NYS Climate Impacts Assessment & Buildings - What You Need to Know

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Lt. Col. (Ret.) Erik C. Backus, PhD, PE

Co-Authors, Buildings Chapter, NYS Climate Impacts Assessment

Meet our Speakers

Illya Azaroff, FAIA

is a licensed architect and an internationally recognized leader in disaster mitigation, resilient planning strategies and design. Currently, he served as a technical advisor on the New York State Climate Impact Assessment. He is advising the federal government serving with the US State department on foreign exchange programs on climate adaptation, and part of the 2024 Hazard Mitigation Plan for NYC. Prior he served as a Technical Advisor to ASPR - Assistant Secretary for Preparedness and Response in D.C. informing the NDRF-National Disaster Recovery Framework.

- Founder, +lab Architect PLLC (New York - Los Angeles)
- AIA National President Elect 2025-26
- Professor at New York City College of Technology
- New York State Disaster Assistance co-Coordinator

Meet our Speakers

Erik C. Backus, Ph.D., P.E., LEED AP BD+C, ENV SP, FMP

is a Professor of Practice at Clarkson University with a bevy of expertise, experience, and knowledge in the sustainability and resilience decision making space. Heavily credentialed in this area, Backus is practicing and teaching facilities resilience planning, project design, and project/program delivery through and with undergraduate and graduate students. This has included efforts in the building/campus development, energy, and transportation sectors. Some key roles/credentials include:

- Co-author of the NYS Climate Impacts Assessment, Buildings Chapter
- Former FEMA liaison officer for the US Army
- Engineering, infrastructure, and resilience planner for George Mason University.
- Professional Engineer, holds a Bachelor's and Master's in Civil Engineering and a PhD in Engineering Science

Abstract

The New York State Climate Impacts Assessment provides a science-based analysis of what to expect from climate change across the State. The assessment is a comprehensive research effort to enable decision-makers at all levels to better understand the impacts of climate change and make informed choices about how to prepare for them. The session will also provide opportunities to enhance equity and reduce the vulnerability of those most at risk. In a first, the assessment includes a chapter on Buildings and the impact climate change will have on these critical spaces in our communities and lives. During this session, the participants will get a deep dive into the impacts that buildings across NYS will see in the next 20 to 50 years as a result of our changing climate.

Learning Objectives

1. Participants will gain awareness of the contents of the NYS Climate Impacts Assessment.
2. Participants will be able to identify the various climate driven risks that impact buildings across NYS.
3. Participants will be able to recognize the differences of climate impacts to buildings across the various regions of NYS.
4. Participants will be able to identify the most likely and most dangerous climate impacts risks that will affect NYS buildings over the next 20 to 50 years.

Agenda

- Introduction to the NYS Climate Impacts Assessment
- What is likely to happen: Local/Statewide Impacts & Extreme Events
  - Central NY/Finger Lakes Example of Impacts
- How does NYS Fit within the National Picture?
- Impacts on Buildings
- Mitigation & Adaptation Options and Strategies
- Q&A

Assessment Results

Learn how climate change is affecting New York State—and what we can do to prepare.

nysclimateimpacts.org

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Introduction to the Assessment

Note: Slides in this section are courtesy of Amanda Stevens, NYSERDA

NYS Climate Impact Assessment

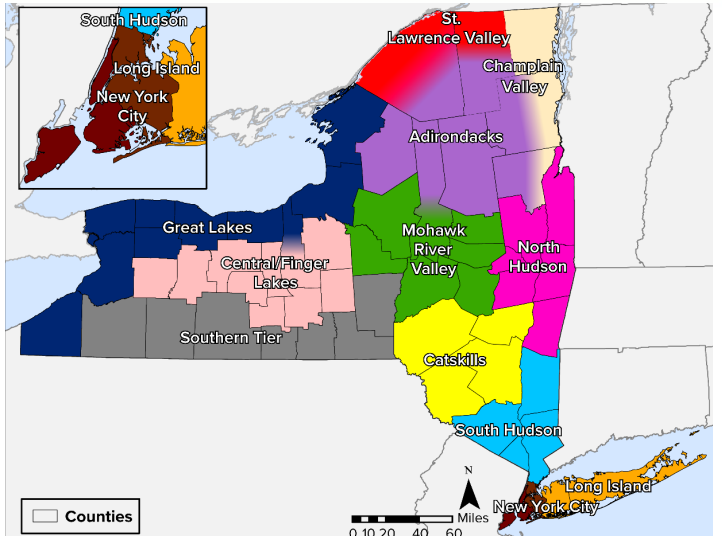
NEW YORK STATE CLIMATE IMPACTS ASSESSMENT

https://nysclimateimpacts.org/explore-the-assessment/

- Most Comprehensive Assessment of Climate Change Impacts in the history of NYS
- Provides analysis along “sectors” (see chapters) and geographic regions
- Applicable to us today:
  - Central NY & Finger Lakes: https://nysclimateimpacts.org/explore-by-region/the-central-finger-lakes/
  - New York City: https://nysclimateimpacts.org/explore-by-region/new-york-city/

Download the Chapters

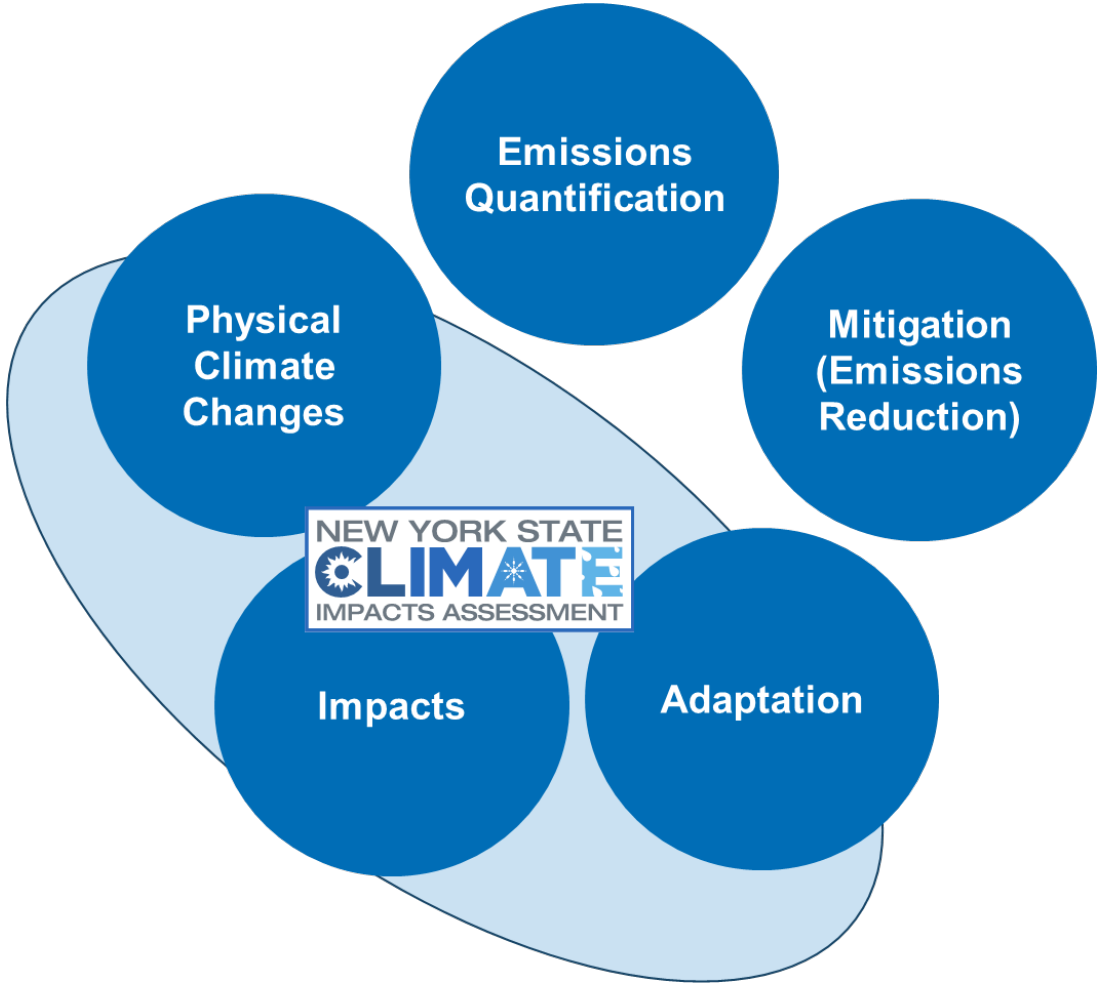
- Chapter 1: Assessment Introduction
- Chapter 2: New York State’s Changing Climate
- Chapter 3: Agriculture
- Chapter 4: Buildings
- Chapter 5: Ecosystems
- Chapter 6: Energy
- Chapter 7: Human Health and Safety
- Chapter 8: Society and Economy
- Chapter 9: Transportation
- Chapter 10: Water Resources



What Is the Assessment?

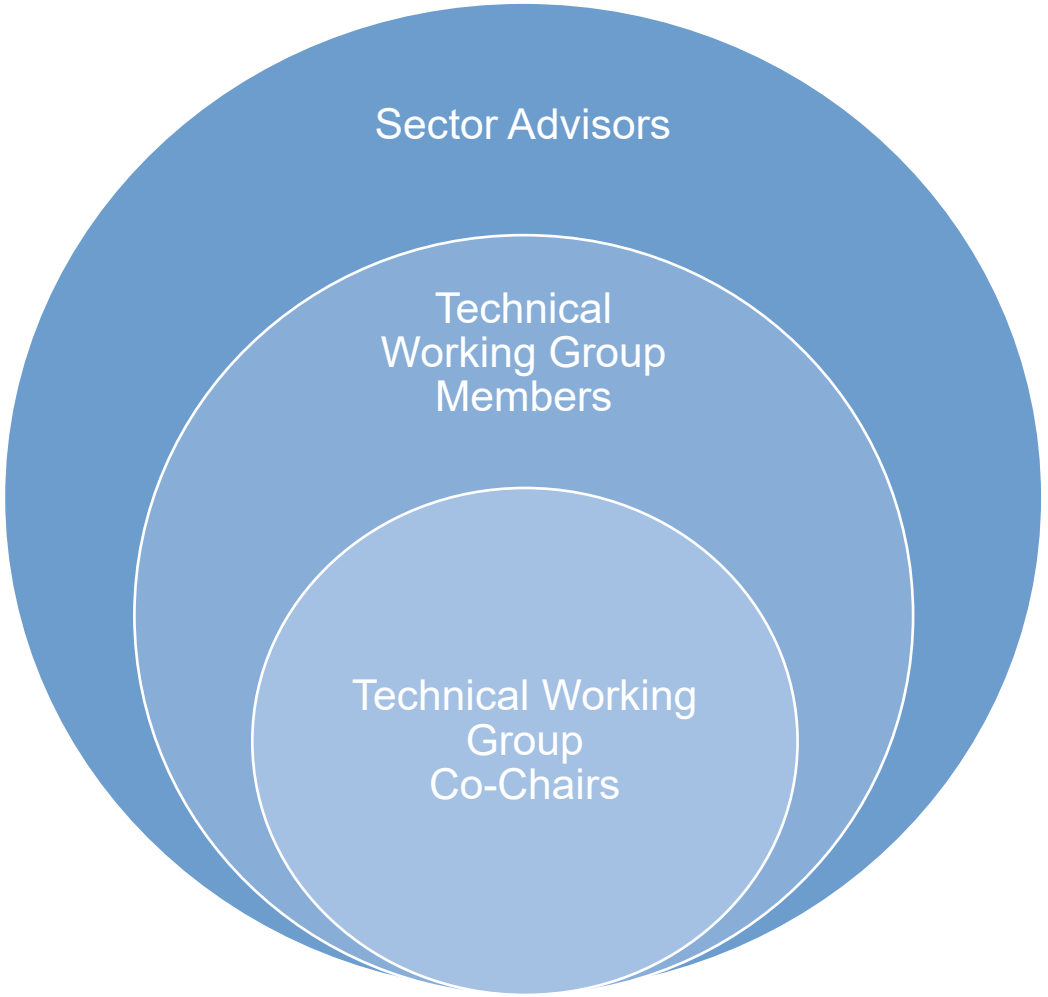
- A scientific investigation into how climate change is affecting New York State's communities, ecosystems, infrastructure, and industries

- It will help residents, businesses, and decision-makers:
  - **Understand** how climate change might impact the state
  - **Take action** to deal with existing impacts
  - **Plan** and prepare for future impacts



Who Developed the Assessment?

- NYSERDA coordinated the assessment
- Academic institutions, science organizations, community leaders, industry representatives, and others have contributed
- Nearly **80 experts** from 60 organizations served as technical workgroup members
- More than **165 additional individuals** served as advisors
- Climate projections developed by Columbia University



What Does the Assessment Include?

- **Projections** of future climate conditions in New York State
- A peer-reviewed **technical report** on climate change impacts across eight sectors
- **Adaptation strategies** and **case studies**
- Accompanying **communication materials** designed for various audiences

Sectors

1. Agriculture
2. Buildings
3. Ecosystems
4. Energy
5. Human Health and Safety
6. Society and Economy
7. Transportation
8. Water resources

Climate Projections: Chapter & Summary

DOI: 10.1111/nyas.15240

TECHNICAL REPORT

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

NEW YORK STATE CLIMATE IMPACTS ASSESSMENT

New York State Climate Impacts Assessment Chapter 02: New York State's Changing Climate

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Abstract

Many fundamental aspects of New York State's climate have already begun to change, and the changes are projected to continue—and in some cases, accelerate—throughout the 21st century. This chapter explores observed and projected changes in a variety of physical variables that relate directly to weather and climate, starting with average and extreme air temperature and proceeding to the associated effects on precipitation, extreme events, and core properties of New York's coastal and inland waters. These climate attributes and hazards lead to impacts throughout the eight sectors of this assessment.

KEYWORDS
climate change, future projections, historical observations, precipitation, temperature, New York State, extreme events, sea level rise

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NEW YORK STATE CLIMATE IMPACTS ASSESSMENT

ABOUT | PROJECTIONS AND MODELING | EXPLORE THE ASSESSMENT | RESOURCES | NEWS

Average Temperature

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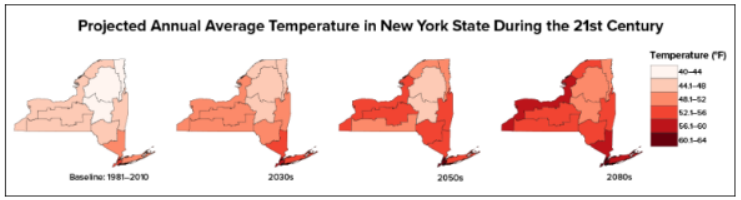
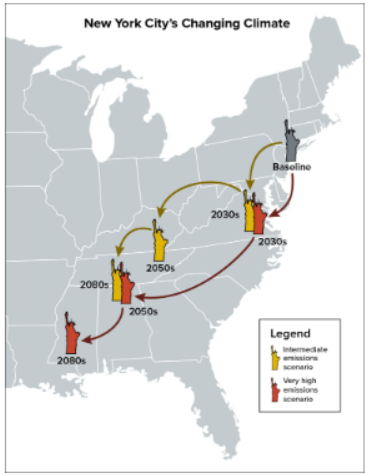
Average temperature is defined as the daily average air temperatures at ground level, averaged over an entire year. Average temperatures are rising in New York State:

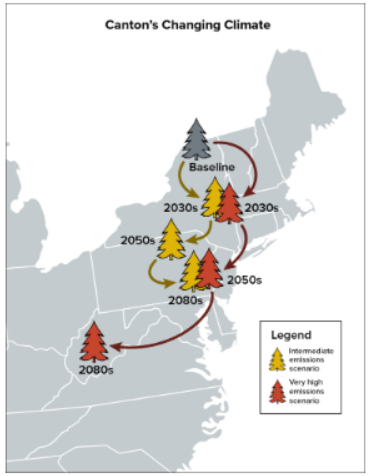
- **Historical observations:** Since 1901, average temperatures in New York State have increased by almost 2.6°F. Temperatures since 2000 have been higher than in any period in recorded history. New York has warmed more quickly than the U.S. average.
- **Projections for the future:** Average temperatures are projected to increase in all regions of the state. Temperatures are projected to rise between about 5°F and 11°F by the end of the century.

Warmer temperatures contribute to conditions that allow invasive species and pests to spread, increase drought risk, and stress animal species that need a colder climate. Higher temperatures also generally lead to longer growing seasons and could increase yields for certain crops.



Projected changes to annual average temperatures over the course of the century. Refer to Chapter 2, New York State's Changing Climate, to learn more about this figure. Source: Projections developed for this assessment..





Climate Projections: Data Tables

About Our Future Climate Projections

These pages include information about what New York State's climate is likely to be in the future. These projections for the future are based on sophisticated computer models that scientists have developed to simulate how the Earth's atmosphere, oceans, and other physical features respond to the amount of heat-trapping greenhouse gases that accumulate in the atmosphere. To project not only how but *how quickly* the climate will change, modelers have to make assumptions about how the level of greenhouse gases in the atmosphere will change in the future. That means predicting if countries around the world will continue to produce more greenhouse gas emissions—and how quickly the world adopts renewable energy and other ways to reduce emissions.

There are many different possibilities. Climate scientists commonly use a set of scenarios called Shared Socioeconomic Pathways (SSPs) to represent these different possibilities. The New York-specific projections developed for this assessment are based on two future scenarios: "intermediate emissions" (called SSP2-4.5) and "very high emissions" (SSP5-8.5). The results from these two scenarios have been combined in many places to provide a single range of likely changes in the climate, which some users may find more useful than multiple sets of numbers. However, it is still important to recognize that the degree of future change projected here is not inevitable. If the world takes serious action to reduce greenhouse gas emissions and control future warming, the resulting climate changes could be closer to the low end of the projected range, or perhaps even lower.

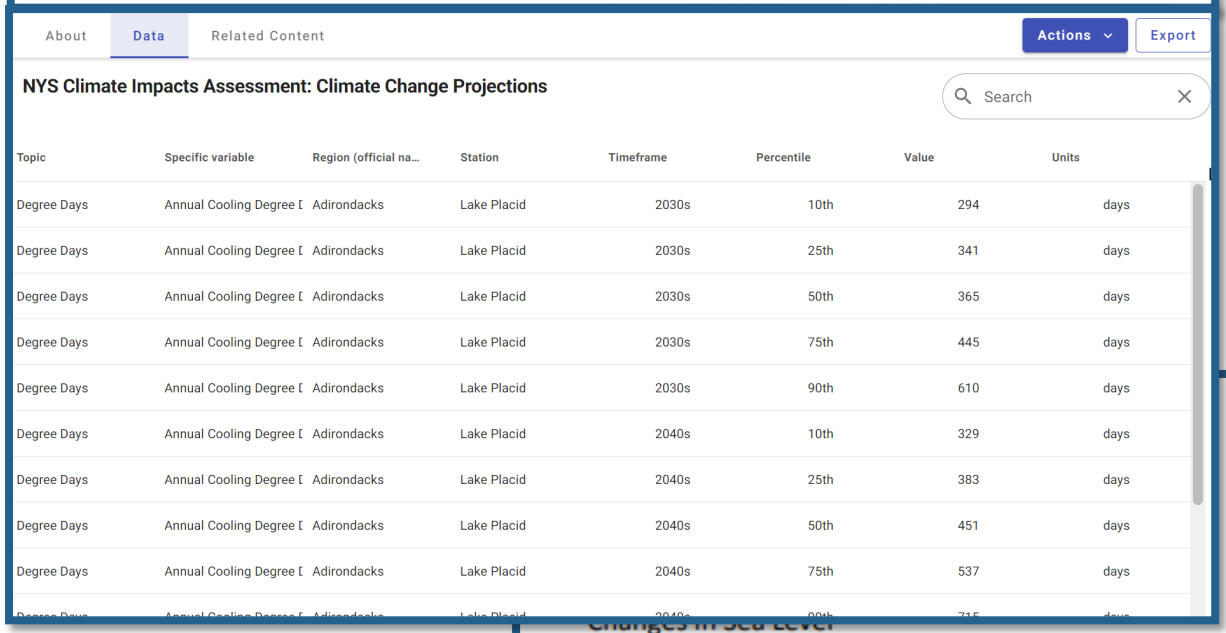
More information on these projections can be found on our About Our Future Climate Projections web page. Readers interested in more technical details about the projections can refer to the New York State's Changing Climate chapter and the accompanying methodology report below.

Data Files

- Data tables—interactive and downloadable
- Data tables—PDFs (revised December 2023)
- Methodology report (models, scenarios, calculation approach, and key results)

Using and Citing the Assessment

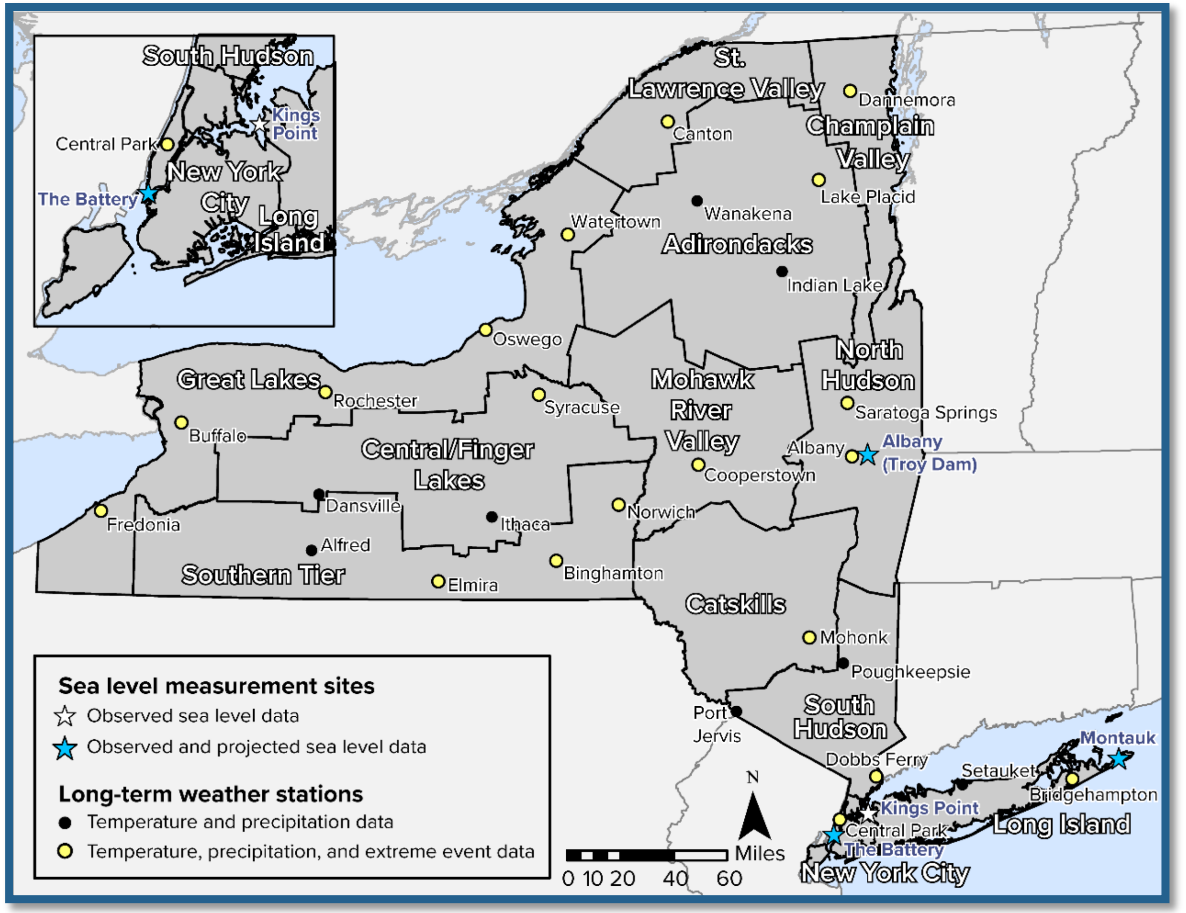
We encourage everyone to use and cite information from the New York State Climate Impacts Assessment. Please refer to our **guidelines for using and citing the assessment**.



Topic	Specific variable	Region (official na...	Station	Timeframe	Percentile	Value	Units
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2030s	10th	294	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2030s	25th	341	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2030s	50th	365	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2030s	75th	445	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2030s	90th	610	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2040s	10th	329	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2040s	25th	383	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2040s	50th	451	days
Degree Days	Annual Cooling Degree [	Adirondacks	Lake Placid	2040s	75th	537	days

What Do the Projections Cover?

- Data are available for each region
- Average temperature and precipitation
  - Annual, seasonal, monthly
- Extreme events
  - E.g., Hot days, heat index, heat waves, cold days, heavy precipitation
- Degree days
  - i.e., heating and cooling degree days
- Sea level



Information by Sector

Sector Chapters

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TECHNICAL REPORT

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NEW YORK STATE CLIMATE IMPACTS ASSESSMENT

New York State Climate Impacts Assessment Chapte Agriculture

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Abstract

Agriculture is a vital industry in New York State, which ranks amon states for dairy, fruits, and several other commodities. As agricult weather and specific climatic conditions, this sector faces extraor New York's climate changes. This chapter explores the many impa mate on agriculture, the ways these impacts interact with other c York farmers and farmworkers face, and opportunities for the ag adapt and build resilience.

KEYWORDS
adaptation, climate change, crops, farmworkers, harvest, impacts, resilienc

Chapter Summaries

Agriculture Chapter Summary

Agriculture is a vital industry in New York State. It provides food and other products to communities, creates jobs, and contributes more than $5.3 billion to the state's economy annually. At a national level, New York is a top producer of milk and dairy products, fruit, maple syrup, and more. Agriculture takes place in—and benefits—all regions of the state, including urban areas.

This summary provides an overview of climate change impacts on agriculture in New York State. It includes a synopsis of key climate change hazards, equity and justice considerations, impacts on Indigenous Peoples and Tribal Nations, key findings from the assessment's Agriculture chapter, and opportunities for the future.

Farm in the Finger Lakes region of New Y

Climate Change Hazards and Impacts | Technical Workgroup Key Fin
Climate Equity and Justice | Opportunities
Indigenous Peoples and Tribal Nations | Conclusions

Climate Change Hazards and Impacts on New York State's Agriculture

Agricultural activities are heavily exposed to and dependent on weather and climate. As a result, New agriculture sector faces numerous challenges as the climate changes. A wide range of climate hazards influence agriculture, including:

- More extreme heat events.
- Changes in the amount and duration of precipitation, including heavy rainfall and drought.
- More frequent and intense storms.
- Sea levels rise, and saltwater intrusion into farmland and water sources.

Case Studies

Preserving Sustenance, Income, and Generational Traditions in the Face of Growing Climate Impacts: Marine and Land Farming Adaptations Among the Shinnecock Nation

The Shinnecock people are experiencing climate change impacts on shellfish and crops that are key sources of revenue, food, and cultural traditions. Their community is using multiple strategies to adapt.

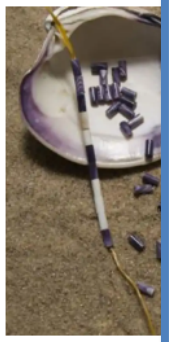
The Shinnecock Nation is a federally recognized Tribe with ancestral lands extending from present day Easthampton, Massachusetts to Brookhaven, New York. Today the Shinnecock people live on 1200 acres of their homelands, including 900 acres on what is known as Shinnecock Neck—a peninsula that juts into Shinnecock Bay.[1] They rely on shellfish, seaweed, and crops for sustenance and income. As both land and marine farmers, the Shinnecock people are experiencing multiple climate change impacts and are using multiple adaptation strategies to address them.

Shellfish such as oysters and clams are vital to the Shinnecock community. The hard clam is particularly important to their culture, serving as a form of sustenance and a component for making jewelry, tools, musical instruments, and wampum. "[Clamming] is a part of who we are and how we identify....It is an activity that is easily passed down," said Shavonne Smith, Director of the Shinnecock Environmental Department.

Clam populations have declined in Shinnecock Bay for decades, and ongoing reseeding efforts attempt to increase populations so that this source of food, revenue, and cultural traditions remains available. The threat of ocean acidification and its potential impact on the hard clam is a concern. If the hard clam does not survive, a portion of Shinnecock generational knowledge and traditions will be lost.

Highlights

- The Shinnecock pe multiple climate cha
- Climate change affe are important sourc identity, and cultura
- The Shinnecock co adaptation strategie impacts.



Wampum beads made from c

Shinnecock Bay is subject to several climate hazards. Although a barrier island protects increasing storm surge threatens the coastline. Oysters, which serve as food and incon as an important source of shoreline protection by decreasing erosion. According to Sm are "actively growing oysters to add to the reef with the purpose of addressing climate helping shoreline erosion." The Shinnecock inlet allows for water exchange between th Shinnecock Bay; the flushing of the Bay maintains water quality and helps keep the she However, excessive algae growth in the bay has led to closures of the shellfishing grou

Fact Sheets

NEW YORK STATE CLIMATE IMPACTS ASSESSMENT

Climate Change and Agriculture

Highlights from the New York State Climate Impacts Assessment

Agriculture is a vital industry in New York State. It provides food and other products to communities, creates jobs, and contributes more than $5.3 billion to the state's economy annually. At a national level, New York State is a top producer of milk and dairy products; fruits, such as apples, grapes, and cherries; maple syrup; and more. Agriculture takes place in—and benefits—all regions of the state, including urban areas.

Climate Change Impacts on New York State's Agriculture

Agricultural activities are heavily exposed to and dependent on weather and climate. As a result, agriculture in New York faces many challenges as the climate changes. A wide range of climate hazards can influence the sector, including:

- More extreme heat and cold events.
- Changes in the amount and duration of precipitation, including heavy rainfall and drought.
- More frequent and intense storms.
- Sea level rise and saltwater intrusion into farmland and water sources.

Because farmers rely on the weather, more uncertainty and more extreme weather events pose planning challenges for farmers and create a variety of risks to agricultural operations.

- **Extreme rainfall** can damage crops, flood fields, increase diseases and weeds, and cause delays in planting and harvesting. More frequent flooding has forced farmers to rethink which crops to plant and where to plant them.
- **Short-term drought** reduces crop yields and causes water shortages. Higher summer temperatures increase the risk of short-term droughts.
- **Warmer temperatures and longer growing seasons** could increase yields for some crops and offer opportunities to grow new crops.
- **Heat stress** affects livestock, crops, farmers, and farmworkers. High soil and air temperatures can harm plant growth and reduce crop yields. Heat stress can threaten the health of dairy cows and other livestock. Extreme heat can cause illness or death among workers exposed to high temperatures.
- **Increased weeds, diseases, and insects** damage crops. Warmer temperatures can increase the populations and ranges of some insects and other pests. Warmer temperatures might also allow new invasive species to take hold and increase the range of herbicide-resistant weed species, creating management challenges for farmers. Crops may become more susceptible to diseases as the climate becomes warmer and more humid.

Flooding caused by extreme rainfall has damaged this tomato crop on a farm in Upstate New York.

Equity and Justice

Geography, Government, Economy, and Demographics

Equity and Justice: Historical Context

Climate Change Impacts on Indigenous Peoples

Climate Change Impacts, Vulnerability, and Equity

Agriculture Chapter Summary

Climate Equity and Justice

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Everyone deserves to live, learn, work, and play in a safe and healthy environment, even as the climate changes. That is climate equity. However, some groups are more exposed to climate change hazards, are more at risk of harm, or have fewer resources to recover and adapt. This is often the case among historically underserved and underrepresented groups of people. Working to help these groups adapt to climate impacts is a form of climate justice.

Farmworkers planting onions in Upstate New York.

For agriculture, economic differences and a lack of diversity are important climate equity and justice considerations. These factors can magnify climate impacts and make it more difficult for farmers to adapt. For example, Indigenous, Asian, Black, and biracial farmers represent only 1.2% of New York State farm owners. Recent research has found that farmers of color, immigrant farmers, and female farmers typically have smaller farms and grow higher-value, more labor-intensive crops. These farmers typically have fewer resources to adapt or respond to climate hazards that threaten their businesses.

The high cost of land also makes it harder for new farmers to enter and remain in agriculture. Available land is often of lower quality, making it harder for farmers to make a living or adapt to climate impacts. Farmers who cannot afford to buy and own land may choose to rent instead, and they may not have the resources to adapt or respond to climate hazards that threaten their businesses.

Because farmworkers work mostly outdoors, they are directly exposed to climate hazards. One major concern with the changing climate is the impact of more frequent and hotter heat waves have on farmworkers' health. About 50% of farmworkers in New York State are undocumented, and they face added challenges that limit their ability to cope with these hazards. For example, they may avoid seeking help because of the fear of deportation and potential lost wages. They may also live in housing that is unable to withstand extreme weather.

Indigenous Peoples and Tribal Nations

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There are eight federally recognized Tribal Nations and one state-recognized Nation in New York State, as well as several other Indigenous communities that maintain ties to the state and live in surrounding states. The colonization and dispossession of Tribal lands, as well as forced migration to lower-quality lands, have contributed to the climate risks Indigenous Peoples face.

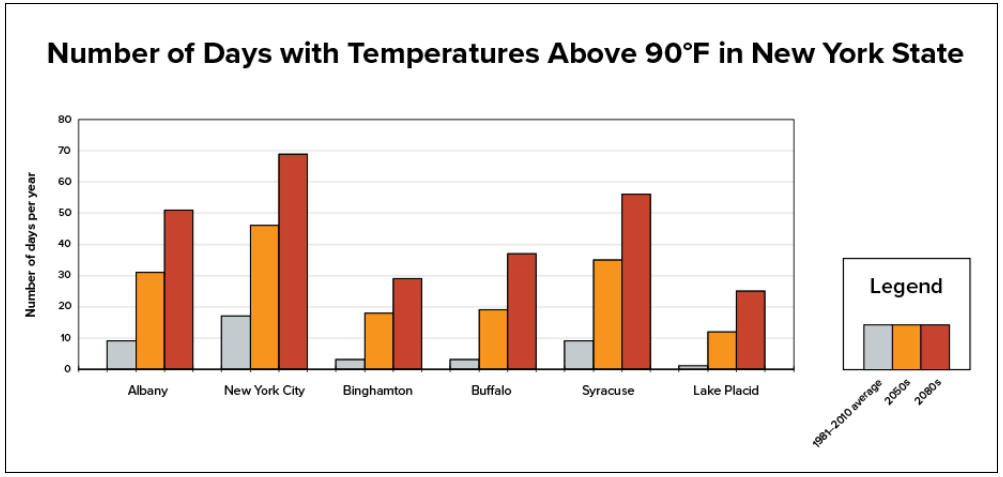
For example, Tribal Nations and Indigenous Peoples engage in agriculture for food, medicines, and materials for cultural traditions. Tribal Nations were forced off ancestral lands to lands with lower economic value. Agricultural activities on these lands are more exposed to climate impacts from extreme heat, less precipitation and more drought, and sea level rise. Climate change threatens some key products that are important as food and serve other purposes for Indigenous people, such as northern quahog, a type of clam that is essential for both sustenance and wampum-making within the Shinnecock Nation. Indigenous Peoples in New York are working on climate adaptation solutions. For example:

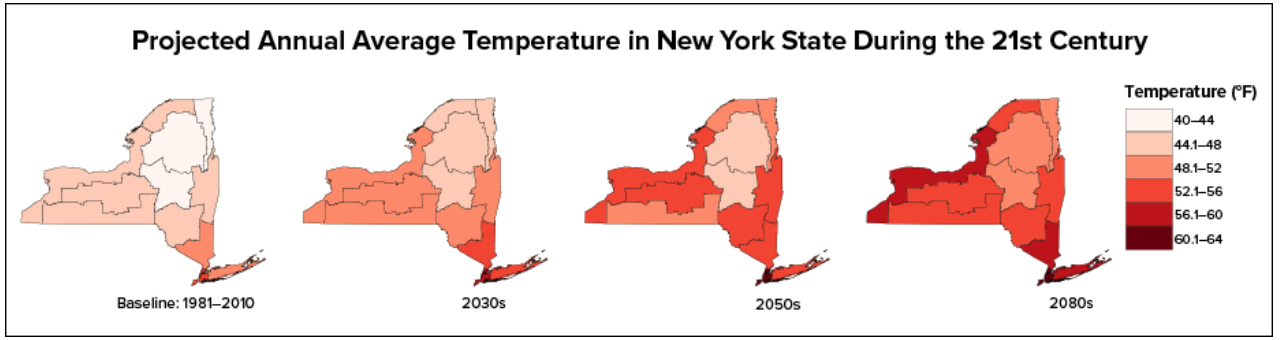
- The Oneida Nation will produce certified organic maple syrup and cannabis to provide additional income in the

Central NY/Finger Lakes Example of Impacts

What is likely to happen: Extreme Heat

- The number of extremely hot days is projected to increase as well. Syracuse—the weather station in the region with the best long-term weather records for this climate assessment—has historically experienced an average of **nine days per year over 90°**; this number is projected to increase to 24 to 42 days per year by mid-century and **to 35 to 70 days per year by the end of the century**.
- … heat index is also a concern. Humidity increases the danger of heat-related illness and death; heat index is a measure that combines temperature and humidity, has historically peaked at around 101°F in the region. Maximum heat index values in the region are expected to increase throughout the century.



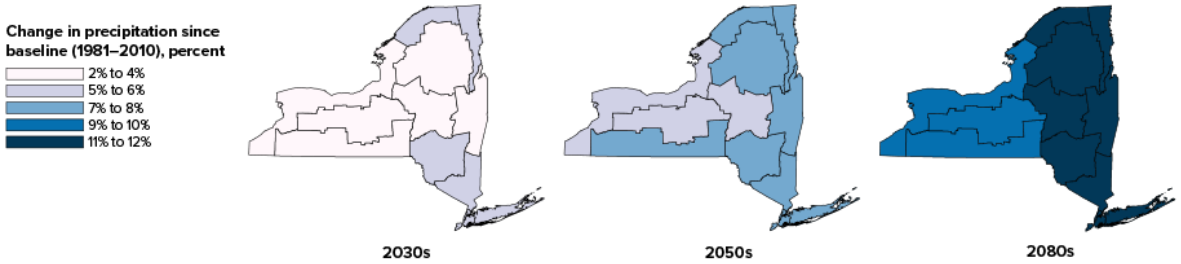


Source: [Climate Impact Spotlight: Central NY & Finger Lakes]

What is likely to happen: Precipitation

- Total Annual Precip.: Like elsewhere in New York State, total annual precipitation in the Central/Finger Lakes region is projected to increase in the next century. As weather patterns change, however, **more of this precipitation will fall in heavy bursts, and short-term droughts lasting weeks to months could increase**, particularly in the summer.
- Seasonal Precip.: Warmer winter temperatures also mean less precipitation will fall as snow. **There is potential for lake-effect snowfall in the region to increase in the short term as warmer water and decreased ice cover allow more water to evaporate from the lakes**. Over the long term, however, more of this is likely to fall as rain. In Syracuse, winter precipitation has increasingly fallen as rain rather than as snow since 1949 due to warmer temperatures. This trend is expected to continue.
- Snowfall: Less snowfall, less snow cover and accumulation, potentially winters without snow at all.

Projected Annual Precipitation in New York State During the 21st Century



Source: Chapter 2: NYS's Changing Climate

What is likely: Lake Temp. & Wine Prod.

- Warmer air temperatures also lead to increasing surface water temperatures in the Finger Lakes and other waters throughout the region. Oneida Lake, for example, is projected to see **surface water temperatures increase by 6.7°F by the end of the century**. Some of the lakes in the region will see increasing differences between surface and deep-water temperatures, known as thermal stratification. Stratification prevents the water from mixing and can change water chemistry and harm aquatic life. It can also prevent dissolved oxygen from reaching deeper waters, which, in severe cases, can kill fish.
- Warming temperatures in late winter and early spring can cause grapevines and other fruit crops to blossom early. A late spring frost can then damage flowers and cause crop failure. This is a major concern for wine growers in the region, who have experienced large crop losses in recent years, for example, a **loss of up to 67% of European grape varieties in spring 2014**. As temperatures rise throughout this century, some growers might be able to shift to different grape varieties, though replacing long-lived grapevines can require a substantial investment of money and time.

Source: Climate Impact Spotlight: Central NY & Finger Lakes

What this means for CNY/Finger Lakes?

- Climate Change Summary
  - Flooding is a paramount concern for coastal adjacent communities (including along Lake Ontario)
  - More precipitation, especially in winter. Much higher humidity levels throughout the year. Less snowfall/snowpack, shorter winters, potentially winters without snow; icing more likely
  - Increased extreme precipitation events; overall more hot days; extreme heat will be an issue for the NYC area
  - Expect the unexpected – more frequent hurricanes, wildfires, pests, micro-bursts, convective storms
- Impacts/Adaptation needs:
  - **Aging storm water systems will be taxed/overwhelmed**; increased disruption to mass transit and tunnels
  - **Costly flood damage, needs for improved stormwater systems and littoral infrastructure adaption strategies**
  - **Building structural and materials changes**, overhead infrastructure at increased risk
  - Transportation and supply chain disruptions; spill over effects from other parts of the continent, food insecurity will rise

Source: Chapter 2: NYS's Changing Climate

What is likely: Statewide Impacts

1: Climate change is affecting New York State now and is projected to continue to change and affect every region of the state.

2: Even under a lower-emissions scenario, climate change impacts across New York State will be substantial.

3: The **frequency and intensity of extreme events such as heavy rainstorms, seasonal droughts, and heat waves are projected to increase**.

4: Sea level along New York State's coastline has risen almost 1 foot in the past century and is projected to increase by another 1 to 2 feet by midcentury.

5: **Climate hazards often do not occur in isolation, and impacts can be compounded when multiple events happen near each other in time or space.**

6: New York State residents and communities that are marginalized or suffer from legacies of displacement or discrimination are more vulnerable to climate impacts.

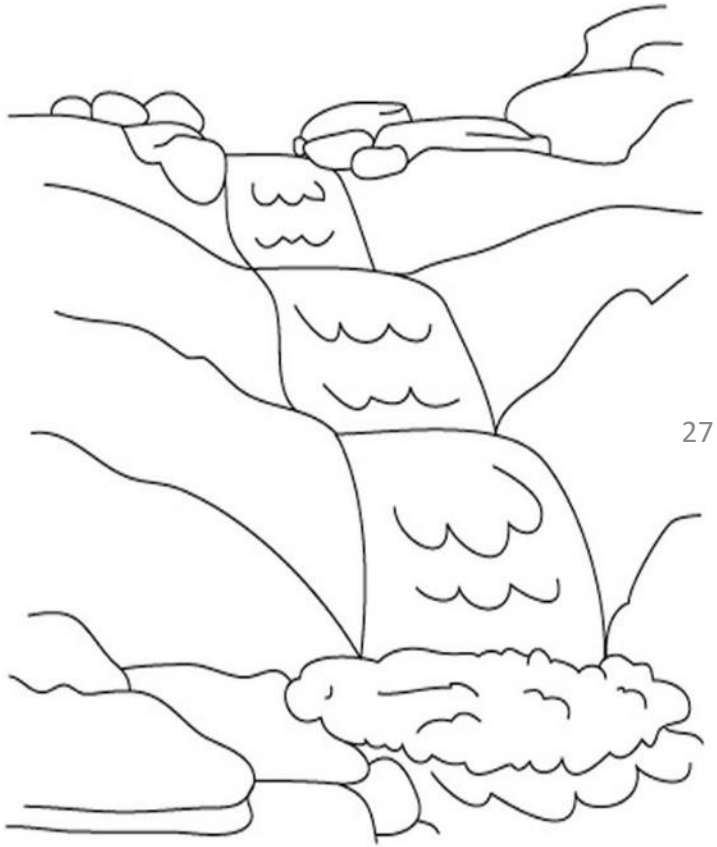
7: Climate change will introduce new risks and opportunities into nearly every dimension of New York State's economy.

8: Climate change poses escalating health and safety risks for the people of New York State, including risks to mental health.

9: Infrastructure provides vital services across New York State but is vulnerable to climate-related impacts.

10: Every community and every sector in New York State has the **potential to contribute to innovative climate solutions that reduce vulnerabilities, foster resilience, and enhance equity**.

Cascading Impacts: A chain or series of connected impacts

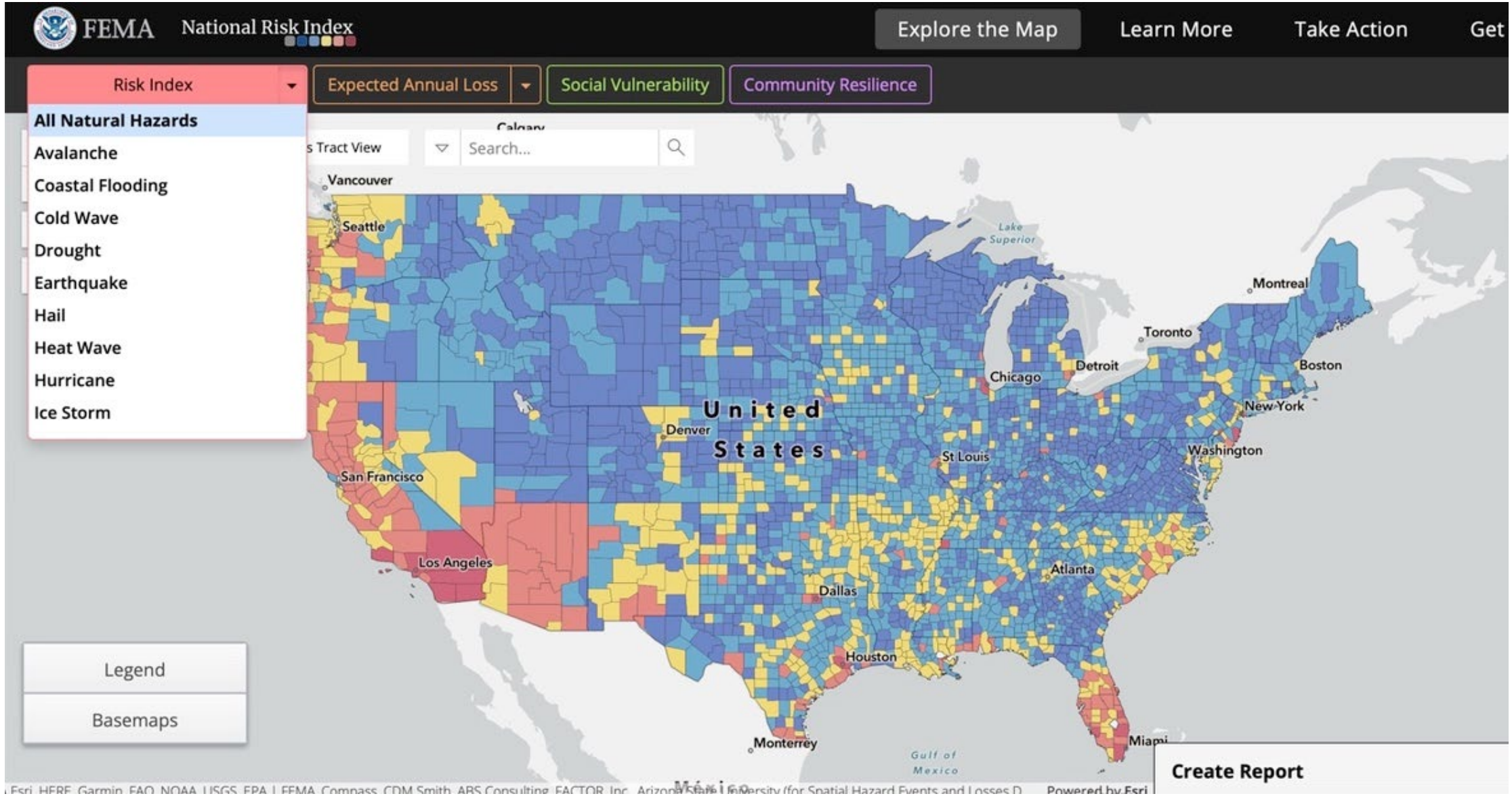


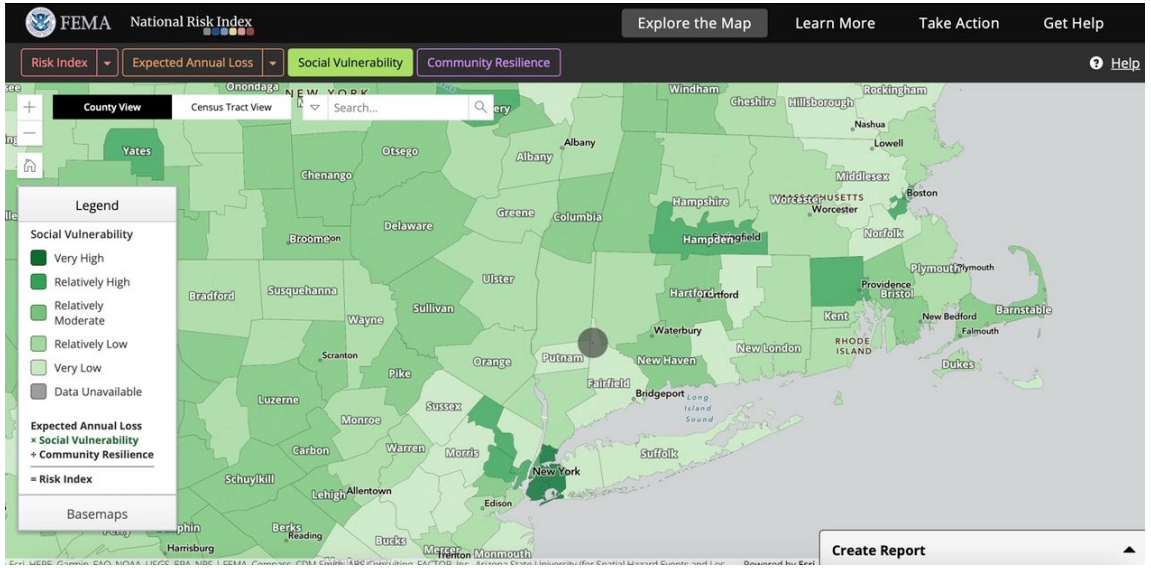
Snow Event → Heavier Snow → Roof Collapses → People Needing Shelter/ Businesses Closed → Disruption in Community Patterns/Economy

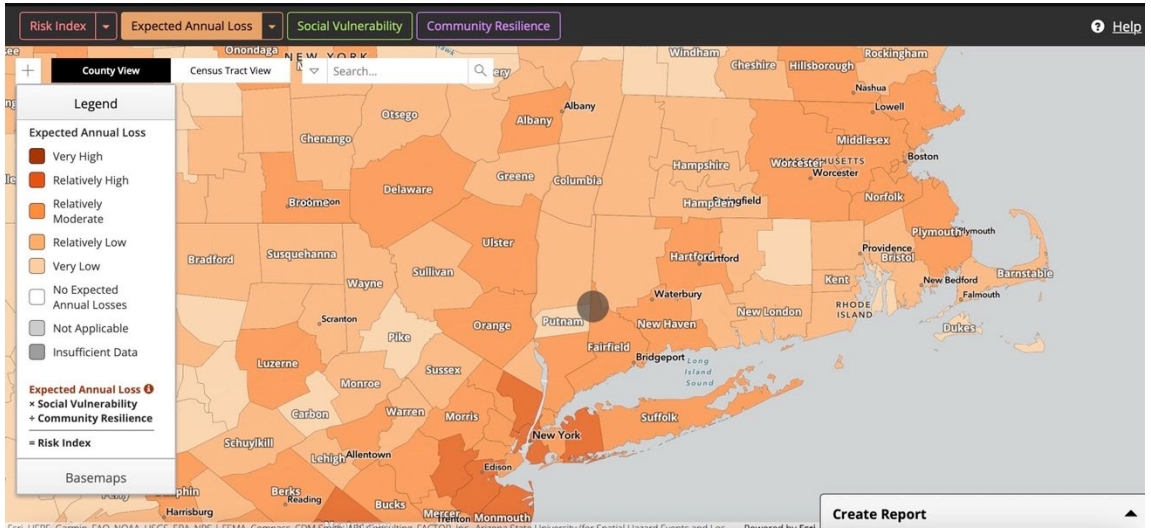
How does NYS Fit within the National Picture?

Goldilocks? Or not?

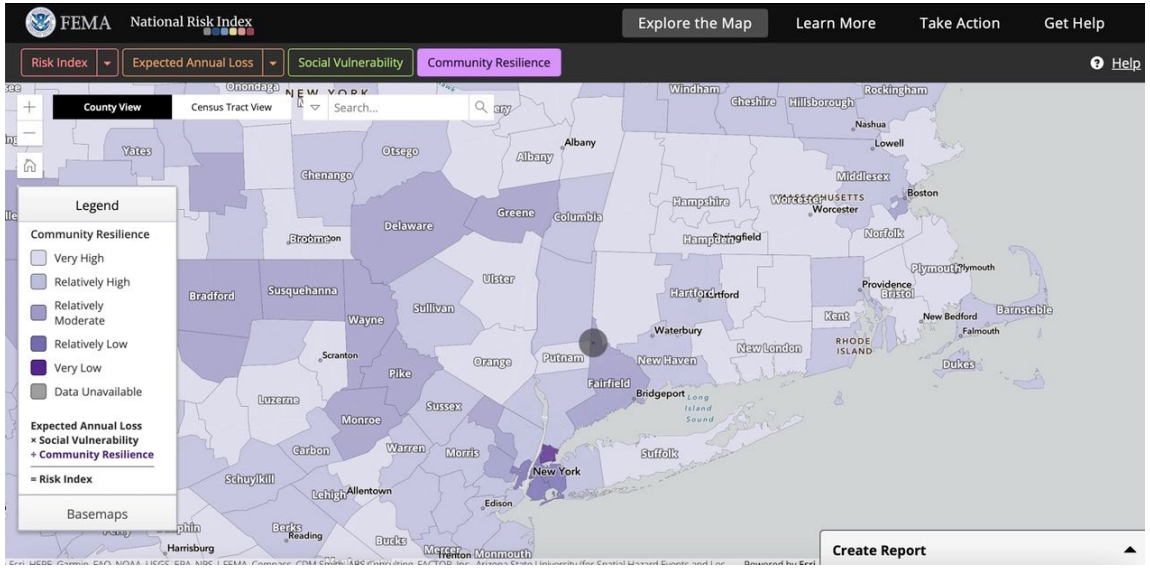
National Risk Assessment







Hazard Index by location
Social Vulnerability
Community resilience

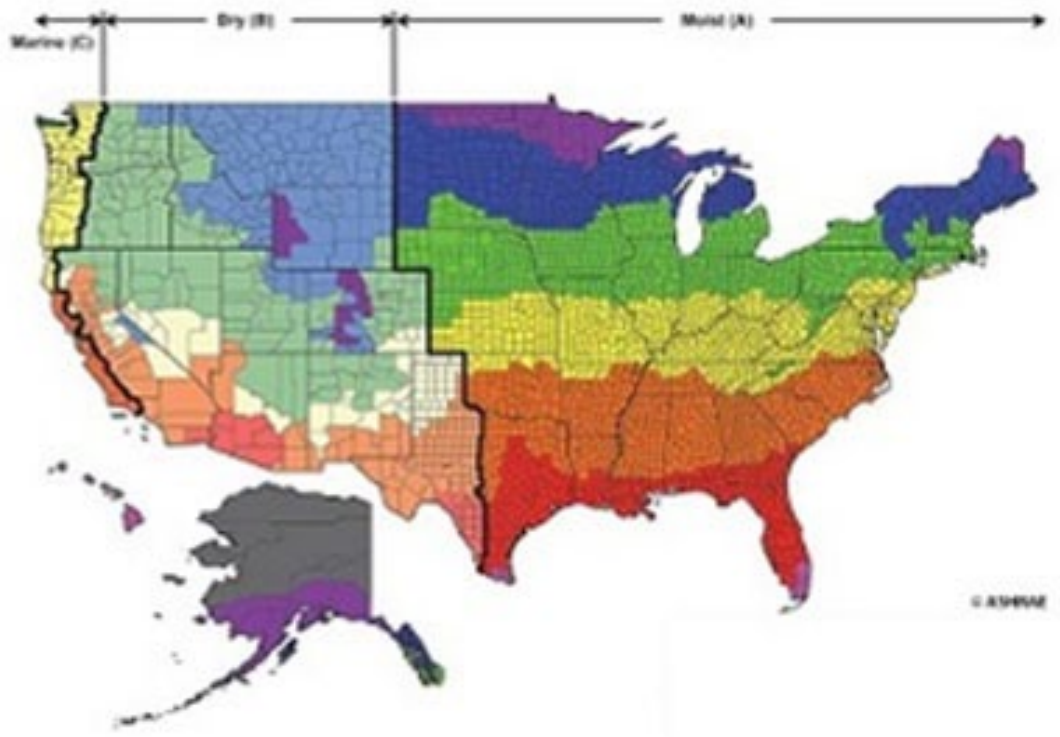


Assessment + Investment

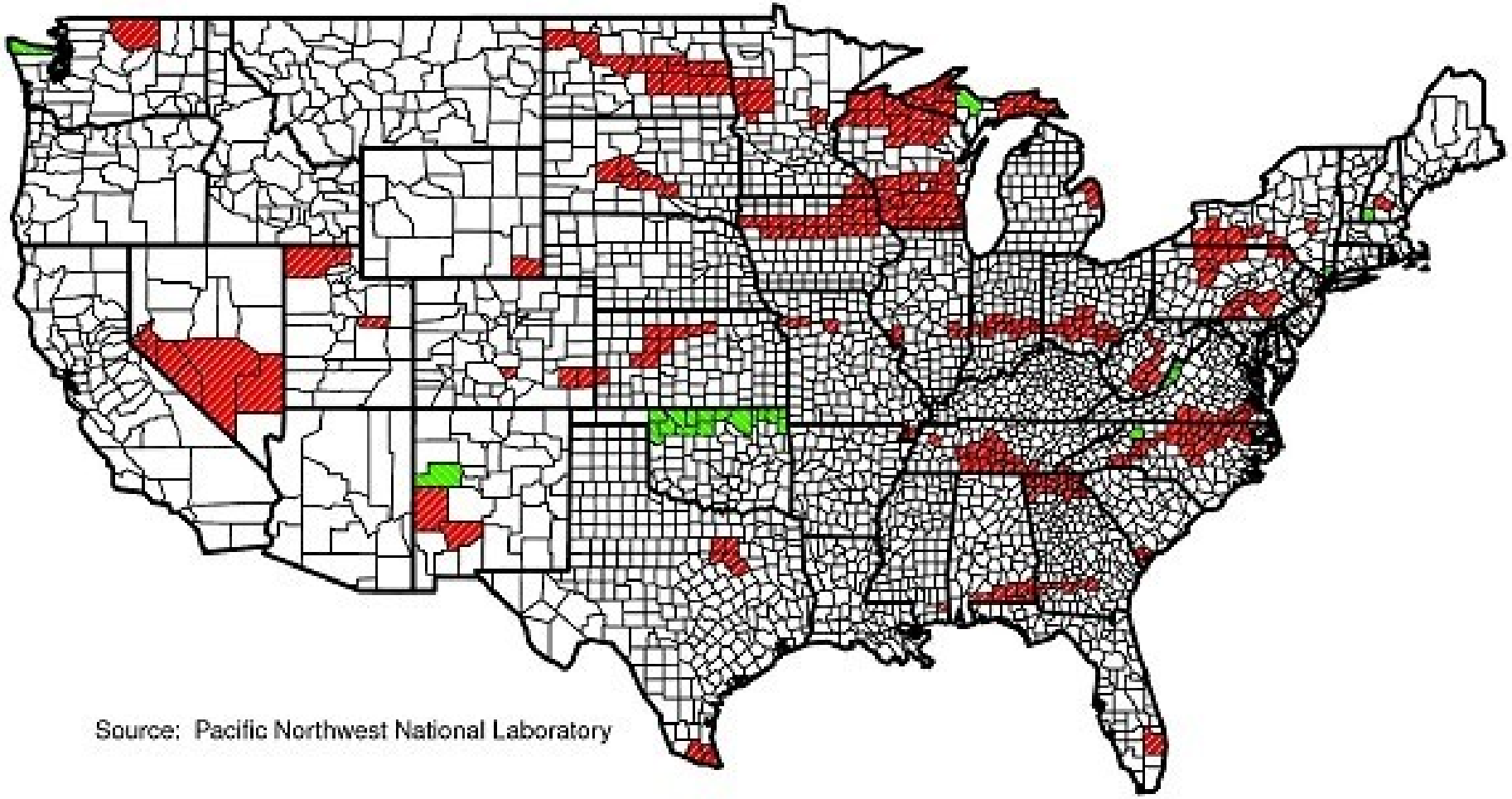
Are there zones of safety?

Does Goldilocks exist?

- Adaptive ecosystems
- New hazards introduced in new areas

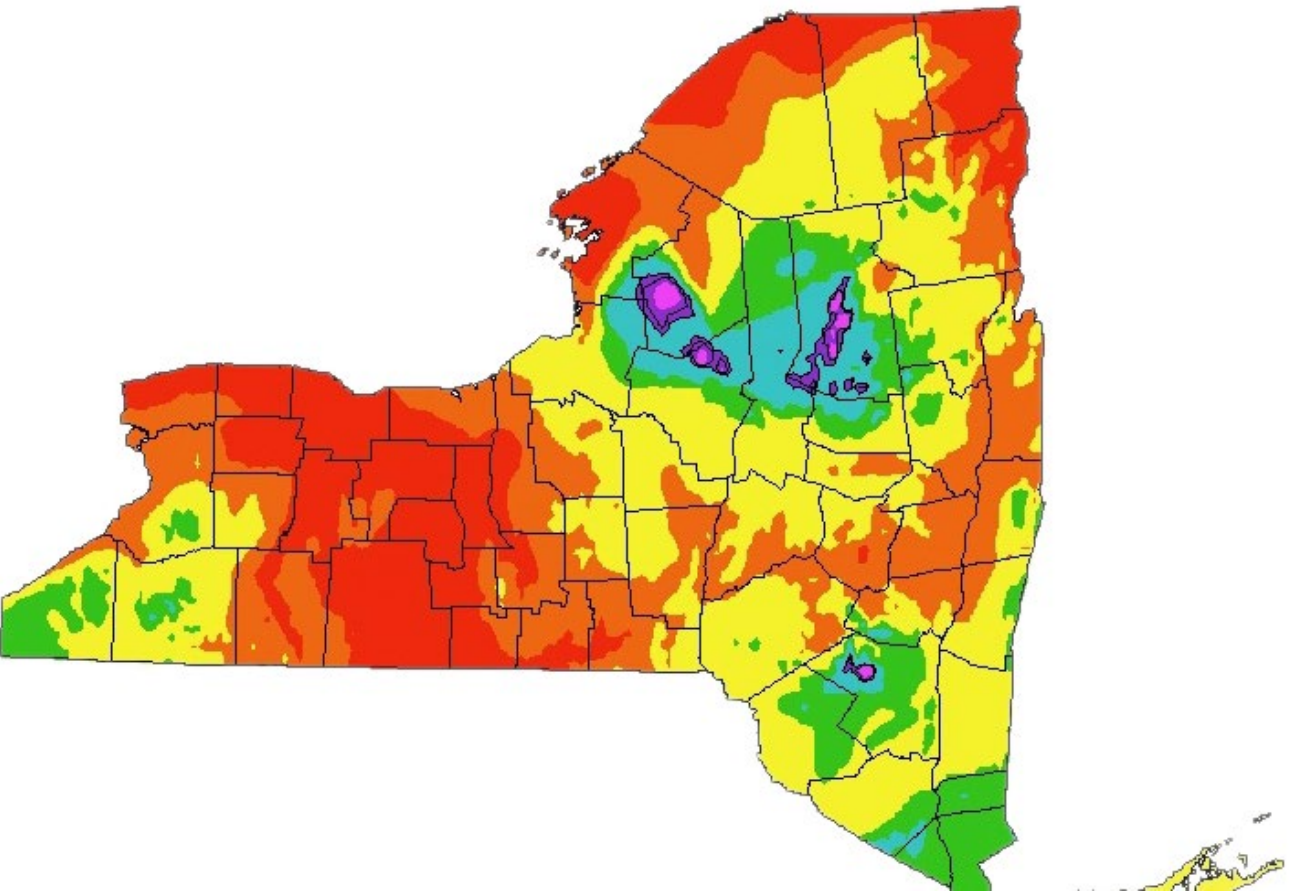


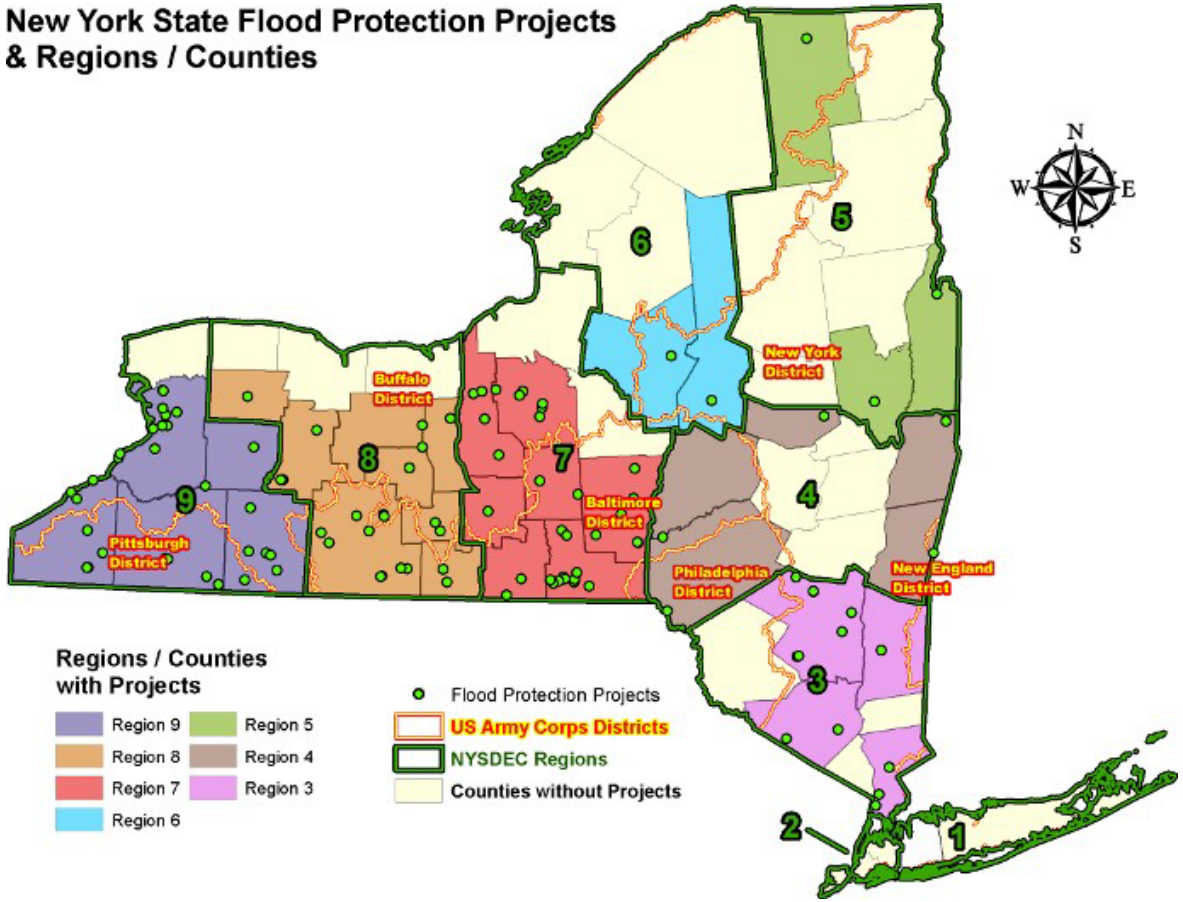
- Short term changes
- Long term?



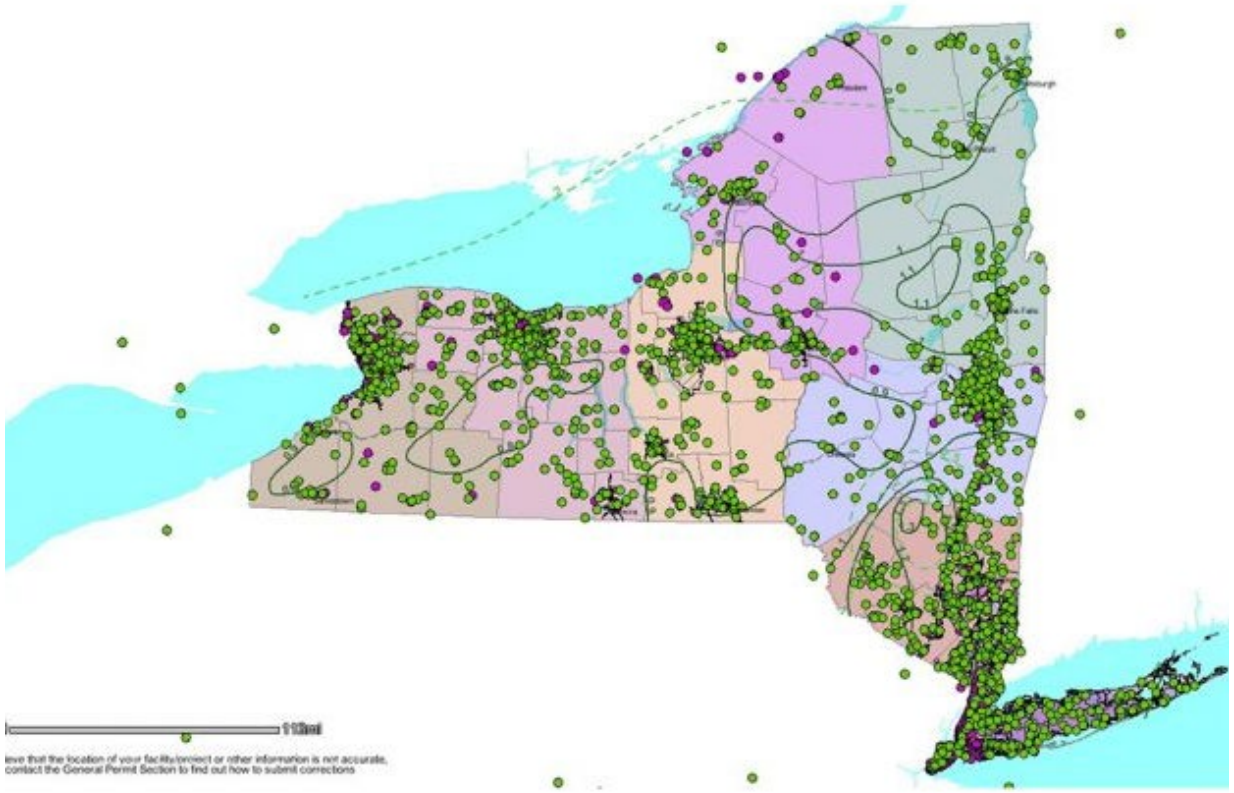
Source: Pacific Northwest National Laboratory

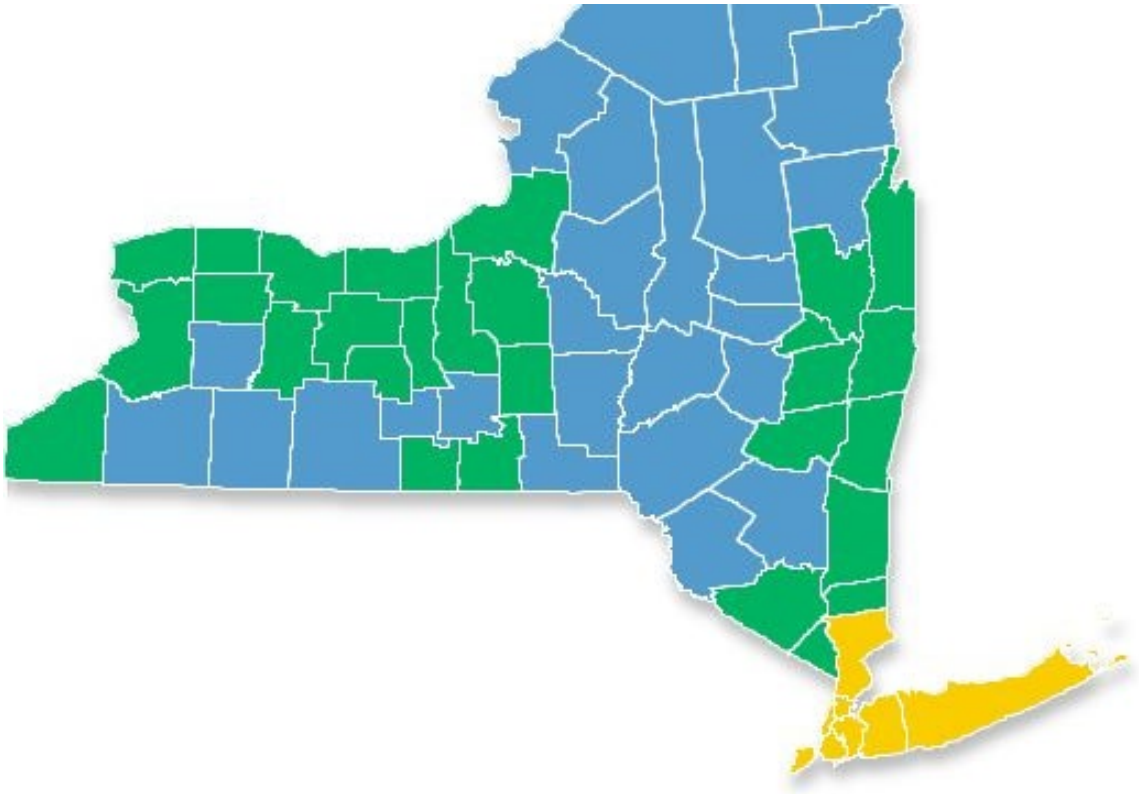
Precipitation and Flood State

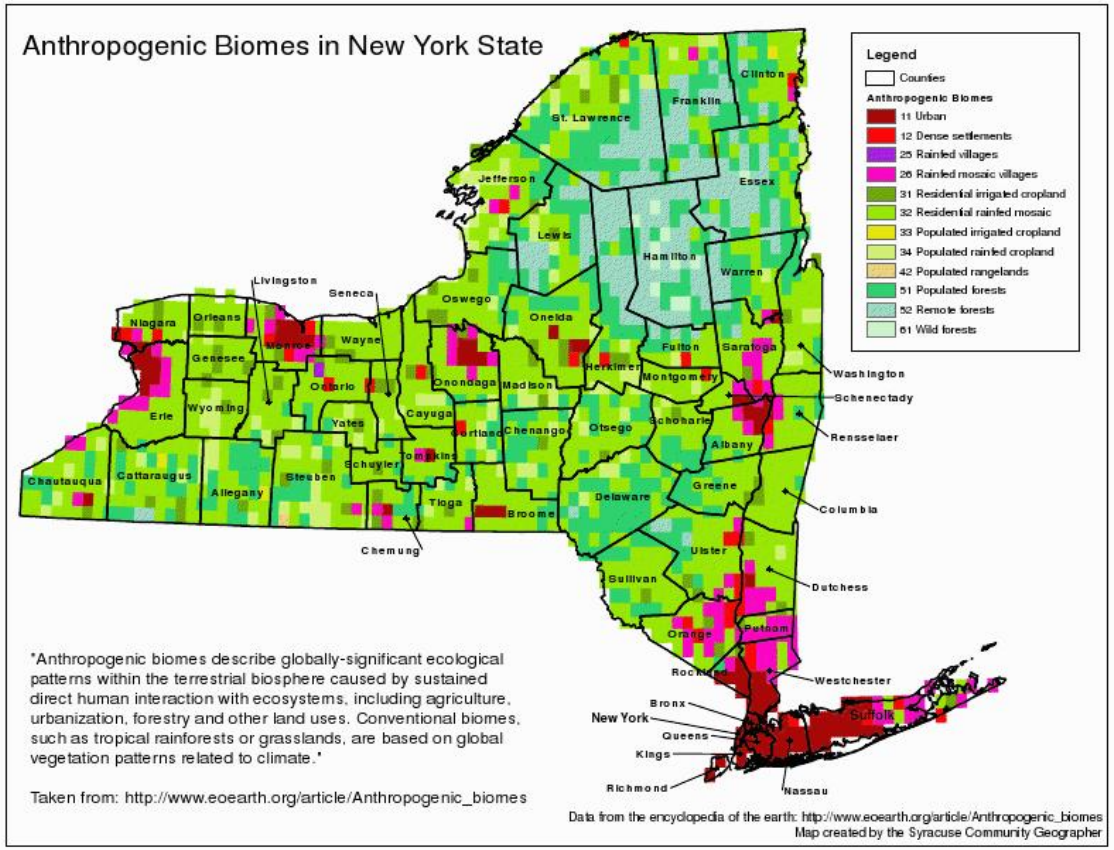


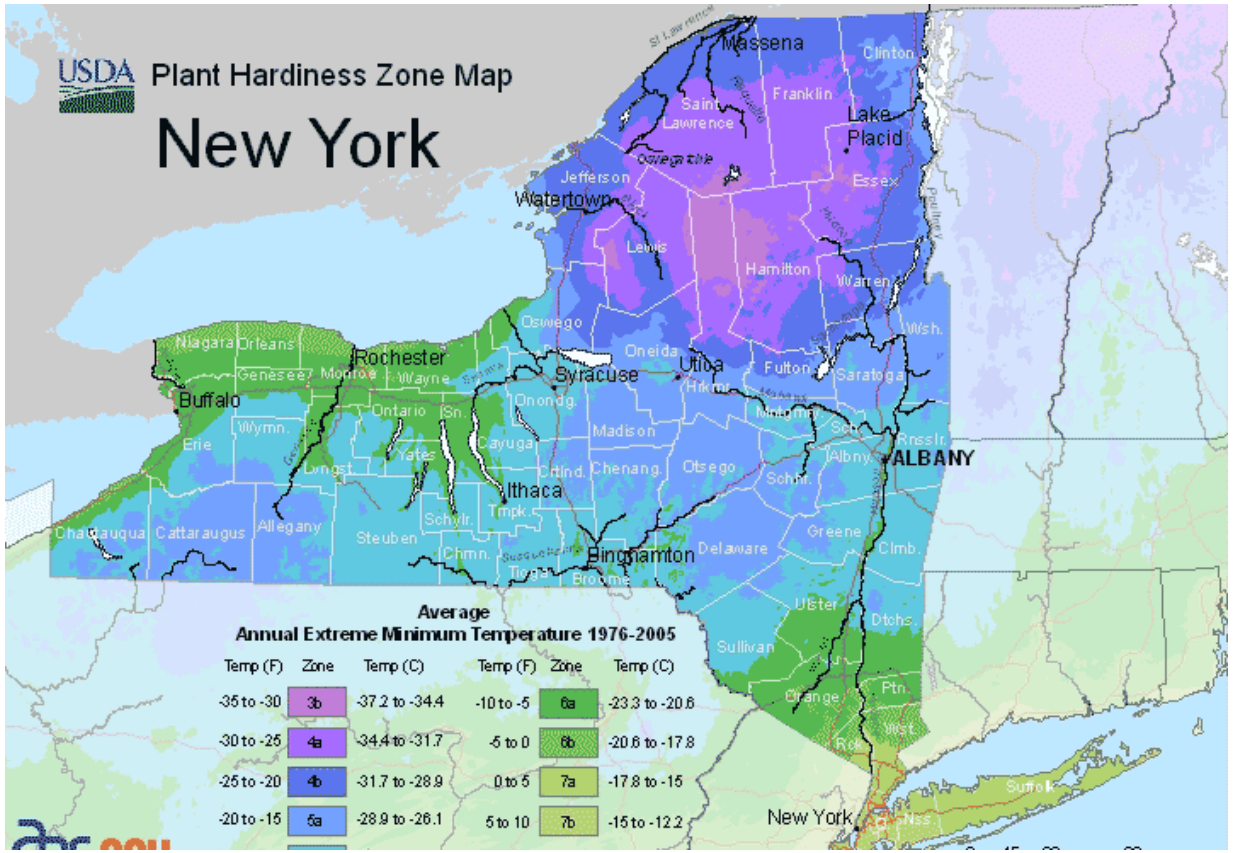


Climate zones and storm water






Anthropogenic Biomes in New York State
Legend
Counties
Anthropogenic Biomes
11 Urban
12 Dense settlements
25 Rainfed villages
26 Rainfed mosaic villages
31 Residential irrigated cropland
32 Residential rainfed mosaic
33 Populated irrigated cropland
34 Populated rainfed cropland
42 Populated rangelands
51 Populated forests
52 Remote forests
61 Wild forests
"Anthropogenic biomes describe globally-significant ecological patterns within the terrestrial biosphere caused by sustained direct human interaction with ecosystems, including agriculture, urbanization, forestry and other land uses. Conventional biomes, such as tropical rainforests or grasslands, are based on global vegetation patterns related to climate."
Taken from: http://www.eoearth.org/article/Anthropogenic_biomes
Data from the encyclopedia of the earth: http://www.eoearth.org/article/Anthropogenic_biomes
Map created by the Syracuse Community Geographer


USDA Plant Hardiness Zone Map
New York
Average
Annual Extreme Minimum Temperature 1976-2005
Temp (F) Zone Temp (C)
-35 to -30 3b -37.2 to -34.4
-30 to -25 4a -34.4 to -31.7
-25 to -20 4b -31.7 to -28.9
-20 to -15 5a -28.9 to -26.1
-10 to -5 6a -23.3 to -20.6
-5 to 0 6b -20.6 to -17.8
0 to 5 7a -17.8 to -15
5 to 10 7b -15 to -12.2
Massena
Watertown
Lake Placid
Rochester
Buffalo
Syracuse
Ithaca
Binghamton
ALBANY
New York

Identify 'Goldilocks Zone,' or Habitable Zone

- Lower risk profile= fewer hazards over time
- Climate change impact to ecosystem of food production
- Existing carrying capacity is high and can “receive” populations

- Candidate for receiver communities - Action
  - Improve and prepare infrastructure
  - Build capacity for increase in population across sectors

Impacts on Buildings

Climate Change Impacts on Buildings

- Key Finding 1: Buildings of all ages, functions, and locations across New York State are vulnerable to the impacts of climate change.
- Key Finding 2: Given the long lifespan of buildings, **new construction and retrofits that consider long-term climate projections will better address future climate risk**.
- Key Finding 3: Climate impacts to buildings can ripple to many different parts of a community.
- Key Finding 4: Communities of color, Tribal communities, and low-income communities are more likely to congregate, live, and work in buildings that have greater exposure to climate hazards.
- Key Finding 5: **Individual adaptation and resilience strategies can address multiple climate impacts**.

Source: Chapter 4: Buildings

Climate Change Impacts on Buildings

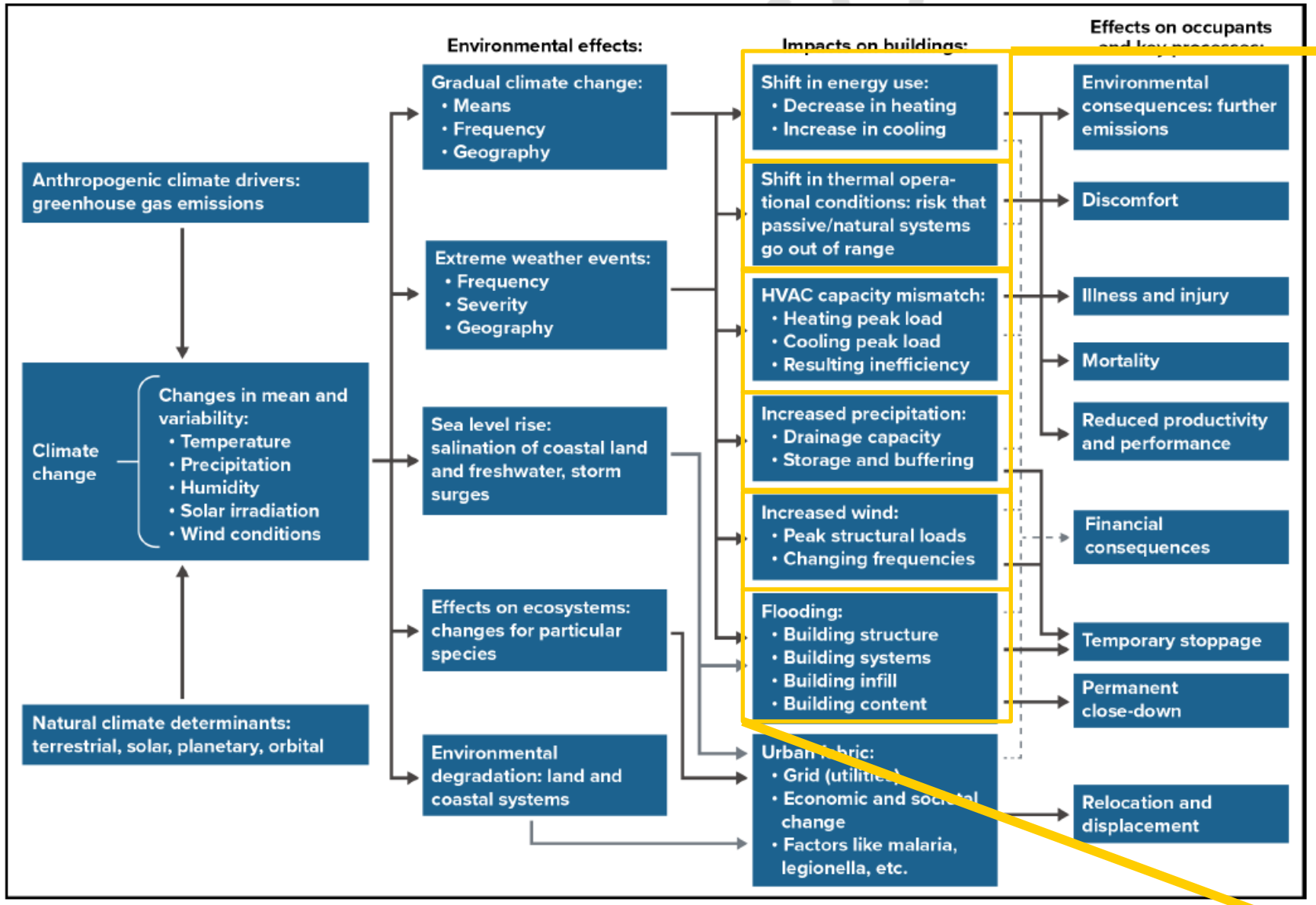


Figure 4-4. Climate change impacts on buildings and effects on building occupants. Figure by de Wilde and Coley (2012).[39]

Impacts on buildings:

Shift in energy use:
- Decrease in heating
- Increase in cooling

Shift in thermal operational conditions: risk that passive/natural systems go out of range

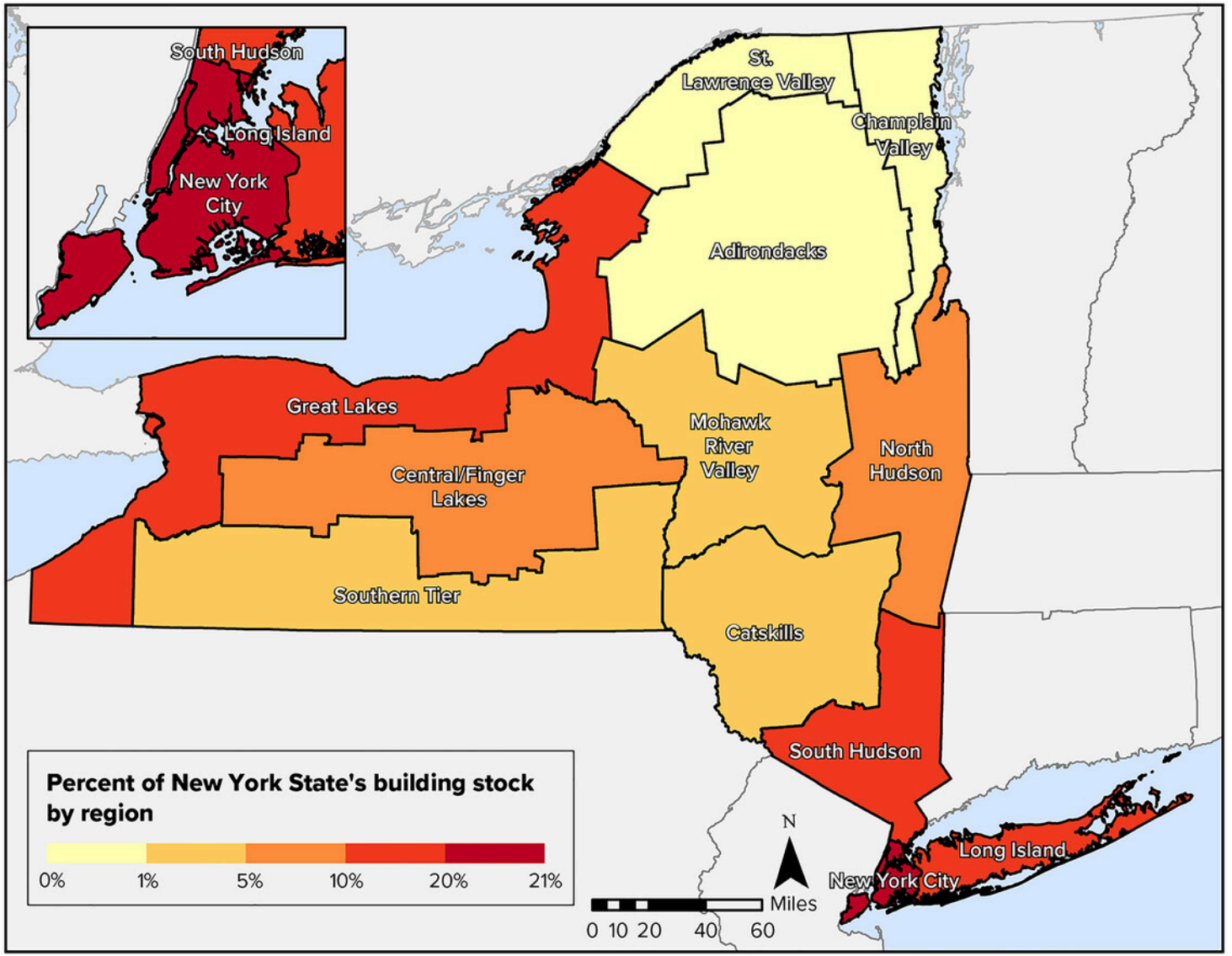
HVAC capacity mismatch:
- Heating peak load
- Cooling peak load
- Resulting inefficiency

Increased precipitation:
- Drainage capacity
- Storage and buffering

Increased wind:
- Peak structural loads
- Changing frequencies

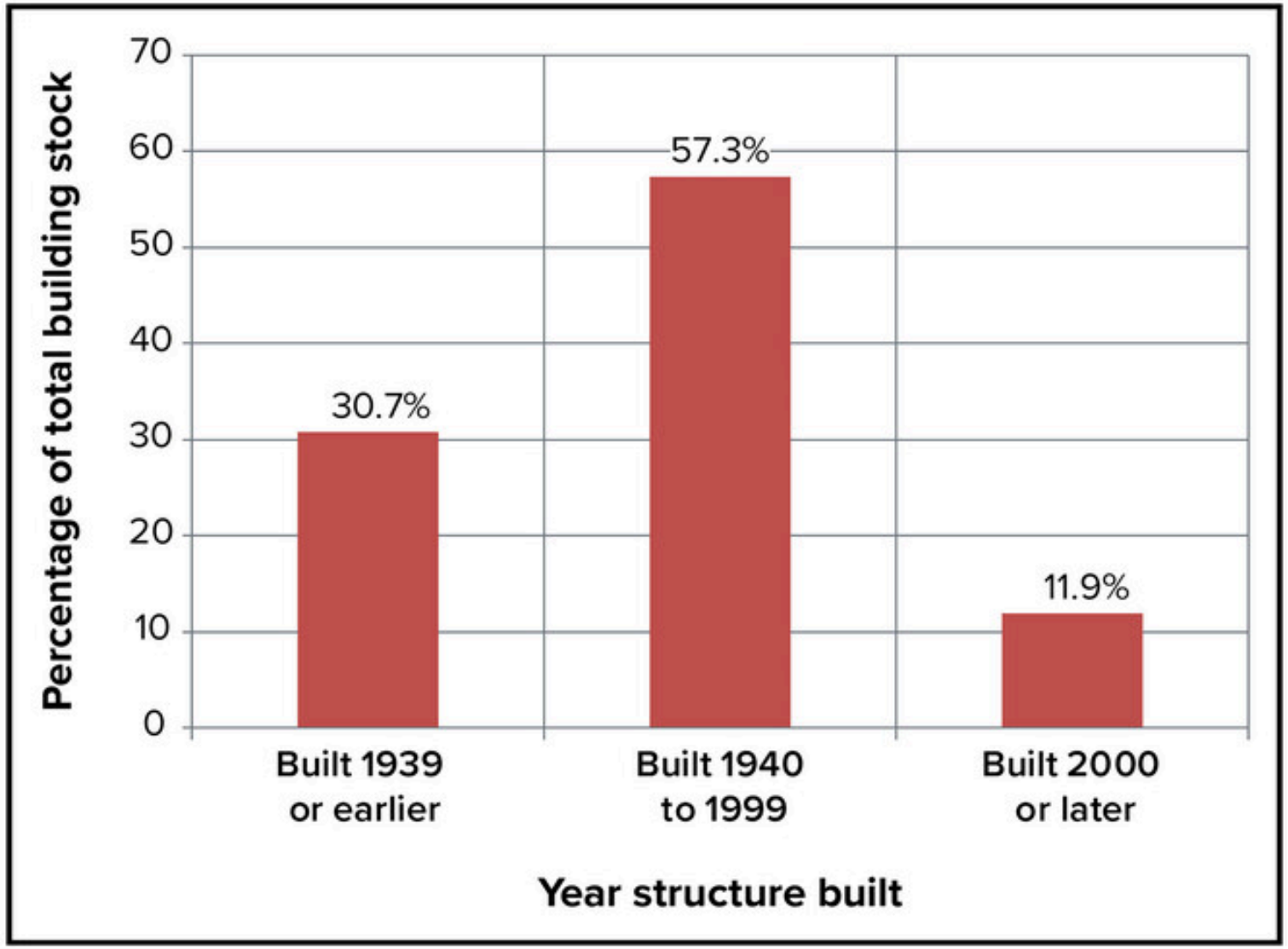
Flooding:
- Building structure
- Building systems
- Building infill
- Building content

New York State Climate Impacts Assessment Chapter 04: Buildings



Source: Annals of the New York Academy of Sciences, Volume: 1542, Issue: 1, Pages: 214-252, First published: 09 December 2024, DOI: (10.1111/nyas.15200)

New York State Climate Impacts Assessment Chapter 04: Buildings



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New York State Climate Impacts Assessment Chapter 04: Buildings

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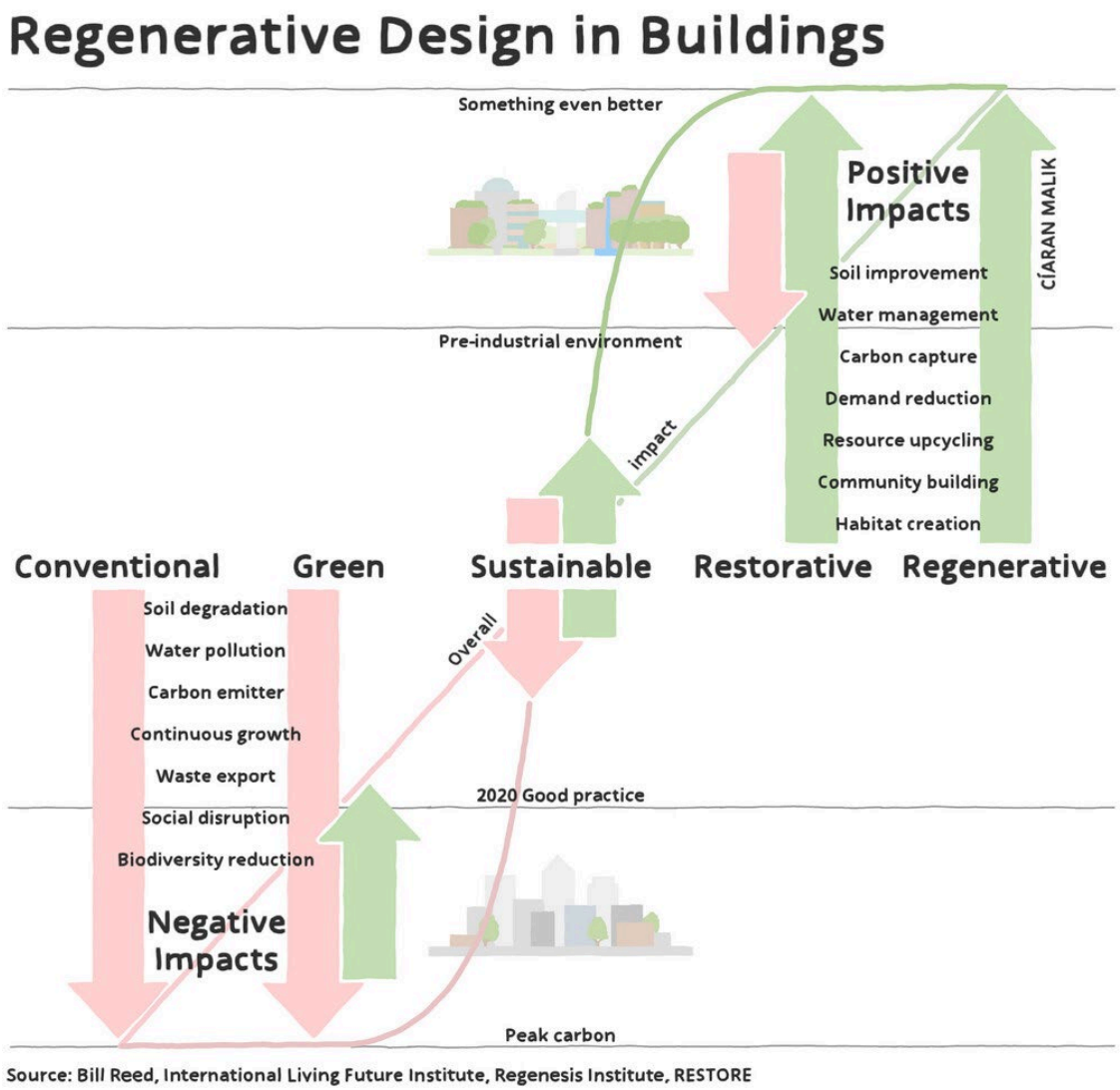
New York State Climate Impacts Assessment Chapter 04: Buildings



Source: Bill Reed, International Living Future Institute, Regenesis Institute, RESTORE

2.6 Opportunities for positive change

Climate change is expected to lead to primarily negative direct outcomes for New York State's buildings, aside from reducing winter heating needs as temperatures increase. By rising to the challenge and adapting to climate hazards, however, the state has opportunities to create additional positive outcomes.

- Synergies and co-benefits of resilient buildings

Source: Annals of the New York Academy of Sciences, Volume: 1542, Issue: 1, Pages: 214-252, First published: 09 December 2024, DOI: (10.1111/nyas.15200)

Attainable Solutions for Single-Family Resilience: The Hurricane-Strong Home in Breezy Point, Queens

This single-family home rebuild in Breezy Point, Queens, began after Superstorm Sandy in 2012 and incorporated resilience measures such as elevated foundation walls, flood vents, concrete and foam wall and floor systems, spray foam insulation, concrete roof tiles, and fiber-cement siding. Photo by +LAB architect PLLC.

Highlights

- Building occupants are reluctant to relocate, even in communities highly vulnerable to climate change impacts. Building resilience measures allow residents to stay safely in their homes while saving money in the long term.
- Resilience measures provide savings in insurance, maintenance, energy, and rebuilding costs throughout the building's lifecycle. The new hurricane-strong home in Breezy Point is only 7% to 9% more expensive to build than a typical home. With energy, maintenance, and insurance savings, the upgrades pay for themselves in 8 to 10 years.

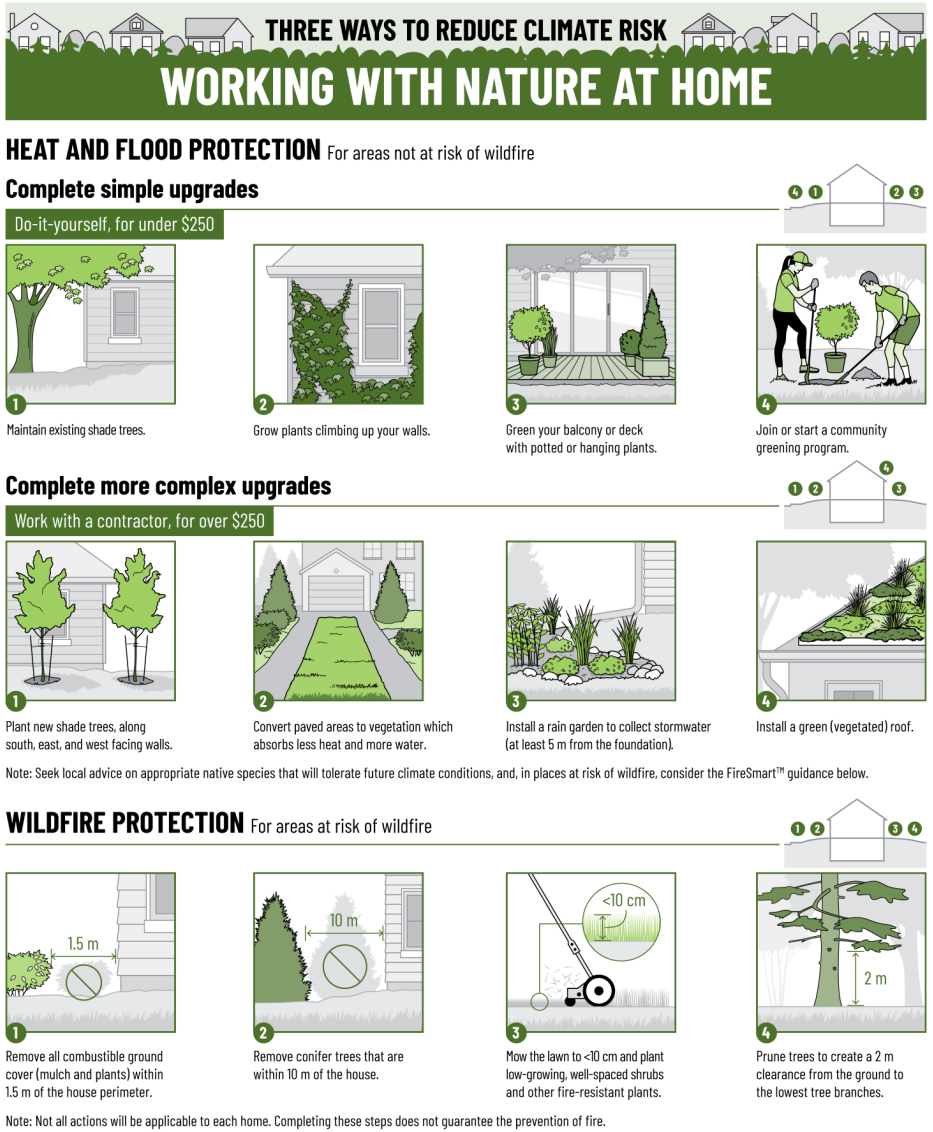
Mitigation & Adaptation Options and Strategies

What can we do about this? Adapt!

- Mitigation Saves
  - Putting in place measures ahead of the events, has proven cost savings (not just for public owners, but for all impacted)
  - 2019 NIBS Report
  - FEMA Factsheet

National Institute of BUILDING SCIENCES™

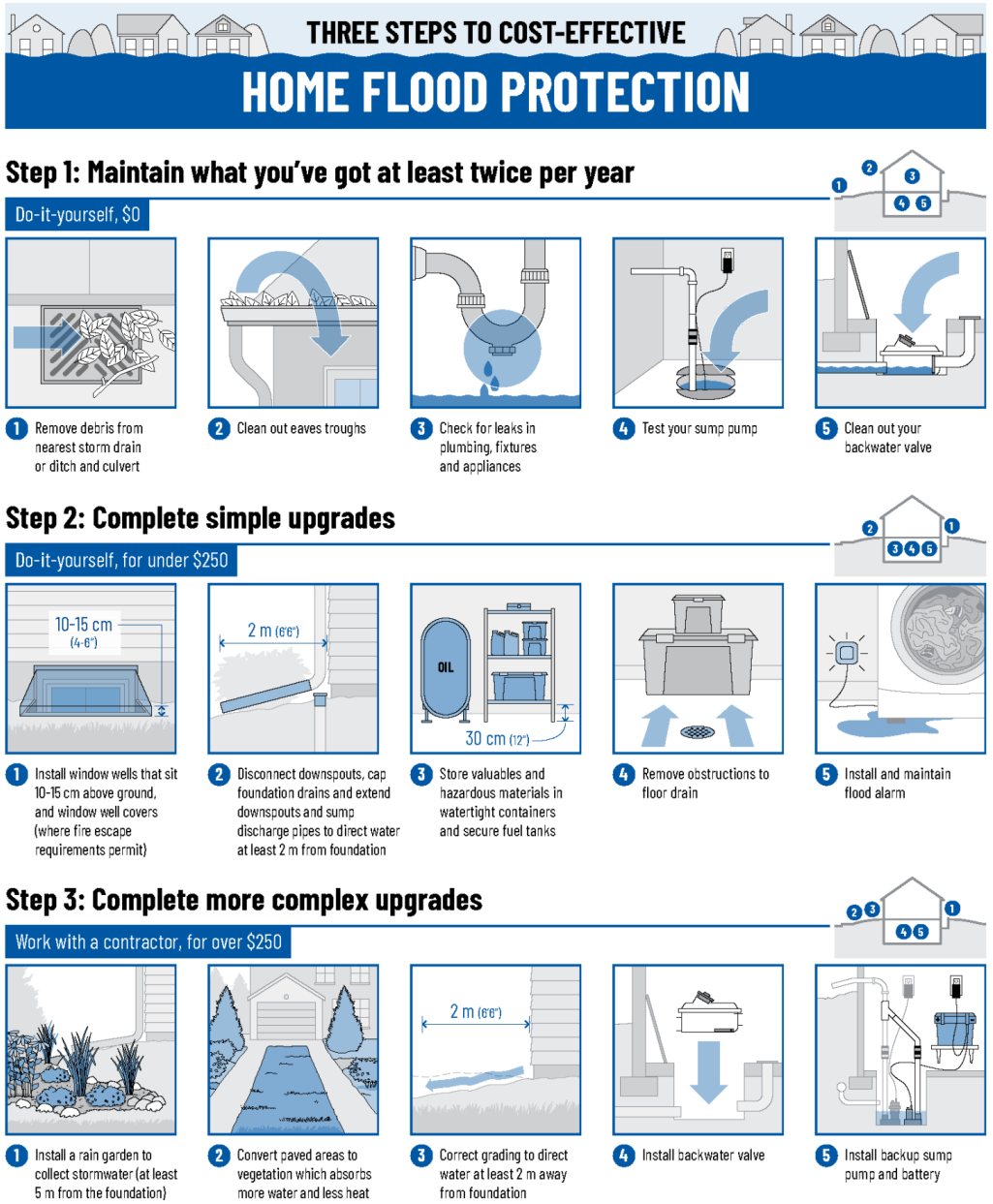
	ADOPT CODE	ABOVE CODE	BUILDING RETROFIT	LIFELINE RETROFIT	FEDERAL GRANTS
Overall Benefit-Cost Ratio	11:1	4:1	4:1	4:1	6:1
Cost ($ billion)	$1/year	$4/year	$520	$0.6	$27
Benefit ($ billion)	$13/year	$16/year	$2200	$2.5	$160
Riverine Flood	6:1	5:1	6:1	8:1	7:1
Hurricane Surge	not applicable	7:1	not applicable	not applicable	not applicable
Wind	10:1	5:1	6:1	7:1	5:1
Earthquake	12:1	4:1	13:1	3:1	3:1
Wildland-Urban Interface Fire	not applicable	4:1	2:1	not applicable	3:1



Source: Intact Centre on Climate Adaptation, Climate Ready Infographics

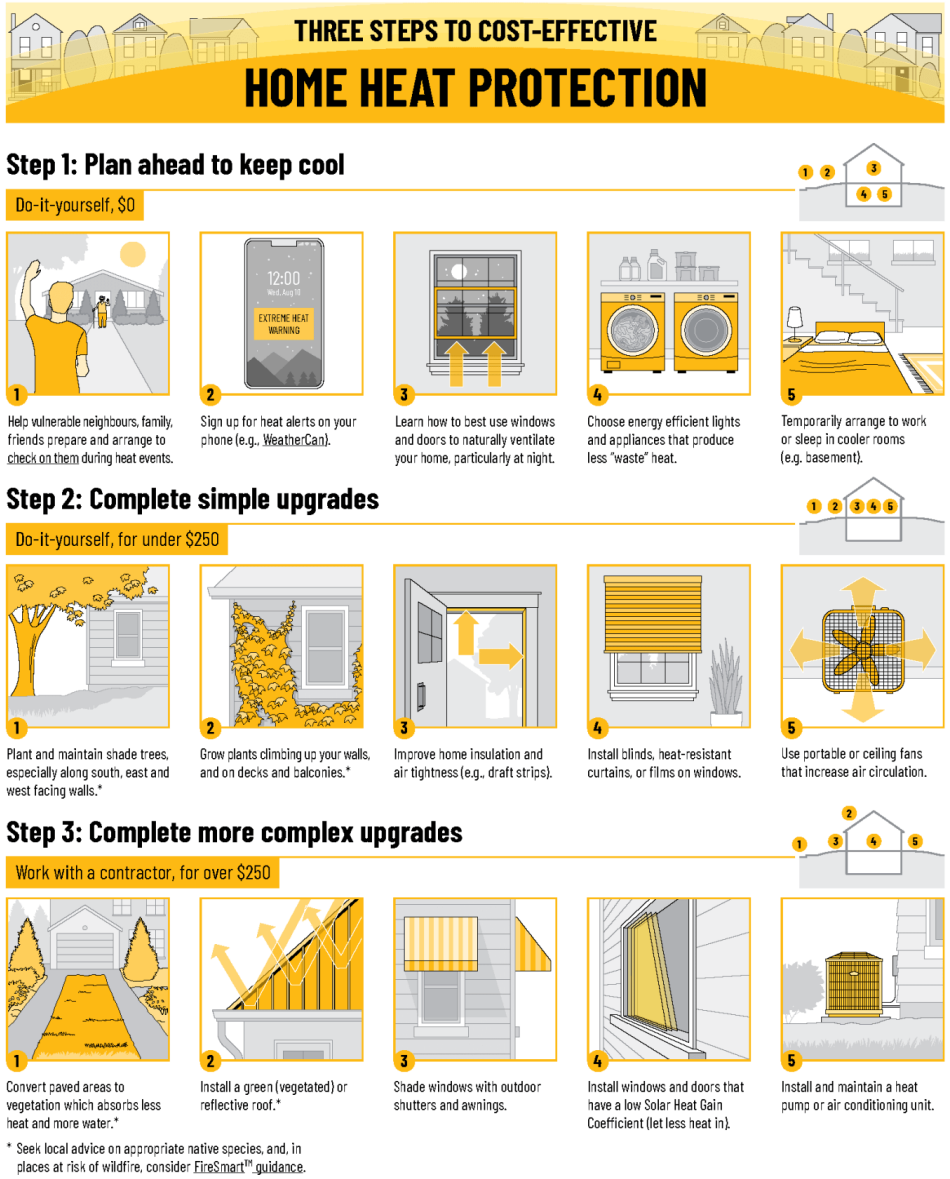
Flood-Resilience Measures for Residential Properties

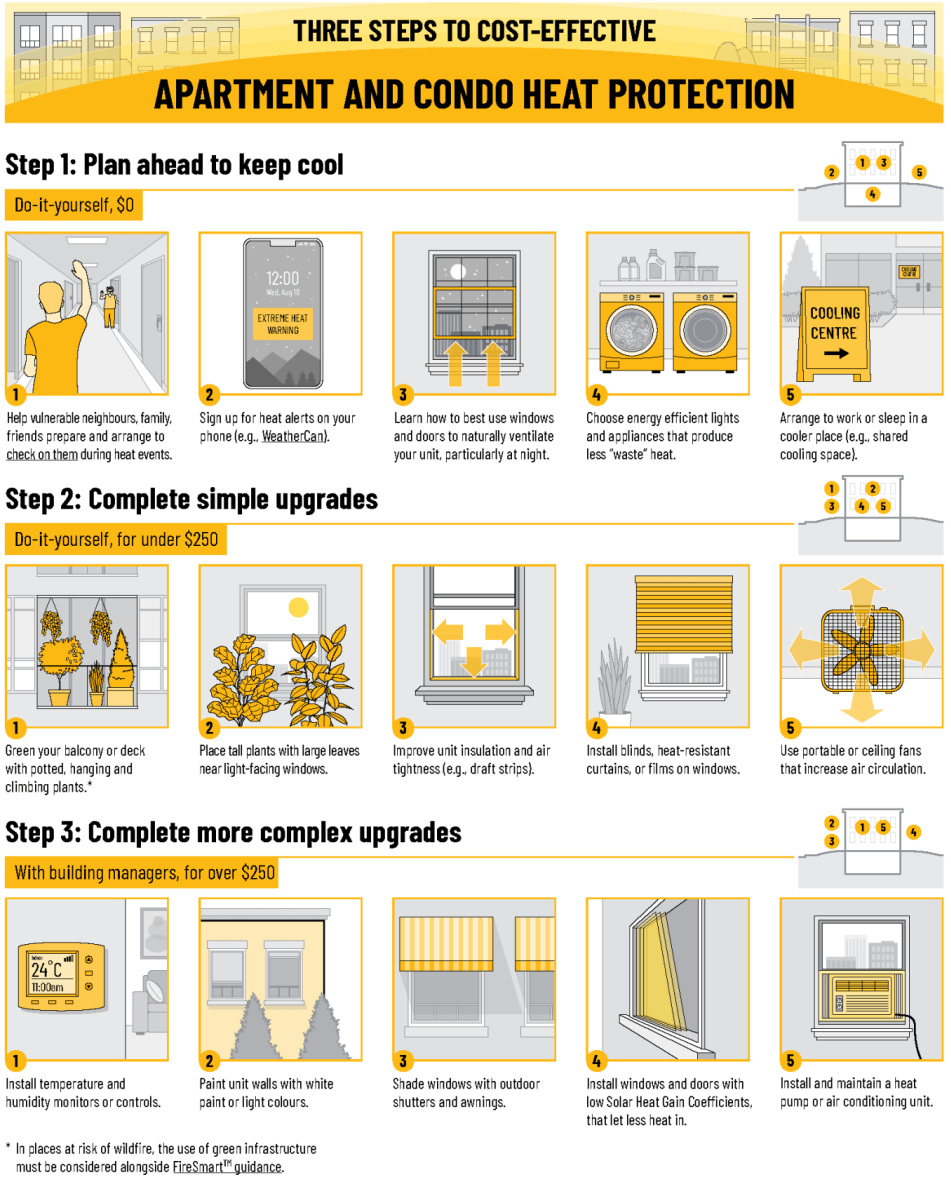
- Stay "Ahead of the Storm"
  - At the residential/building level
  - At the commercial level
  - At the community level
  - 2019 Report by the Intact Centre
- Understand the Vulnerabilities
  - Example: 2020 Potsdam Climate Vulnerabilities Assessment Report
  - Tools
    - NYS Climate Impacts Assessment
    - Municipal Flood Risk Check-up
    - EcoAdapt Rapid Vulnerability and Adaptation Tool (RVAT)



Source: Intact Centre on Climate Adaptation, Climate Ready Infographics

Extreme Heat Adaptation at Home





Source: Intact Centre on Climate Adaptation, Climate Ready Infographics

Nature Based Solutions – Beyond your Home

WATERSHED SCALE

LAND CONSERVATION

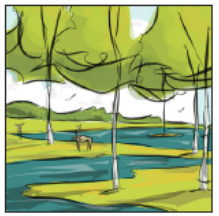
Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities.

Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.

GREENWAYS

Greenways are corridors of protected open space managed for both conservation and recreation.

Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.



WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff.

Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.

STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.

By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.

FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat.

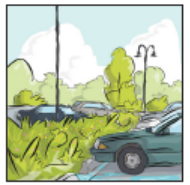
Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.

NEIGHBORHOOD OR SITE SCALE

RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.



VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.

GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building.

Extensive green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.

RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water.

Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.

PERMEABLE PAVEMENT

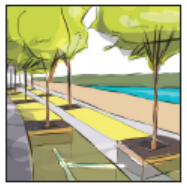
Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.

TREE CANOPY

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the "urban heat island effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.



TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.

GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

Source: FEMA 2021 Nature-Based Solutions: A Guide for Local Communities

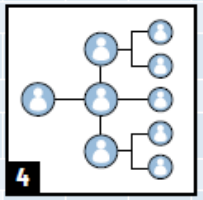
Flood-Resilience Measures for

Plans and Procedures

1 Emergency plans

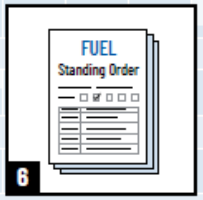
2 Practice drills

3 Emergency funds



4 Tenant communication channels

5 Emergency operations centres

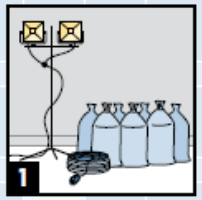


6 Emergency response supply contracts

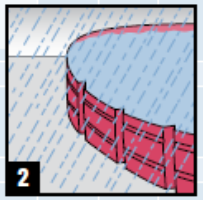
7 Emergency contact information

8 Insurance documentation

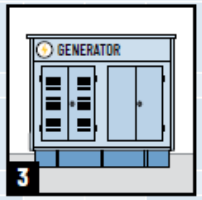
Equipment and Supplies



1 Critical equipment and supplies



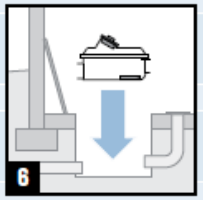
2 Portable flood barriers and sandbags



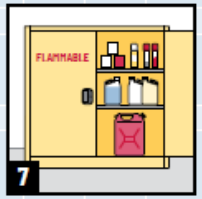
3 Back-up generation

4 Emergency lighting

5 Elevator water sensors

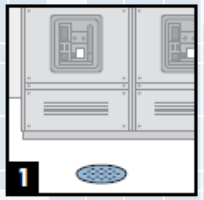


6 Backwater valves

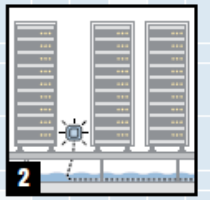


7 Hazardous materials storage

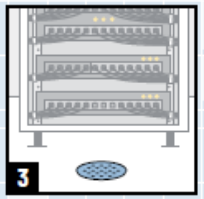
Major Retrofits*



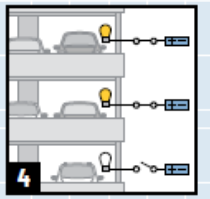
1 Elevating and flood-proofing critical equipment



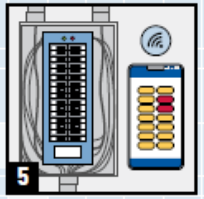
2 Protecting server rooms



3 Protecting high-voltage and telecommunication pull rooms



4 Isolating electrical circuits



5 Electrical panel upgrades

* These retrofits may be cost-prohibitive to implement post-construction, but they may be warranted for critical sites.

Source: Intact Centre on Climate Adaptation, Climate Ready Infographics

TRANSITIONING FROM RHETORIC TO ACTION: INTEGRATING PHYSICAL CLIMATE CHANGE AND EXTREME WEATHER RISK INTO INSTITUTIONAL INVESTING

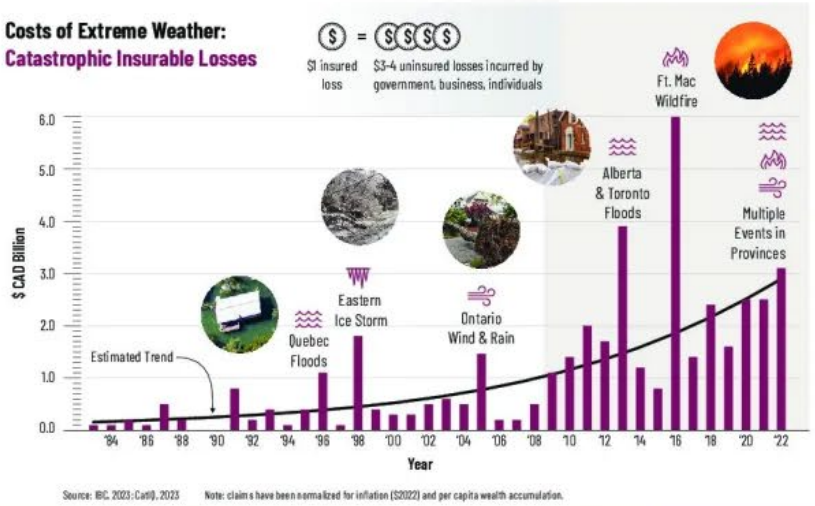
UNIVERSITY OF WATERLOO
INTACT CENTRE ON CLIMATE ADAPTATION

Due to escalating impacts of climate change and extreme weather events, investors must incorporate climate risk into portfolio management. This report provides a framework that will act as **a**) a **template** for companies to self-evaluate their management of physical climate risk, and **b**) an industry-wide **benchmark** to compare company efforts that reduce risks within an industry sector.

Growing Costs of Climate Change

Many companies fail to consider the financial impacts that physical climate risks have on their business. Catastrophic insured losses associated with extreme weather in Canada ranged from $250-$450 million per year from 1983-2008. Losses increased to approximately $2 billion per year from 2009-2022.

Costs of Extreme Weather:
Catastrophic Insurable Losses



Source: IBC, 2023; Cat IQ, 2023 Note: claims have been normalized for inflation (S2022) and per capita wealth accumulation.

Climate Risk Matrices (CRMs)

Six CRMs are profiled in the report:

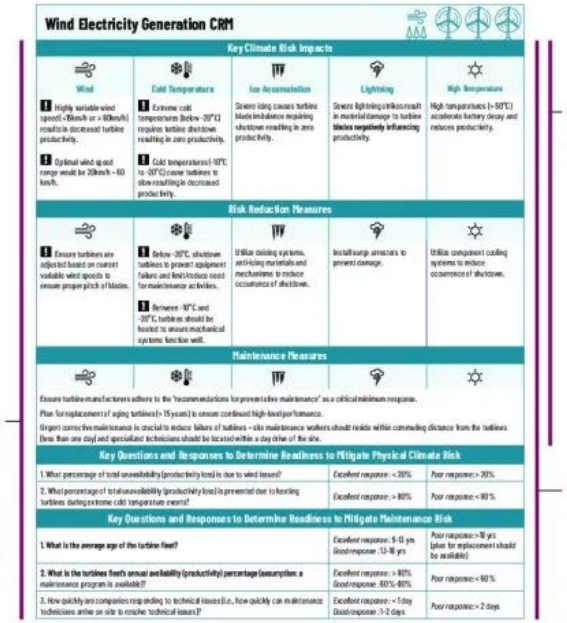
Each CRM offers industry-specific standardization and is a practical tool to:

1. prioritize the top means by which climate-related events may negatively impact business continuity, and
2. identify actions investors should expect a company to take to mitigate prioritized risks.

Key elements (a-d) reflect pillars from the International Sustainability Standards Board and Task Force on Climate-Related Financial Disclosures Framework.

a. Governance
The organization's governance around climate-related risks and opportunities can be informed by the CRM.

b. Strategy
CRMs represent the actual climate-related risks and opportunities that can inform an organisation's business strategy and financial planning.



c. Risk Management
Processes used to identify, assess, and manage climate-related risks.

d. Metrics and Targets
Metrics and targets to identify, assess, and manage relevant climate-related risks and opportunities.

Supported by

The financial community should lead the development of CRMs for all 77 industry sectors as recognized by the Sustainability Accounting Standards Board. This will enable investors, and financial market participants, to price climate risks and investment opportunities. For details, see the **TRANSITIONING FROM RHETORIC TO ACTION: INTEGRATING PHYSICAL CLIMATE CHANGE AND EXTREME WEATHER RISK INTO INSTITUTIONAL INVESTING** report on the Intact Centre on Climate Adaptation website.

Source: Intact Centre on Climate Adaptation, Climate Ready Infographics

Questions and Answers

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