Fellow for Economic Analysis, 2024.

135 See, for example, The Analysis of Buildings/Thermal Energy Sector Emissions Reduction Policies for Vermont, November 2023.; and Vermont Public Utility Commission. Report to the Vermont Legislature: Second Checkback Report on the Clean Heat Standard Under Act 18 of 2023, Section 6(i), January 2025.

While it's a tough challenge, we know it can be done. Vermont has a long and successful track record of earned energy savings through Efficiency Vermont and other utility efficiency programs, the Weatherization Assistance Program, Tier 3 of the Renewable Portfolio Standards, and the cap-and-invest policy of the Regional Greenhouse Gas Initiative. These programs have saved Vermonters billions of dollars, based on moderate but persistent year-after-year investments in energy efficiency and weatherization. In this CAP we recommend an extension of this type of investment program, targeted to reducing fossil fuel costs and emissions.

Our recommendations would provide one or more stable sources of revenue to help Vermonters to invest in buildings and heating systems that would pay off in savings over time. Such policies—including weatherization at scale, thermal efficiency programs, energy performance standards and cap-and-invest options—can be implemented gradually. They can be designed to leverage program revenues to maximize private investments. And they can be designed to include cost caps to minimize near-term impacts on the price of fossil fuels and promote affordability.

Ability to Pay

Programs to reduce climate pollution should be designed to minimize adverse effects on low-income households, especially Vermonters most burdened by energy and housing-related costs.

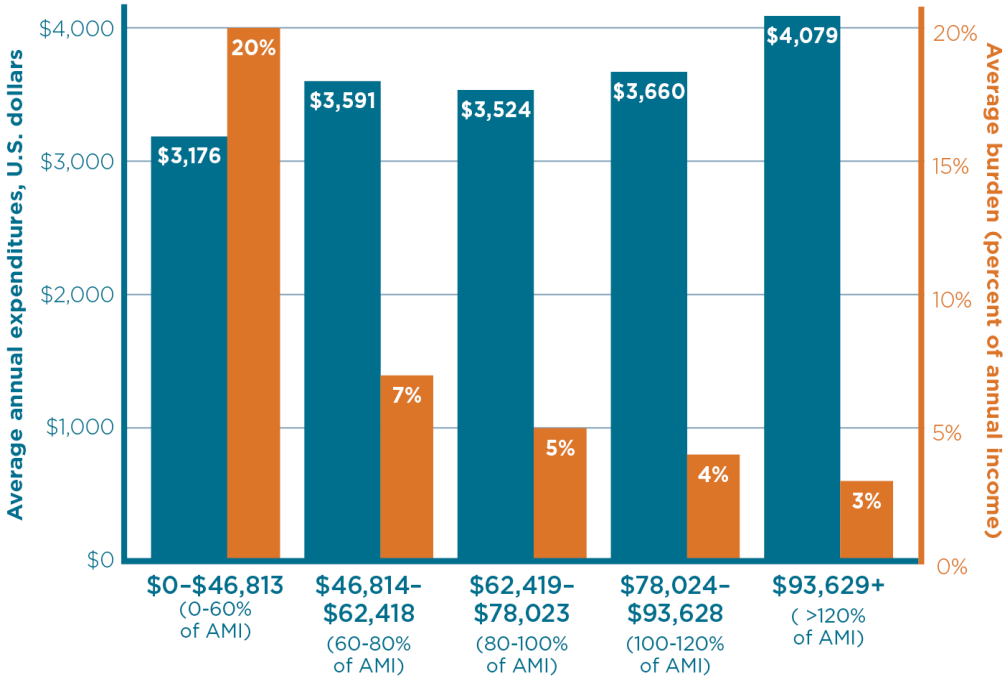
While a central goal of the GWSA is to reduce GHG emissions, we must also limit the effects of various GHG reduction policies on all Vermonters, especially those who struggle with the cost burdens associated with housing and energy use. In 2019, Efficiency Vermont studied energy burdens in the state and determined that, on average, Vermonters spent about 10% of their income, or roughly $5,800 annually, on energy expenses. However, the actual energy burden that Vermonters face ranges statewide from 6% to as much as 20%.[(136)]

Focusing just on household heating and electricity bills, a more recent analysis shows that the percentage of household income spent on those bills is at its highest level (19% of household income) for households in the lowest-income quintile (the one-fifth of households, who earn less than 60% of the Area Median Income). The percentage is 7% to 4% in the middle-income categories and hits a low of 3% among the richest one-fifth of households.[(137)] This is true even though average energy consumption is higher in higher-income households.

136 "What is the impact of energy burden in Vermont?" Rebecca Foster, Director, Efficiency Vermont, last modified October 13, 2019.

137 US Census Bureau, 2018-2022 American Community Survey 5-year Public Use Microdata Samples. Energy Action Network. Annual Progress Report 2024. p.13.

FIGURE 17.1: Vermont combined average household heating and electricity fuel costs and burden by income level, 2019–2023.[138]



Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-year Public Use Microdata Samples.
Notes: Income categories are based on 2019-2023 median household income in Vermont of $78,024. Energy burden refers to the share of annual household income spent on energy. Costs include fuel only and are not inclusive of equipment and maintenance costs.

The important lesson to be drawn from these numbers is that thermal programs can be designed equitably if they raise revenues in proportion to consumption and target bill assistance and investment supports to the households with the highest energy burdens. We recommend that the thermal energy policies set out in this CAP be implemented in line with these principles.

Specific Affordability and Climate Policies Are Needed for the Rental Sector

The challenges of the thermal transition are even greater, and somewhat more complicated, in the rental sector. Of Vermont's roughly 340,000 homes, about a quarter of them (80,000) are used or intended for renters.[139] While the median construction year for owned homes in Vermont is the mid-1970s, the median construction year for Vermont rental housing is significantly older: 1964. In addition to the number of relatively old rental properties, roughly 80% of the Vermonters who rent are categorized as low-income

138 Energy Action Network, Annual Progress Report for Vermont 2025. (Energy Action Network, 2025), 6.

139 Vermont Housing Finance Agency. VHFA Housing Needs Assessment p. 1. June 2024.

earners, according to Efficiency Vermont and Vermont Housing Finance Agency.[140] Efficiency and other heating programs in the rental sector must also overcome the so-called "landlord-tenant problem" in cases where tenants are required to pay the heat and utility bills but can't make investments in weatherization or heating equipment that would lower the unit's total energy burden over time.

The Thermal Challenge Is Substantial, but Vermont Has Strong Institutions and Experience to Draw Upon

Vermont has decades of experience developing policies and designing and implementing weatherization, energy-efficiency and clean-energy initiatives that reduce energy use in buildings throughout the state—including residential, commercial, and industrial buildings of all sizes and types. Substantial work has been done (and is ongoing), including delivering weatherization, energy-efficiency and clean-energy rebates, incentives and services through Efficiency Vermont, electric and gas utility companies and the Home Weatherization Assistance Program. These initiatives should be continued and potentially expanded and enhanced in the future.

However, it is clear from multiple recent analyses that significant, additional initiatives are needed beyond what is already underway to meet the GHG reduction obligations established in the GWSA and to do more to reduce Vermont's dependence on high-cost, price-volatile fossil heating fuels.

Continued and accelerated progress is possible and necessary. Summarized below are the seven major pathways recommended in this CAP for reducing GHG emissions from thermal uses and buildings in Vermont.

Pathway 1: Adopt a broad, sector-wide approach to reduce greenhouse emissions from thermal uses in buildings

A variety of approaches could be taken, but the essential purpose of this recommendation is to create an overall structure and a steady pace of emissions reduction consistent with GWSA obligations that can be measured and supported over time. Among the options available, we recommend continued examination of a modified clean heat performance standard, designed for gradual implementation and containing a price cap to provide assurance that costs on fossil fuels will be moderate and at or below preapproved levels.

140 Sears, J., Lucci, K. Efficiency Vermont. Vermont Energy Burden Report. October 2019 Vermont Housing Finance Agency.

If the Legislature chooses not to adopt a thermal performance standard in the near term, it should create a distinct source of stable funding for heating initiatives. Two options are expanding the current weatherization fund or creating a thermal energy benefits charge on fossil fuel sales, as recommended in the Public Utility Commission's second checkback report to the Legislature.[141] Such a source of funding will be essential to make progress on the thermal transition until a more comprehensive performance standard or cap-and-invest program is in place.

We also recommend continued examination of Vermont's joining a multi-state cap-and-invest program that could include coverage of emissions from both the transportation and thermal sectors. Furthermore, we recommend adoption of a rule requiring reporting of fossil fuel sales by fuel dealers to provide the basic information that governmental decisionmakers would need to design effective programs to reduce fossil fuel emissions. This information is needed whether the Legislature and regulatory agencies choose to adopt the broad-based programs we recommend or more targeted programs to reduce climate pollution.

Pathway 2: Focus on buildings directly

We recommend implementing the recommendations of the Weatherization at Scale Coalition to close the gap between the state's long-term weatherization goals and existing pace of weatherization. To improve the thermal quality of new construction we recommend improvements in building codes and building code compliance. We support increased funding for modern, energy-efficient mobile homes in alignment with the Act 47 Mobile Home Task Force recommendations. And we recommend a study by the Department of Public Service on possible energy efficiency standards for multi-family rental properties, keyed to well-established energy conservation standards.

Pathway 3: Focus on the efficiency and emissions of heating equipment

We recommend that the Agency of Natural Resources, in consultation with the Department of Public Service, study the feasibility of adopting emission standards for new water heating and/or space heating equipment in Vermont. A second set of recommendations addresses the problem of refrigerants with high global warming impacts and supports action by the Agency of Natural Resources to lower their leakage rates and, possibly, their use.

141 Vermont Public Utility Commission. Report to the Vermont Legislature: Second Checkback Report on the Clean Heat Standard Under Act 18 of 2023, Section 6(i). January 2025.

Weatherizing Homes and Supporting Vermonters

As Vermont works to adapt to climate change, comprehensive weatherization of buildings enhances the resilience of the state's aging housing stock, supporting current and future generations to live in health, safety, and comfort. Impacts of a changing climate—such as flooding, excessive heat, increased humidity leading to mold, more frequent power outages from storms, and more—directly affect Vermonters, especially those in precarious housing situations. Weatherization projects reduce the amount of fuel needed to heat homes, allowing Vermonters to keep money in their pockets while keeping harmful pollution out of the air.

Read more

Pathway 4: Focus on GHG reduction through increased installations of high-efficiency electric space and water heating equipment

We recommend development of a long-term sustainable source (or sources) of funding to ensure equitable access for all Vermonters to electric heat pumps as replacements for fossil fuel heating equipment. We also recommend improvements in the rules governing low-income heating assistance to permit households with multiple heating sources to qualify for financial support from the Low Income Home Energy Assistance Program. And we recommend that utilities and their regulators adopt standards and programs to support geothermal networks and to ensure that electric water-heating loads can be managed to reduce grid impacts and peak-load power system costs.

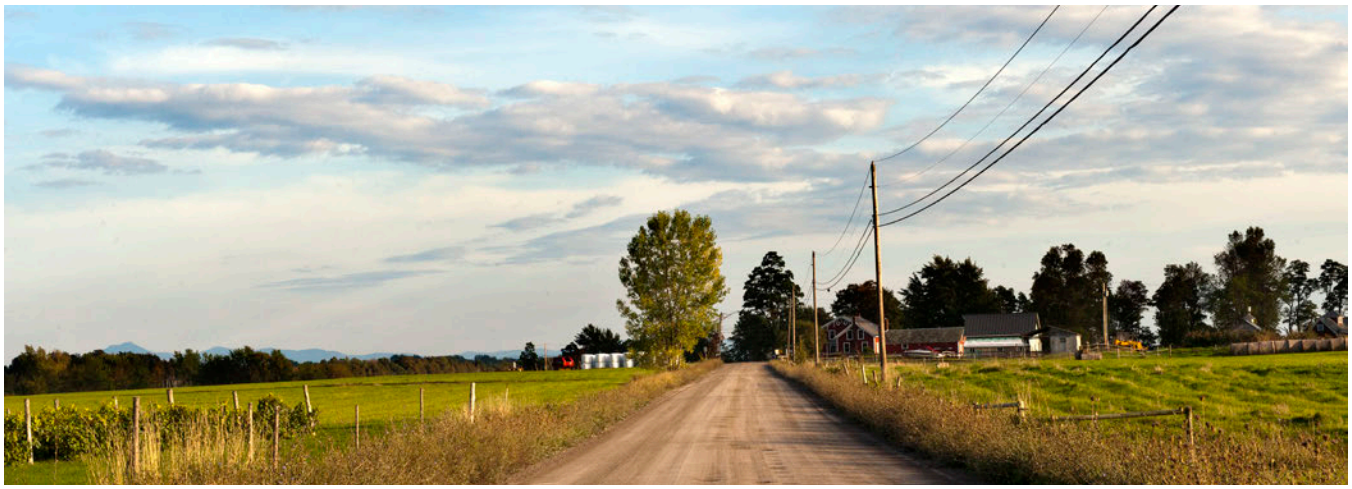
Pathway 5: Focus on heating fuels

We recommend the adoption of a performance-based clean fuels standard to reduce the GHG intensity of fuels used for thermal purposes. This recommendation is consistent with one of the major recommendations of the Public Utility Commission in their recent report[142] to the Legislature and could advance one of the implementation options proposed by the Legislature in the Affordable Heat Act.

Pathways 6 and 7: Utilities and Workforce

In Pathways 6 and 7, this Plan examines two broad issues affecting a number of specific policy and regulatory areas. The Legislature should direct the PUC, or the PUC of its own volition should, open a proceeding to examine how the performance metrics of regulated utilities could be adjusted to better align with the goals of the GWSA. We also recommend a coordinated effort among multiple agencies, educational institutions and employers to ensure the training and availability of the skilled workforce that we know will be needed to achieve the energy transition required to meet Vermont's goals for a modern, climate-responsible energy sector.

142 Vermont Public Utility Commission. Report to the Vermont Legislature: Second Checkback Report on the Clean Heat Standard Under Act 18 of 2023, Section 6(i). January 2025.



18. Electricity Sector Pathways for Mitigation

Beneficial Electrification Is Key to Reducing Climate Pollution

In the preceding sections on Transportation and Buildings we set out high-level recommendations to lower emissions from the two most climate-polluting sectors of the Vermont economy. The most significant of those recommendations would accelerate the use of electric vehicles and electric heat pumps in place of existing fossil-fueled vehicles and furnaces. These new electric technologies are more efficient, less polluting, and over time are less expensive than their fossil counterparts. Providing clean electricity to power those devices is foundational for a low-emissions economy. Using electricity in this way is called "beneficial electrification."[143]

Vermont is in an especially strong position to advance beneficial electrification because our existing electric power mix is substantially lower emitting than the power mix in other states. In 2024, Vermont's electricity supply was 75% renewable, about 16% nuclear, and only 9% fossil-based, and electricity accounted for just 3% of the state's total emissions.[144] Replacing fossil fuel–powered vehicles and heating appliances with electric technologies can significantly lower the emissions from those uses. Adding these new loads to the grid can be "beneficial" in climate terms but the right policies also need to be in place to minimize power system costs, meet reliability standards and promote climate resilience.

143 Farnsworth, D., Shipley J., Lazar J., Seidman N. "Beneficial Electrification: Ensuring Electrification in the Public Interest." Regulatory Assistance Project. June 2018.

144 Energy Action Network. Annual Progress Report on Emissions, Energy, Equity, and the Economy (page 11). 2024.

Expanding Renewable Electricity Supplies

Since the release of the *Initial Vermont Climate Action Plan*, steps have been taken to further decarbonize Vermont's already very clean electricity supply and to enhance grid resilience. Notably, the passage of bill H.289 in 2024, which amended Vermont's Renewable Energy Standard (RES), addressed a recommendation in the Initial Plan to move toward 100% carbon-free or renewable electricity supply by mandating a 100% renewable electricity supply for all regulated utilities by 2035, with some larger utilities mandated to reach that by 2030. The updated RES also includes provisions to increase the supply of in-state renewable generation along with new regional renewable energy, enhance load growth planning, and incorporate equity considerations.[145]

Recognizing this recent legislative action, the updated priority recommendations for the electricity sector in this CAP focus on the following interrelated and complementary areas:

- Ensure a strong, affordable, and resilient electric grid to support deep emissions reductions in the transportation and thermal sectors.
- Enable all Vermonters to electrify their homes, businesses, and transportation affordably and equitably.
- Expand access to and participation in local renewable energy programs, especially for disadvantaged communities.

The priority recommendations are briefly summarized below as pathways.

Pathway 1: Keep the electric system strong and affordable to support beneficial electrification of buildings and transportation

In coming decades, Vermont utilities will likely need to reliably serve hundreds of thousands of new heat pumps and electric vehicles, while also interconnecting new utility-scale and distributed renewable generators and storage batteries. Ensuring that essential electric services remain both reliable and affordable is an important priority and a substantial challenge.

Vermont utilities and regulators will need to employ leading-edge regulatory policies, investments and technologies in this rapidly emerging field. At least three types of actions are needed:

- Utilities support grid modernization and the optimal use of transmission and distribution assets by leveraging their system and customer data to determine where grid-enhancing technologies may be deployed to secure the greatest value.

145 Importantly, the updated RES also includes a legislatively mandated check-in regarding progress, or barriers that may develop, in 2029. This review, in addition to provision for waivers from the Public Utility Commission when needed, will help ensure affordability and practicality as these requirements come into effect while regional renewable energy projects evolve.

- Utilize tools such as advanced metering, storage, and distributed energy resource management systems to improve the efficiency and design of necessary grid infrastructure investments.
- Avoid or defer grid infrastructure expansions where feasible and cost effective.

The Public Utility Commission (PUC) should continue to ensure that utilities employ efficiency, demand response, and flexible load management programs and rate structures to manage peak loads and overall demand as well as to promote affordability and equity. Utilities and stakeholders should utilize energy storage, including both short-duration and proven long-duration technologies, where appropriate, to enhance grid flexibility, affordability, and support reliability during peak periods.

Utilities should target grid-hardening investments that improve resilience against extreme weather events. They should coordinate these resilience investments with state and local efforts, invest in cost-effective solutions, and leverage funding where available. Expanded investments in storm resilience and preparation will be required as the effects of climate change intensify, and all sectors must glean lessons from the severe weather events Vermont has already experienced.

Pathway 2: Enable all Vermonters to choose electrification

In this pathway we recommend actions to support the transition to electrified transportation, heating, and industrial energy across Vermont. The focus in this pathway is on customer-facing policies that facilitate customer decisions to switch from fossil to electric end uses.

In support of this objective, utilities should:

- Deploy cost-effective infrastructure upgrades (e.g., service panel upgrades, service drops, transformers, grid hardening) to support statewide resilience and electrification goals, through both customer-requested projects and utility projects.
- Provide electrification incentives through Tier III of the RES and other programs to encourage customer decarbonization, including for low-income customers and those in multi-family housing, all the while keeping an eye on moderating electricity rate impacts to help customers choose beneficial electrification options.
- Continue to deploy innovative programs to help cost-effectively manage electric vehicles, storage, and other distributed energy resources. Offer rates (e.g., time-of-use pricing), where cost-effective, to encourage efficient energy consumption.

Pathway 3: Increase access and participation in renewable energy programs

In this pathway we seek to ensure that all Vermonters, especially rural and frontline communities and low-income earners, benefit equitably from renewable electricity programs. As a foundation, policies should continue to support appropriate development of in-state renewables, in line with the updated RES Tier II requirements, which mandate a 20% share of new in-state renewable generation for most of the state's consumption, consistent with the overarching goal of energy affordability.

In addition, the PUC and utilities should implement appropriate recommendations from the Act 179 study[146] regarding evolution of community-level renewable energy programs, especially for low-income customers. Utilities, with PUC support and stakeholder input, should enable customer enrollment programs that expand participation in local renewable energy projects, including for disadvantaged communities and low-income customers. Wherever possible, utilities and developers should seek state and federal funding for community-scale renewable energy projects. Such funding will lower costs for participating customers and help to keep electricity rates lower, in support of electrification objectives generally.

Finally, regulators and utilities should adopt and implement policies to support deployment of geothermal heating systems, including thermal energy networks like community-scale geothermal and waste heat recovery, as an additional option to provide efficient, renewable heating and cooling services.

Vermont's electric sector has long been low emitting, and we have made significant strides toward fully decarbonizing this sector over the past decade. By continuing to advance these electricity sector priorities while working to maintain affordability for customers, Vermont can continue to be a leader in a clean, affordable, resilient, and community-driven energy transformation.

146 Act 179 of 2024 Report. This report was prepared by the Department of Public Service as required in Act 179, An Act Relating to the Renewable Energy Standard

19. Non-Energy Pathways for Mitigation

The *Vermont Climate Action Plan 2025* continues to focus on pathways that advance the reduction of non-energy emissions. "Non-energy" emissions encompass those from industrial processes, solid waste, wastewater, and other sectors that contribute significantly to the state's GHG footprint. Key sources include the use of ozone-depleting substance substitutes, semiconductor manufacturing, and fugitive methane emissions, among others. The majority of these emissions consist of gases such as methane (CH_4), nitrous oxide (N_2O), and various fluorinated gases, which have a much higher global warming potential (GWP) than carbon dioxide (CO_2). For instance, sulfur hexafluoride (SF_6) is approximately 22,800 times more potent than carbon dioxide over a 100-year period. Given the potency and, in some cases, the short atmospheric lifetimes of these gases, reducing emissions of high GWP short-lived climate pollutants (SLCPs) is a priority for achieving impactful GHG reductions in the near term.

Taken together, these non-energy sources comprise about 10.5% of Vermont's GHG emissions. This chapter outlines strategic pathways to mitigate emissions from the wastewater sector, high GWP refrigerants, semiconductor production, and solid waste.

Pathway 1: Reducing emissions from refrigerants

High global warming potential (GWP) hydrofluorocarbons (HFCs) are widely used in commercial and industrial refrigeration systems, such as refrigerators and freezers. When these systems experience leaks or accidental releases, they can significantly contribute to GHG emissions. To address this issue, the CAP outlines a strategic approach to reducing emissions from high GWP refrigerants. This involves transitioning refrigeration systems

to low GWP alternatives, which is a critical step in reducing emissions from the industrial processes sector.

Vermont is actively implementing incentives to encourage the improvement or replacement of refrigeration systems. With state funding, the Vermont Energy Investment Corporation (VEIC) is providing enhanced support through increased project incentives for grocers, convenience stores, and other facilities that require refrigeration for perishable products. This support aims to facilitate the transition to lower GWP and natural refrigerants as well as the installation of leak-detection systems to minimize emissions from existing systems.

Additionally, the CAP recommends providing incentives for businesses to voluntarily transition from high GWP refrigerants to lower GWP alternatives. This initiative would use data collected for the Refrigerant Management Program (RMP) to target appropriate facilities, supplementing reductions achieved through rulemaking resulting from Act 65 (2019), an act relating to the regulation of hydrofluorocarbons. Furthermore, the CAP recommends considering the inclusion of heat pumps in Act 65 to provide a comprehensive approach to managing refrigerant emissions. Moving forward on these strategies will support the reduction of emissions from refrigeration systems in buildings and in the commercial and industrial sectors.

Pathway 2: Continue to explore efficiencies and alternatives to high GWP fluorinated gases in the semiconductor manufacturing process

In Vermont, semiconductor manufacturing is a significant contributor to GHG emissions, accounting for approximately 34% of the total emissions in the industrial processes sector. Global Foundries, the state's sole semiconductor manufacturer, relies on several high GWP fluorinated gases, such as sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, and nitrogen trifluoride (NF_3). These gases are integral to etching and chemical vapor deposition processes and as heat transfer fluids in various tools. While reducing emissions from these high GWP gases presents technological challenges, it is imperative to reaching Vermont's climate goals.

Strategies focus on exploring efficiencies and alternatives to high GWP fluorinated gases in semiconductor manufacturing. To achieve this, Global Foundries is advancing the adoption of emissions reduction technologies, such as combustion abatement units. These technologies aim to destroy high GWP gases or replace them with less harmful chemicals during the manufacturing process. Additionally, Global Foundries is actively seeking funding through the CHIPS and Science Act to support research, development, and implementation of these technologies. It is through these strategic investments in sustainable technologies and the application of federal funding that Global Foundries plans to make progress in reducing emissions within the semiconductor manufacturing sector.

Pathway 3: Reduce fugitive emissions from wastewater treatment facilities by improved methane flaring and waste heat recovery

Greenhouse gas emissions from wastewater treatment facilities in Vermont primarily consist of methane, a potent GHG that is 25 times more impactful than carbon dioxide on a per mass basis. These emissions occur during the anaerobic decomposition of organic materials in digesters. While methane can be combusted for beneficial uses like generating heat or electricity, it is often flared to convert methane to carbon dioxide, reducing its environmental impact. Ensuring that flares at these facilities are operational is a priority in mitigating methane emissions.

The most effective way to reduce fugitive emissions from wastewater treatment facilities is by ensuring the functionality of flares at existing anaerobic digesters. The Vermont Department of Environmental Conservation's Watershed Management Division has completed a survey of treatment facilities with anaerobic digestors, providing valuable data on their operational status. The CAP prioritizes installing or repairing functional flares at the next facility upgrades for Barre City and Newport City. Specifically, Barre City wastewater treatment facility has a non-functional flare that needs fixing, while Newport City lacks a flare altogether, prompting a recommendation to design and install one during the next upgrade.

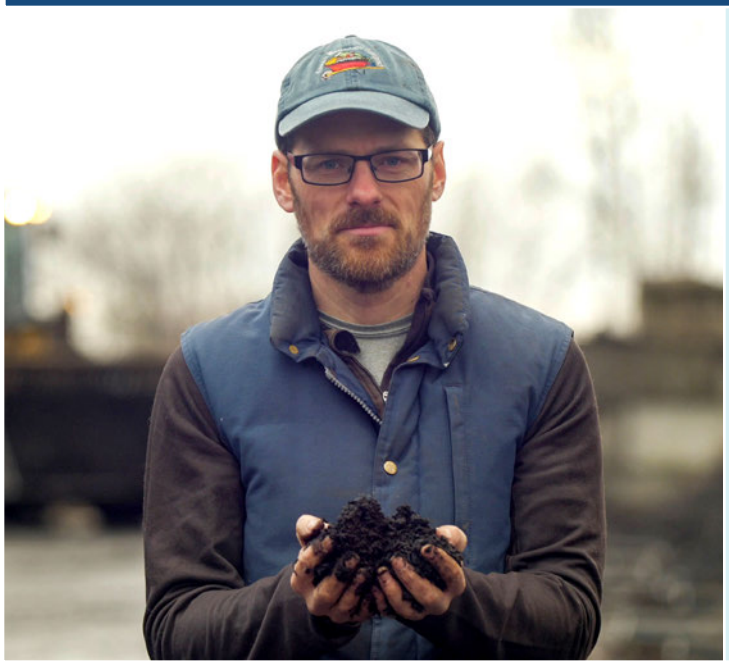
Additionally, the requirement of waste heat recovery capabilities in new wastewater system projects and significant expansions are cost-effective. These projects can be funded through state wastewater programs. Implementing these actions and strategies will enable Vermont to significantly reduce methane emissions from wastewater treatment facilities.

Pathway 4: Waste prevention and reduction

In broadening the scope of non-energy emissions reductions, this plan has introduced new pathways which focus on waste prevention and reduction. The Department of Environmental Conservation (DEC) has begun taking action to reduce the environmental impact of waste and, thus, to reduce non-energy emissions. One set of actions focuses on general waste reduction, such as hosting a statewide conference and establishing a Reduce, Reuse, and Repair Network. The goal of the Reduce, Reuse, and Repair Network is to form a group of individuals and organizations who promote waste reduction in order to keep materials out of landfills and reduce the resources needed to make new things. They will support the reuse of materials more than once before being recycled or discarded and help Vermonters share, repair, refurbish and repurpose as many materials as possible. When it comes to reducing food waste, the DEC is implementing actions that enhance communication on best practices, including maintaining the ScrapFoodWaste.org website, which serves as a central hub for food waste reduction and composting information

and resources. Furthermore, Vermont DEC's contractor completed a Recycling Systems Analysis Report in 2025. This report provides critical data on emissions associated with various recycling systems, guiding future discussions on the Vermont Bottle Bill and other recycling policies. Vermont DEC has been actively implementing these strategies, with many initiatives already underway. The CAP seeks to build upon the momentum of waste prevention and reduction strategies to continue contributing to overall non-energy emissions reductions.

Slashing Trash



Organizations of all sizes—from large companies to homegrown non-profits—are carefully stewarding resources by reducing consumption and responsibly managing waste. Beyond saving money here in Vermont, reducing waste lessens climate pollution that comes from extracting resources, manufacturing new items, and shipping them. What's more, less waste means fewer greenhouse gas emissions at the landfill.

Read more

Next Steps in Other Non-Energy Emissions Reductions

The expansion of scope and strategies to reduce non-energy emissions represents a critical component of the state's comprehensive plan to meet requirements of the Global Warming Solutions Act. By addressing emissions from refrigerants, semiconductor manufacturing, wastewater, and waste management, Vermont is taking steps to reduce its GHG footprint. The collaborative efforts of state agencies, businesses and communities are essential to achieving these goals. Through leveraging data-driven insights and promoting sustainable practices, we can ensure that the strategic pathways outlined to reduce non-energy emissions are both cost effective and long lasting.

20. Agriculture and Ecosystems Pathways for Mitigation and Adaptation

Overview

Protecting, sustainably managing, and enhancing Vermont's working and natural lands[147] provides a critical climate mitigation, adaptation and resilience opportunity. The "green hills and silver waters" referenced in Vermont's state song represent a widely shared image of the Vermont landscape, with walkable and livable communities surrounded by farm fields and forested hills, all bounded by Lake Champlain and the Connecticut River. This image represents not just a shared sense of the past, but of the future, and represents a way of living on the land that is deeply embedded in Vermont's cultural heritage and way of life. Today's Vermonters are just the most recent group of people to have taken on the responsibility for stewarding a landscape that has supported humans since time immemorial. Protecting, stewarding and restoring these landscape features, including farms and working forests as well as our wild and undeveloped spaces and the rich diversity of life within this landscape, is necessary to life here for generations to come and is critical to achieving the climate mitigation, adaptation and resilience benefits described in legislative findings of the Global Warming Solutions Act.

147 For the purposes of this document, we use the language "working and natural lands" as used (though not defined) in the GWSA, a usage that implies a distinction between lands used to produce food, fiber and forest products for human use and consumption, on the one hand, and lands that are left in a natural and unmanaged state on the other. We note, however, that natural lands do work through providing ecosystem goods and services such as wildlife habitat, water quality, forage, shelter, spiritual sustenance, aesthetic value and many others. As well, working lands have natural features that provide these same benefits.

Rationale

Vermont's open landscape is not just beautiful but also our greatest opportunity to both sequester GHG emissions and adapt to climate change. This landscape is already a significant source of carbon storage and sequestration, and improved protection, restoration and management of our forests and farms can further enhance this capacity.

Further, Vermont would be at much greater risk from the increased intensity and frequency of extreme weather events but for the abundance of open lands, forests and fields, and healthy functioning watersheds.

The benefits of investing in Vermont's natural and working lands are not limited to the physical landscape, but also to our human communities. Our forests and farms are the source of food and forest products and are the foundation of Vermont's rural community economies.

Through careful stewardship of our lands, we have opportunities to prioritize food security, ensure equitable land access and home ownership for Vermonters from historically marginalized or disadvantaged communities, and support landowners seeking to steward their land for its ecological and climate benefits. The Intergovernmental Panel on Climate Change emphasizes that sustainable land management can help meet climate goals, slow ecological crises, and provide access to nutritious food.[148] Education and financial support are essential in helping land stewards adopt practices that benefit the economy and the environment. Relying on science, braided with and informed by Traditional Ecological Knowledge, and drawing on a long and evolving history of land stewardship by Vermont landowners, our state can take advantage of and learn from the new ideas, concepts and information that demonstrate the many co-benefits associated with the implementation of policies aligned with our natural and cultural heritage.

Climate Mitigation Benefits of Natural and Working Lands

Vermont's landscapes play a crucial role in carbon sequestration and storage, helping to offset emissions while enhancing resilience. Natural climate solutions, such as conservation, restoration, and improved land management, increase carbon storage while preventing GHG emissions. When combined with aggressive emissions reduction efforts, they provide some of Vermont's most effective tools for addressing climate change.

Currently, Vermont's natural and working lands sequester and store significant levels of carbon. Preserving and enhancing this sequestration capacity requires supporting the people who live and work within these ecosystems. Landowners, farmers and foresters must have the knowledge and resources to make informed decisions that reduce emissions while increasing carbon sequestration and storage. Thoughtful land

148 Special Report on Climate Change and Land. Intergovernmental Panel on Climate Change. 2019.

management in forests, wetlands, and agricultural landscapes can ensure Vermont continues to capture more carbon than it emits. Public engagement, education, and careful planning are essential to align land-use policies with Vermont's climate goals while supporting local communities.

Forests play a critical role in Vermont's carbon storage in tree biomass and the organic soil layers beneath them. Forest protection, restoration and management should focus on maintaining these vital ecosystems, recognizing their importance for both biodiversity and climate resilience. While forests store carbon above ground, below-ground ecosystems—including soil microbial communities and root networks—are equally vital for long-term sequestration.

Protecting Nature for Climate Resilience

Vermont Conservation Design identifies the most important lands and waters for maintaining ecological function. Together, they make up a connected landscape of large, intact forests, healthy waterbodies and wetlands, and a full range of physical and geologic features. Protecting these places supports natural and human communities alike in the face of climate change, now and into the future.

Read more

Vermont's landscape has undergone a dramatic transformation over the past century. A century ago, the state's forests had been reduced by logging and clearing for agriculture and development to only 20% of the landcover. Today, as a result of a shift away from a landscape dominated by small hillside farms, combined with land protection policies, nearly 80% of Vermont's landscape is forested. This recovery highlights the potential for ecosystem regeneration but also reveals a critical gap—many recovering forests lack the structural complexity and biodiversity of old-growth ecosystems. The current state of our forests, both in terms of the permanent conversion of forests to development and in terms of the ecological health of our forests, underscores the need for proactive policies that ensure forests regain their ecological function rather than simply regrowing tree cover.

Vermont's landscape is continuing to transform as forest cover has been declining in recent years and farmland is under increasing pressure from development coupled with economic challenges faced by farmers. Carbon sequestration in agricultural landscapes is an emissions-related strategy for agriculture that yields great co-benefits. Soil health is another essential but often overlooked aspect of carbon sequestration. Healthy soils store more carbon through the development of soil aggregates, root exudates that feed microbial life, and the formation of stable organic matter. Vermont can prioritize soil health initiatives by supporting farmers in adopting practices such as reduced tillage, nutrient management, manure management, cover cropping, perennial systems, riparian tree plantings, and managed grazing. These methods enhance soil resilience and contribute to long-term carbon sequestration, while also reducing carbon emissions and increasing local food production.

Another lens for understanding the importance of natural and working lands to achieving Vermont's goals for reducing and mitigating GHG emissions is watershed health. Protection and restoration of Vermont's headwater streams, wetlands, and floodplain ecosystems are all critical to achieving Vermont's climate mitigation goals. As some of the most efficient natural carbon sinks on a per acre basis, these landscape elements store substantial amounts of carbon. Low oxygen levels in wetlands slow decomposition and prevent carbon from being released as carbon dioxide. Additionally, wetlands continuously accumulate organic material, enhancing their carbon storage capacity over time. In contrast, when filled, altered, drained or degraded, these ecosystems release stored carbon back into the atmosphere. Protecting and restoring headwater streams, wetlands and floodplains is essential for maintaining their function as long-term carbon sinks.

Climate Adaptation Benefits of Natural and Working Lands

The northeastern region of the U.S. is already experiencing an increase in extreme weather as a result of climate change, including severe precipitation events, winter ice storms, drought, flooding, wildfires, temperature extremes, and localized wind events (see Chapter 6, Climate and Climate Change in Vermont).

Our region is also experiencing a general warming trend, with impacts including loss of outdoor winter recreation opportunities, ground conditions no longer conducive to sustainable logging, the spread of invasive and pest species, loss of biodiversity, declining northern forest ecosystem health, and associated changes in forest structure. The breadth of climate change impacts on Vermont's communities includes not only disruptions to housing and business development, public health, energy, transportation, and recreation and tourism, but also disruptions to our working and natural lands—the agriculture lands, forests, and watersheds—which are the foundation of our economic health and the backbone of our mitigation, adaptation and resilience strategies.

Vermont's forests and farms, wetlands, connected floodplains and river corridors all absorb excess water and reduce high, erosive energy during flooding events. These

landscape features can also, when properly stewarded, serve as a buffer against droughts and other disruptions, increasing protections for the built environment in our communities and providing public health benefits. In addition, protecting and enhancing our natural and working lands will also provide critical habitat and landscape connectivity for the plants and animals who now need refugia from the changes to their habitat resulting from climate change. Though the interrelationships within and among these systems are sufficiently complex to defy simple assertions in the near term, over the long term, the benefits to plants and wildlife resulting from protecting, stewarding and enhancing natural and working lands will return benefits to Vermont's agricultural and forestry sectors and the people who depend upon them.

Finally, supporting our natural and working lands will also increase protection for the built environment in our communities and provide public health benefits.

Climate change adaptation efforts focused on protecting and enhancing natural and working lands requires significant investments, but climate experts agree that the long-term savings justify these investments, given the rapidly increasing cost of climate change impacts.[149] Beyond economic returns, adaptation efforts yield myriad co-benefits—building community resilience, sequestering and storing carbon, improving soil health, maintaining habitat connectivity, and more.[150]

The recommendations in this section aim to increase the adaptive capacity of Vermont's natural and working lands and support watershed health as well as enhance the resilience of our natural and human systems to a changing climate, through science-based, technical and Traditional Ecological Knowledge. The increased incidence of drought, extreme precipitation events, and changes in temperature patterns associated with climate change in Vermont have already begun to impact our natural and human communities and systems. At the same time, features of Vermont's natural and working landscapes have absorbed, buffered and reduced climate risks, such as the impacts of extreme precipitation and associated floods.

Summary of Agriculture and Ecosystems Pathways

Broadly, the strategies that the State of Vermont must take to secure the health, resilience and benefits of climate adaptation and mitigation from natural and working lands include the following:

- Fund, enhance, and adapt programs that support GHG emissions reductions, carbon sequestration and storage, and climate adaptation and resilience of our forests, fields and farms.
- Utilize best practices to account for carbon sequestration, storage, and emissions reductions from agriculture and forestry.

149 IPCC Sixth Assessment Report, "AR6 Synthesis Report: Climate Change 2023"; Economics of Adaptation, Chapter 17.

150 Id.

- Fund and implement Payment for Ecosystem Services programs for lands to encourage implementation of practices that increase carbon storage, increase stormwater storage capacity, reduce runoff, and improve soil health, crop and forest resilience.
- Create dedicated climate impact emergency recovery funding for farms and forestry operations and related infrastructure, support and expand programs to support the adaptive capacity and restoration of farms and forests, and promote insurance for farm and forest landowners and businesses to ensure that they can equitably and viably recover from climate-induced disasters.
- Fund farm and forest supply chain resilience and state food security, and invest in storage, processing and distribution infrastructure.
- Promote Vermont-sourced agricultural products and sustainably harvested wood-based construction materials.
- Protect the supply and access to local food, fiber, and forest products.
- Support statewide planning and programs to promote landscape connectivity and durable land conservation strategies.
- Incentivize the use of nature-based solutions, Traditional Ecological Knowledge.
- Incorporate Indigenous Knowledge into solutions in order to provide alternatives to engineered and technological solutions for adaptation and resilience.
- Promote healthy and connected river corridors, floodplains, and wetlands.
- Engage and support Indigenous communities, communities of color, and underserved communities in the work of protecting and enhancing natural and working lands.
- Enhance education, outreach, research, peer-to-peer learning, and technical assistance programming to encourage climate-smart strategies by land and water managers.

Interconnections

Vermont has historically invested heavily in policies and practices that protect its forests, farms and open spaces as well as the rich mix of wetlands, floodplains, streams, rivers, lakes and ponds that are vital to managing the increased threats of extreme weather, including flooding and drought, associated with climate disruption. Recommendations should be seen as complementary to the array of existing statutes, policies, and programs that are playing a central role in protecting and enhancing the ecological, economic, and aesthetic qualities of our landscape through a mix of environmental and land-use regulations, financial incentives, and education and outreach.[151] Our recommendations also assume continued and increased investment in the foundational programs established to support individual Vermont landowners, businesses and organizations who seek to steward their privately owned land through sustainable management and permanent conservation.[152]

151 Examples include Act 250, 30 V.S.A. § 248 (Energy Project Siting), state water quality and wetlands protections, local land-use plans and regulations, Use Value Appraisal Program ("Current Use") and the Vermont Housing and Conservation Act.

152 Examples include the Vermont Housing and Conservation Fund and the Working Lands Enterprise Initiative.

Changing Patterns in Wildland Fire Risk

While Vermont is not typically associated with wildland fire risk, higher summer temperatures and drought have increased fire risk in the summer and fall in recent years. In the fall of 2024, drought paired with some of the warmest temperatures on record resulted in more acres burned that year than the past 25 years on average. In 2025 Vermont experienced a record drought, resulting in 164 days with "Moderate" or greater fire danger. The number of fires and acres burned during the summer of 2025 was above average compared to previous years.

Vermonters can sign up for daily Fire Danger Forecasts at bit.ly/FireDangerForecast.

In addition, ongoing initiatives such as the Vermont Conservation Strategy Initiative,[153] *Vermont Forest Future Strategic Roadmap*,[154] and the work of the Governor's Commission on the Future of Vermont Agriculture[155] include ideas that will support and complement the strategies described here. It is critical that a diversity of communities across the state continue to engage actively in defining and supporting the proposals that result from these efforts.

In conclusion, while the benefits of Vermont's forests and farms provide obvious adaptation and resilience benefits, these recommendations should not be viewed through only that lens. Protecting and enhancing our natural environment and working lands also provides direct carbon storage sequestration opportunities and so is tied to mitigation. (See Chapters 14, 16, 17, 18 and Appendix 2 for relevant mitigation strategies.)

153 "30 by 30 (Act 59)." Vermont Housing and Conservation Board.

154 "Vermont Forest Future Strategic Roadmap." Vermont Department of Forests, Parks and Recreation.

155 "Governor's Commission on the Future of Vermont Agriculture." Vermont Agency of Agriculture Food and Markets.

Further, management of Vermont's forests and farms has a direct connection to recommendations related to Vermont's energy future—both as connected to the role of biomass for combined heat and power, advanced wood heat, and agricultural waste methane generation, and as connected to a renewable energy siting policy prioritizing the siting of new projects in already developed areas to reduce pressures on forests, farms and watersheds. (See Chapters 12 and 20 and Appendix 2 for recommendations relating to biomass and renewable energy siting.)

These same strategies are also inextricably linked to the design and investment in building resilient, walkable, and livable communities and a strong, sustainable economy. (See Chapters 13 and 21 and Appendix 2 for relevant rural resilience and cross-cutting strategies.)

21. Pathways for Adaptation and Building Resilience in Communities and the Built Environment

Resilience thinking in the built environment recognizes that our communities are deeply linked with their natural environments. Our response to a changing climate therefore must consider how climate change will disrupt communities and the businesses and individuals within them. We must identify strategies to adapt or transform, develop holistic land-use patterns, and ensure all Vermonters are supported through these transitions. By seeing our communities as connected to both people and nature instead of treating them as separate, standalone places, resilience thinking can work to address climate-related challenges while fostering sustainable local development through collaborative, participatory processes.

Vermont has experienced 25 federally declared major disasters due to extreme weather between 2011 and 2024. Every county has had five or more recent major disasters, and eight counties have had at least 11.[156] Ten disaster declarations have occurred since the *Initial Vermont Climate Action Plan* was adopted in December 2021.[157] In the last three years (2022–2024) Vermont has had four billion-dollar disasters.[158] While catastrophic flooding has been the primary disaster, Vermonters have also been subject to drought and extreme heat events—a less obvious but deadly health risk—and have

156 "Building Resilience in Rural Communities Speaker Series." Rebuild by Design.

157 "Vermont Declared Disasters." FEMA.

158 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters: Vermont Summary (2025).

experienced more frequent and severe impacts from landslides, wind, winter storms, and smoke from wildfires burning in other parts of the North American continent. These hazards have caused, in many cases, irreparable harm to individuals and families, entire neighborhoods, businesses, municipalities, and critical public infrastructure.

Proactive Flood Mitigation along the Lamoille River

In the wake of devastating floods in 2023 and 2024, communities like Wolcott are proactively preparing for future events. Its work to increase flood resilience aims to lower the height of floodwaters, have fewer people in harm's way, and reduce damage to critical public infrastructure. Wolcott exemplifies a watershed-scale approach, partnering with state agencies, regional groups, and non-profits.

Read more

To successfully address the climate factors underlying these disasters, concerted efforts must take place at a global scale. This is currently not occurring at the pace necessary to limit these types of events in the near or medium term. And while mitigation measures have been taken to improve climate adaptation and resilience in Vermont, the underlying historical settlement patterns that put large numbers of people and civic, economic, cultural, and public infrastructure at risk have not changed to a meaningful degree. Understanding that this takes time, it is important to seek both immediate opportunities to reduce risk and long-term strategies to build infrastructure and landscape-level resilience.

Since the adoption of the Initial Plan in 2021, the following important steps have been taken toward building resilience in Vermont communities and the built environment:

- Formation of the Climate Action Office: The CAO has developed the Municipal Climate Change Vulnerability Indicators Tool, begun development of the Municipal Climate Toolkit (to be completed by Fall 2025), and supports the Resilience Implementation Strategy in collaboration with the Office of the State Treasurer.
- Enactment of the Flood Safety Act (Act 121 of 2024): This will move regulation of development in high-hazard river corridors to the state, establish a net-gain wetlands policy, improve dam safety through consolidated oversight, dam owner maintenance

requirements, investment in strategic removal of dams, and study how flood hazard policy might be more effectively administered.

- Enactment of Act 181 of 2024, an act relating to community resilience and biodiversity protection through land use: This overhauls Vermont's planning framework for coordinating state, regional, and municipal land use. It will better enable the mapping of future growth areas that consider the evolution of historic compact settlements up and away from flood hazard risks, plan for new neighborhoods and growth centers, and protect large forest blocks to better protect headwaters and buffer runoff.
- Enactment of Act 59 of 2023, the Community Resilience and Biodiversity Protection Act: The intent is to protect the ecological functions of our landscapes, with the ambitious goals of conserving 30% of Vermont's landscape by 2030 and 50% by 2050. A draft conservation inventory is complete, and the development of a Comprehensive Conservation Plan will soon be underway to be presented to the Legislature in the summer of 2026.
- Enactment of Vermont's HOME Act: This amends the Planning and Development statute, Act 250, and other laws to enable new opportunities for housing development within state, regional, and local planning and development regulations.
- Creation of the Flood Resilient Communities Fund: This prioritizes projects in communities and/or for homeowners with greatest economic need and projects that mitigate repetitive loss among low-income and marginalized portions of the population. The program was designed to fund voluntary buyouts of flood-vulnerable properties that typically would not qualify for federal funding. All available funding has been obligated.
- Opening of a proceeding at the Public Utility Commission (Case No. 25-0339-PET) on grid resilience: This seeks to develop a common and robust framework for planning, valuing, and measuring grid resilience investments (e.g., line hardening, undergrounding energy storage, enhanced vegetation management, storm response, etc.).
- Issuance of an $8 million funding opportunity for grid resilience: Funds were awarded to Vermont through the federal Infrastructure Investment and Jobs Act.
- Development of a Transportation Resilience Improvement Plan: This is prioritizing high-risk locations along state and local highway systems.

While progress is being made, we know there is much more to be done for the 61% of Vermonters living in rural areas. Rural resilience needs to be informed by the people experiencing the impacts.

> "Until we start talking to communities about what they care about, we're having the wrong conversation."
>
> *KELLY PFLICKE*
> *AICP Resiliency Specialist, FEMA Region II*[159]

159 FEMA. A Guide to Supporting Engagement and Resiliency in Rural Communities. July 2020.

Centering Community in Flood Emergency Management

Following devastating floods in 2023 and 2024, Hardwick has transformed its approach to emergency management to one led by the community in an effort to be better prepared for the next emergency. This approach views planning, emergency management, and recovery as a continuous cycle, where every solution centers on local knowledge and collaboration to strengthen future preparedness. It also acknowledges the interdependence of Vermont's towns and the power of regional, collaborative solutions.

Read more

Vermonters have voiced the need to recognize the overlap between resilience in our built environment and our natural and working lands. Many stress the importance and need for more compact development that provides resilience through thoughtful planning and siting of infrastructure in community centers that are surrounded by—and where climate impacts are buffered by—natural and working lands. Others point out the importance of resilient businesses that contribute to the economic vitality of communities and the workforce and housing needed to support both. Communities, businesses and people need incentives, grants, and low-cost loan programs that offer financial and technical assistance to support planning and informed decision-making as well as implementation of existing plans (such as Local Hazard Mitigation Plans) to promote proactive solutions. There is a call to focus on strengthening what exists rather than creating something new and for funding to go to trusted entities that have existing and strong relationships with communities, businesses and individuals.

Resilience in the built environment comes through a focus on communities and infrastructure. It means supporting communities through increased capacity for proactive planning and implementation of solutions that consider adaptive land use as well as ensuring all people have access to safe, accessible, energy-efficient and affordable housing. It means proactively and strategically evaluating risks and vulnerabilities to infrastructure serving communities, evaluating the costs and benefits of different types of

interventions and investments available to mitigate those risks, and prioritizing solutions based on factors including the needs of communities and vulnerable Vermonters. Additional context around the rationale to prioritize health impacts is included in Chapter 7, Understanding the Indirect Impacts of Climate Change on Human Health and Wellbeing in Vermont. The recommended priority actions of this section speak broadly to building upon existing structures, relationships, and programs to provide technical support, proactive planning and implementation of projects, and dedicated and sustained funding.

Summary of Pathways to Support Successful Community and Infrastructure Planning and Project Implementation

Integrating actions required by recently passed statutes, rather than taking a piecemeal approach, creates the opportunity to achieve more holistic and comprehensive plans and actions to achieve climate-adapted and resilient communities and infrastructure.[160] Taken together the statutes modernize Vermont's approach to regional and municipal planning to more uniformly and specifically designate areas suitable for development, encourage the construction of more housing where supported by infrastructure, establish the creation of a statewide land conservation plan, and support state regulation of river corridors, conservation of wetlands, planning for dam safety, and consideration of the efficacy of the current approach to flood hazard regulation. If brought together at the regional scale, in collaboration with planning at the municipal scale, the opportunity exists to:

- Plan more intentionally for future land use that integrates conservation, flood safety, compact settlement and housing, while also identifying gaps and needs for infrastructure investment to make adaptive and resilient community development possible.
- Establish more intentional land-use patterns that consider conservation, development, and infrastructure needs that transcend municipal boundaries.
- Create a statewide land-use map by stitching together the new regional land-use maps, which can both guide development and tell the story of opportunities and barriers to making a more adaptive and resilient Vermont possible.

Resilient community development requires detailed physical master planning, capital improvement and investment planning, and public financing strategies and tools to create conditions for resilient development. Physical master planning considers the appropriateness of particular locations on the Vermont landscape to support resilient development and guides where infrastructure—including water and wastewater, streets, power, and public spaces—should be located. Capital planning must include asset

160 Act 47, HOME Act; Act 181, an act relating to community resilience and biodiversity protection through land use; Act 121 Flood Safety Act; Act 59 Community Resilience and Biodiversity Protection Act

Local Trees Grow Resilient Communities

Vermont communities are grappling with big challenges that hit locally—more extreme weather, aging infrastructure, health disparities, and more. Urban and community trees are a practical, place-based response. They soak up excess water, cool our streets and buildings, capture planet-warming carbon, and improve air quality. They also offer something less quantifiable but deeply needed in hard times: comfort, connection, and a sense of place.

Read more

assessments and prioritize projects that provide long-term resilience. This will likely necessitate the development of public investment and operational structures that are intermunicipal or regional in nature and that involve close coordination between municipal, regional, and state planners as well as utilities and other public and private entities planning for infrastructure serving Vermont communities.

Vermont is currently experiencing a housing crisis driven by high demand and low supply. At the same time, large areas of the state have lost significant numbers of housing units to flooding. Vermont needs not only more housing, but housing where it is best suited to withstand climate risks and the right types of housing for different life stages. The housing status quo threatens the resilience of our economy, social wellbeing, health and healthcare system, education system, senior care, public safety, and tax base, among others. The latest *(June 2024) Vermont Housing Needs Assessment* concludes that 36,000 primary homes are needed in the state in the 2025–2029 period.[161] Developing such quantities of housing requires greater density and while this strategy should make the most of our existing compact settlements, all new settlement and its related infrastructure must occur in a manner that minimizes flood hazard and landslide risk. Creation of new and use of existing tools and resources is critical to thoughtful planning and ensuring successful, long-term sustainable and equitable development.

Compact settlement planning should not occur in a vacuum. What happens on the landscape around the compact settlement influences its success as a desirable place

161 Vermont Housing Finance Agency. VHFA Housing Needs Assessment. June 2024.

to live as well as its ability to be a means of climate resilience and adaptation—and to be climate resilient and adaptive itself. The infrastructure that supports the compact settlement must promote resilience and be resilient. This includes accommodation of drinking water wellhead protection areas, and wastewater disposal sites that minimize energy consumption and minimize the risk of groundwater and surface contamination. Streets leading to, through, and from the settlement should promote—not impair—quality of life. Any development outside designated centers should be well planned. Forest and habitat blocks, and habitat connectors, should be maintained and improved not only for the benefits of habitat and working lands, but also to sequester carbon and maintain land cover and soils that mitigate GHGs and flood and drought risks. Floodplain conservation and improved floodwater access to the floodplain will help mitigate against both flood and drought. Planning compact settlement with river and brook channel migration (fluvial erosion) in mind is essential to avoid the state's primary and most violent hazard. And incorporating wildland fire–adapted community strategies into all aspects of development planning will help mitigate a lesser known but increasing risk in New England and the northeast.

Providing planning resources, in the form of tools and guidance as well as technical assistance in the use of available tools, that assists with applying for grants, implementing projects, and financial assistance, is foundational to a broad array of state, regional, and local policy directives related to land use, energy development and conservation, GHG reduction, land conservation, transportation, education, and economic development.

Summary of Pathways for Strategic and Sustained Funding

We are "Vermont Strong," but the landscape of disaster, recovery, and mitigation aid is changing with the sheer frequency, intensity and scale of events as well as the quantity, terms and conditions of funding. For example, the mitigation funding the state and municipalities receive in the wake of disaster, after damage is done, is orders of magnitude greater than what is normally available in the absence of a disaster. Indications are that longstanding and reliable federal funding formulas could change, requiring state and local governments—as well as Vermont's 16 municipal and cooperative utilities—to provide more of their own taxpayer or ratepayer funding for recovery and mitigation. It is also possible, or likely, that federal disaster declaration thresholds will be elevated and the support services in the immediate aftermath of a disaster, which have traditionally been provided by FEMA, diminished—decreasing the likelihood that robust federal aid will be made available. At the household and business level, the catastrophic floods of 2023 and 2024 were severe enough that federal Individual Assistance (IA) disaster declaration thresholds were exceeded. An IA declaration brings in federal resources to assist individuals, families and businesses with recovery that otherwise would not be available, as Vermonters in towns not included in the IA declarations discovered. This threshold, too, could and likely will increase. As we have learned, IA assistance is insufficient to support

full recovery. By design it is intended to be supplemented by local philanthropic and volunteer aid.

Increasingly, federal and state funding that is intended for resilience and adaptation is being directed to support property buyouts to prevent future damage caused by flooding, fluvial erosion, or landslides. In fact, the majority of mitigation funding Vermont received following the 2023 and 2024 federally declared disasters has gone to buyouts. While these buyouts can result in community-scale flood hazard mitigation outcomes, most are at the individual property level rather than a floodplain or river corridor level. This is of great benefit to individual Vermonters whose property has been or could be damaged or destroyed. However, it is imperative that Vermont also invest in community-scale flood adaptation and resilience, including growing up and away from flood hazards and brook and river channel migration. This is essential to develop and protect our civic, economic, cultural and housing infrastructure in anticipation of more frequent and intense events that threaten our historical settlements that will continue to lie in harm's way.

It is imperative that Vermont establish policies and protocols and recovery and funding structures so that individuals, communities and businesses can properly plan and implement solutions prior to disaster striking and so that they can know before disaster strikes what support for recovery might be available. This will also serve as a framework that allows everyone involved in response and recovery work—state agencies, municipal governments, non-profits, businesses—to anticipate their roles and responsibilities. Preparedness is a form of adaptation and essential to resilience.

Similarly, it is essential that entities planning for critical infrastructure serving communities, such as utilities, are modeling future climate risks and evaluating their systems to understand where vulnerabilities exist and to plan for the appropriate scale, pace and types of investments to cost-effectively reduce the risks and resulting costs to Vermonters of impacts from severe storms and other threats to that infrastructure (e.g., widespread and long-duration power outages).

22. Coordination of the Climate Action Plan with Other State Plans and Initiatives

The GWSA requires that the CAP be coordinated with the Comprehensive Energy Plan (CEP). This was intentionally orchestrated during the *Initial Vermont Climate Action Plan* in 2021 as the CEP was due to be completed only one month after the CAP was adopted. However, the CEP is required to be updated every six years and as a result is not currently being revised. That said, it is still important to understand the distinctions between the two planning processes and the rationale for why the plans should be aligned.

The CAP is an Action Plan for GHG mitigation, sequestration, and adaptation strategies in the face of climate change. The CEP is a mechanism to implement statutory energy policy based on a comprehensive analysis of challenges and opportunities in Vermont. While the CAP and the CEP have considerable areas of overlap, they remain distinct planning requirements, with different objectives. While the CEP must be consistent with and a key component of meeting the state's GHG requirements, it is not a climate change plan nor a comprehensive look at Vermont's non-energy GHG emissions or climate adaptation needs. That said, and as described in this CAP, energy consumption drives a large majority of Vermont's GHG emissions; it is important that the process for the CAP and CEP are aligned.

While the CEP is not currently being updated, the CEP is required to be consistent with the requirements of the GWSA and the CAP. At the same time, the CAP is required to be informed by the CEP. These requirements to closely coordinate the efforts—even if the resulting actions are not necessarily identical—are important. As a result, the Department of Public Service and the Agency of Natural Resources continue to engage around the modeling efforts that underpin the plans and in engagement to support the public's involvement and understanding of both efforts.

In addition to the CEP, there are other state planning efforts and initiatives that align with and further support the recommendations in the CAP. As a starting place for the development of this plan, the Climate Council received a presentation to learn more about the State Hazard Mitigation Plan (SHMP). The *2023 Vermont State Hazard Mitigation Plan* presents the natural hazard impacts most likely to affect Vermont, an assessment of our vulnerabilities, and a mitigation strategy to reduce or eliminate our most significant risks. The 2023 SHMP accounts for both observed and projected hazard impacts and accounts for changes in population and development. It also places a special focus on how hazards affect people beyond loss of life and property damage to account for

quality of life and impacts to our frontline communities. The SHMP is foundational to the resilience and adaptation recommendations found in the CAP, with recommendations in the CAP building off recommendations from the 2023 SHMP that have not been completed or need additional focus. The Rural Resilience and Adaptation Subcommittee of the Climate Council is charged with developing actions that focus on the pressures that adaptation will impose on rural transportation, electricity, housing emergency services, and communications infrastructure, and the difficulty of rural communities in meeting the needs of its citizens.

In addition to recommendations in both the CAP and the SHMP, work is needed to strategically prioritize actions in state government to build resilience and adapt to a changing climate. The devastating flooding of 2023 and 2024, along with heatwaves, droughts, and wildfire smoke, make it clear that climate change is threatening Vermonters' health, safety, quality of life and economic security. The Resilience Implementation Strategy (RIS) is a joint initiative of Governor Scott and State Treasurer Pieciak, announced on January 3, 2024. The RIS will develop a comprehensive strategy to guide and prioritize climate resilience efforts as well as help policymakers understand and address gaps. This strategic set of recommendations will detail where adjustments to state programs can increase resilience to climate change and will augment considerable work done by state government to date to build resilience to climate change. It is intended to complement the CAP by prioritizing capacity and funding for resilience projects. It will also identify available new and innovative funding solutions for climate adaptation activities.

23. Climate Council Next Steps

The *Vermont Climate Action Plan 2025* (CAP) builds off of the *Initial Vermont Climate Action Plan* as well as ongoing public input from Vermonters. The work of the Climate Council is ongoing, and additional efforts are needed to drive climate action forward and meet the emissions reduction targets outlined in the Global Warming Solutions Act (GWSA).

The recommendations in this plan will require a combination of legislative and administrative action. Specifically, the implementation of the CAP will require the Legislature to pass significant legislation as well as allocate the necessary resources to advance the recommendations. The GWSA also requires the Secretary of the Agency of Natural Resources to adopt rules consistent with the CAP, as adopted, on or before July 1, 2026. There are currently no rules being put forward under that timeline.

While the Legislature, the Agency of Natural Resources, and other agencies of state government will work to advance numerous actions put forward in this plan through legislative action and rulemaking, the Council will work to further advance work efforts in several key areas, including but not limited to:

- monitoring and tracking implementation of the CAP
- considering additional resources to make the CAP actionable
- working in partnership with the state government, the Legislature, and the Climate Action Office
- convening Climate Council meetings on a quarterly basis to engage with the public
- bringing subcommittees together as needed to support the work of the Climate Council

Connect with the Climate Action Office

The Vermont Climate Action Office (CAO) plays a pivotal role in coordinating state-led climate initiatives and providing expertise on climate adaptation, mitigation and resilience activities.

The CAO will continue to evaluate progress in meeting the requirements of the GWSA and support implementation of the updated CAP. As a division within the Agency of Natural Resources Secretary's Office, the CAO focuses on three core areas:

Climate program coordination: The CAO supports the ongoing implementation of climate action and solutions, ensuring that climate strategies are effectively integrated across state government.

Community and public engagement: Recognizing the importance of public involvement, particularly from frontline and impacted communities, the CAO is committed to fostering broad citizen participation and partnerships to deliver climate solutions for all Vermonters.

Inter-agency collaboration: The CAO works closely with various state agencies, the State Climatologist, and key stakeholders such as the Climate Council. The Inter-Agency Advisory Board meets regularly to coordinate climate action across state government, focusing on proactive coordination, maximizing resources, monitoring progress, and developing state positions on climate-related issues.

The Inter-Agency Advisory Board includes representatives from:

- Agency of Agriculture, Food and Markets
- Agency of Commerce and Community Development
- Agency of Human Services (Department of Children and Families, and Department of Health)
- Agency of Natural Resources
- Agency of Transportation
- Department of Buildings and General Services
- Department of Labor
- Department of Public Service
- Vermont State Climatologist
- Vermont Emergency Management

Public meetings and events hosted by the CAO are continuously updated and can be found on the CAO's website. The website also provides information on how to get involved and learn additional information about CAO programs.

The Climate Action Office looks forward to continuing its work with Vermonters to achieve transformative climate action for current and future generations. Reach out to the CAO with questions or comments at ANR.CAO@Vermont.Gov or (802) 404-2729.

Appendices

1. Definitions
2. Full Suite of Pathways, Strategies, and Actions
3. 2021 Climate Action Plan Progress
4. Guiding Principles of a Just Transition
5. Signing Statements

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