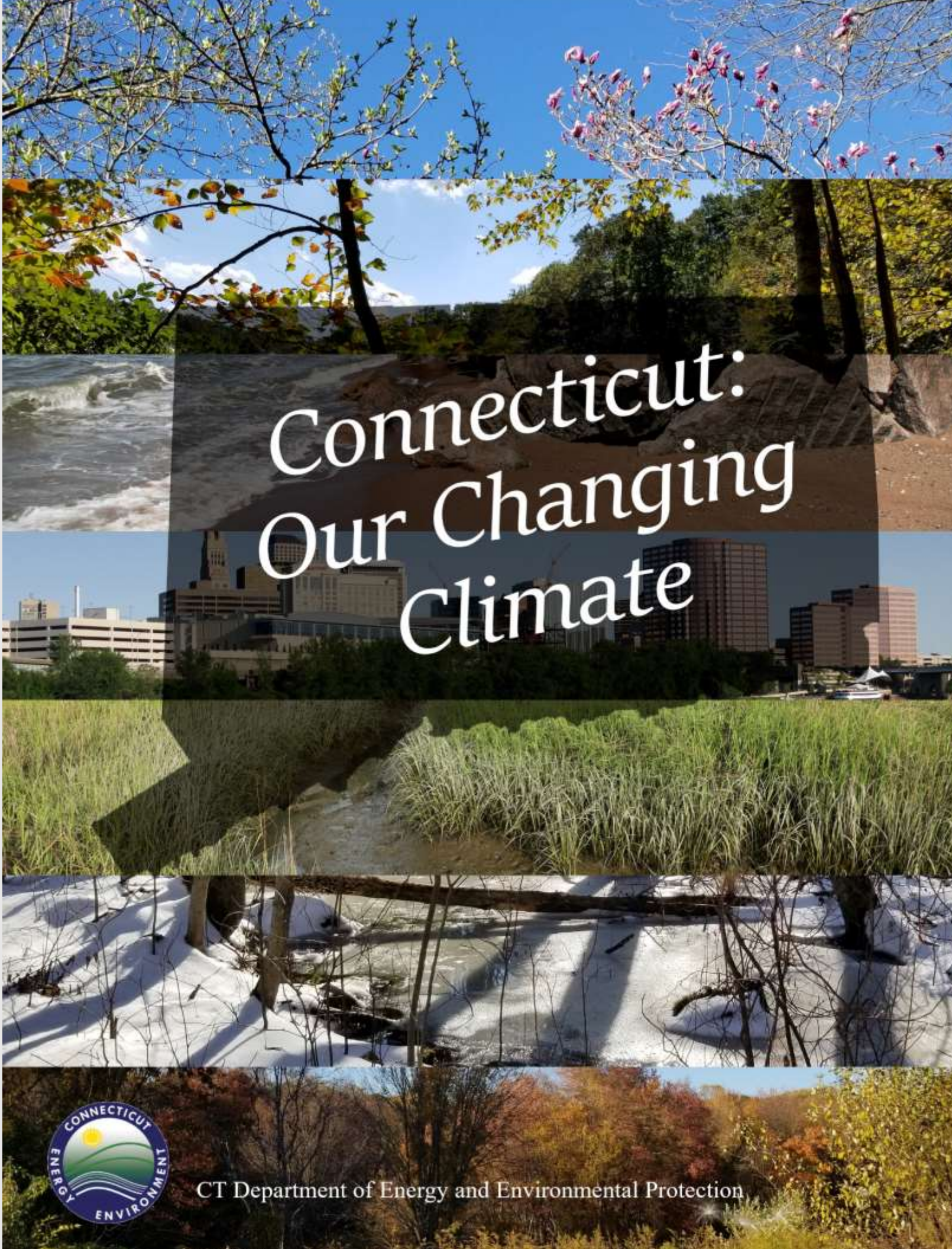

Connecticut:
Our Changing
Climate
CONNECTICUT
ENERGY
ENVIRONMENT
CT Department of Energy and Environmental Protection

Publication written and produced by Susan Quincy with assistance from Aaron Pryzbek, Kara Pritchard, and Evelyn Kubik from the CT DEEP, State Parks Division, Public Education and Outreach Office. Editing and material review provided through offices of Wildlife, Forestry, Air Quality, Water Bureau, Environmental Justice, and Climate Change in the Department of Energy and Environmental Protection and our partners in the CT Agriculture Experiment Station, Department of Agriculture, Connecticut Forest and Park Association, UCONN, Trinity College and CT Department of Public Health.

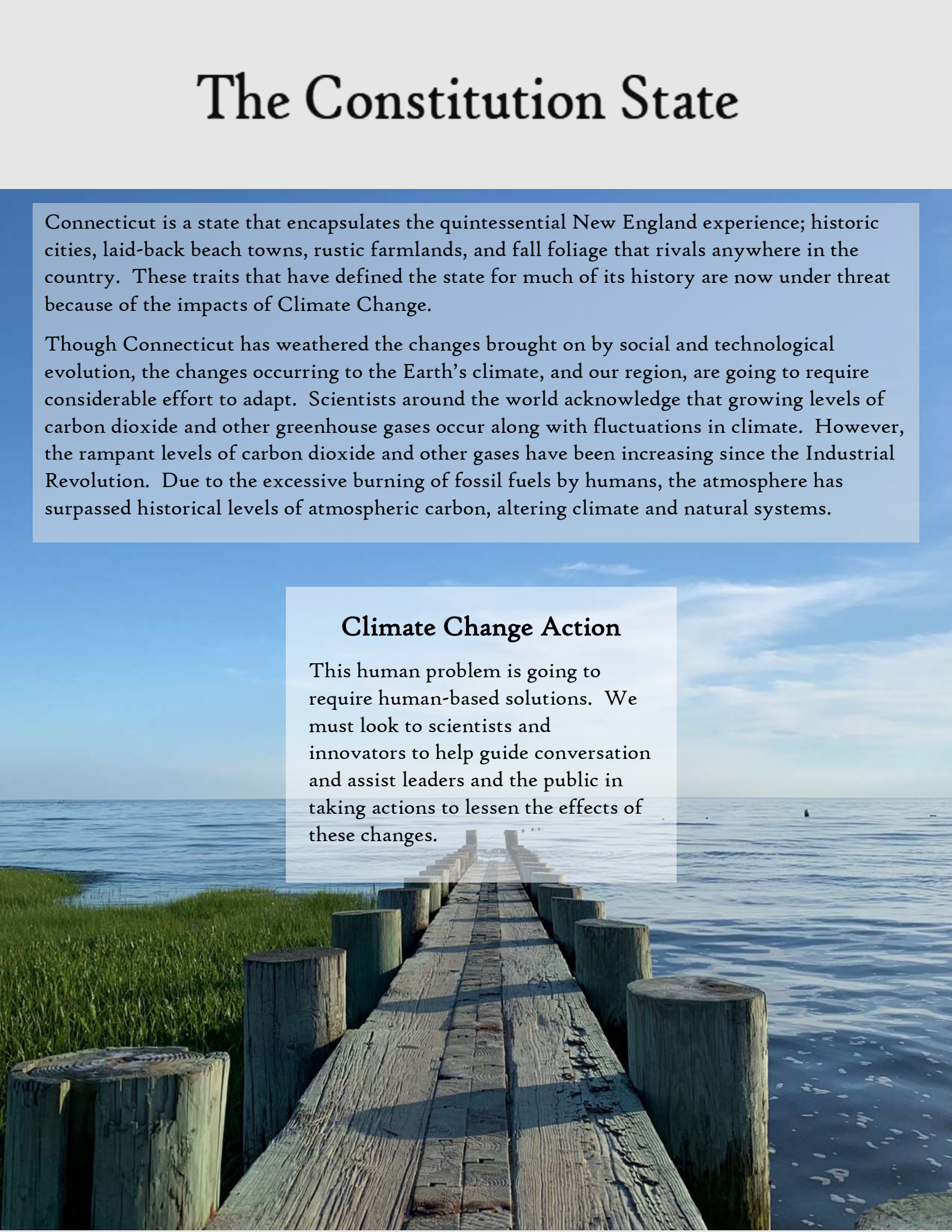
The Constitution State

Connecticut is a state that encapsulates the quintessential New England experience; historic cities, laid-back beach towns, rustic farmlands, and fall foliage that rivals anywhere in the country. These traits that have defined the state for much of its history are now under threat because of the impacts of Climate Change.

Though Connecticut has weathered the changes brought on by social and technological evolution, the changes occurring to the Earth's climate, and our region, are going to require considerable effort to adapt. Scientists around the world acknowledge that growing levels of carbon dioxide and other greenhouse gases occur along with fluctuations in climate. However, the rampant levels of carbon dioxide and other gases have been increasing since the Industrial Revolution. Due to the excessive burning of fossil fuels by humans, the atmosphere has surpassed historical levels of atmospheric carbon, altering climate and natural systems.

Climate Change Action

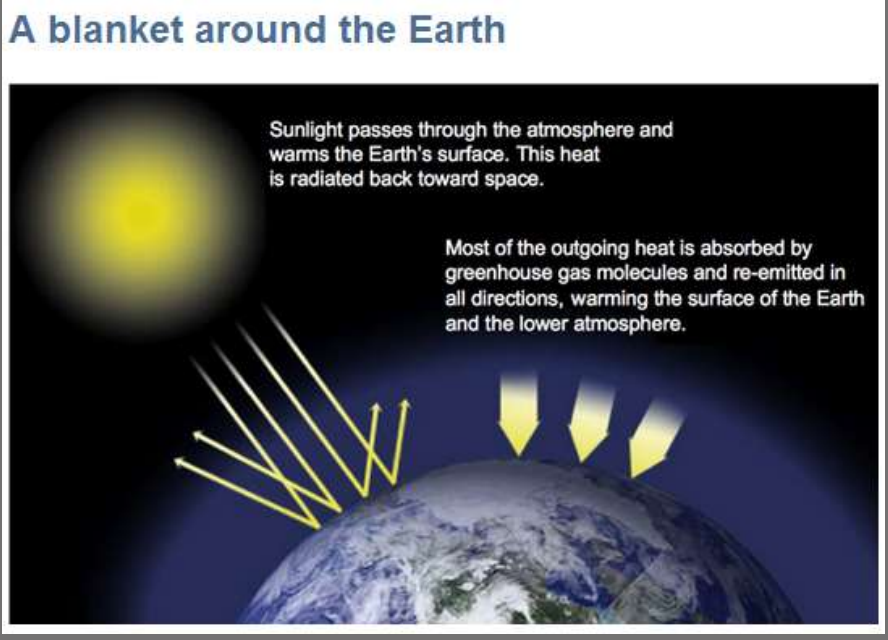
This human problem is going to require human-based solutions. We must look to scientists and innovators to help guide conversation and assist leaders and the public in taking actions to lessen the effects of these changes.



What Is Climate?

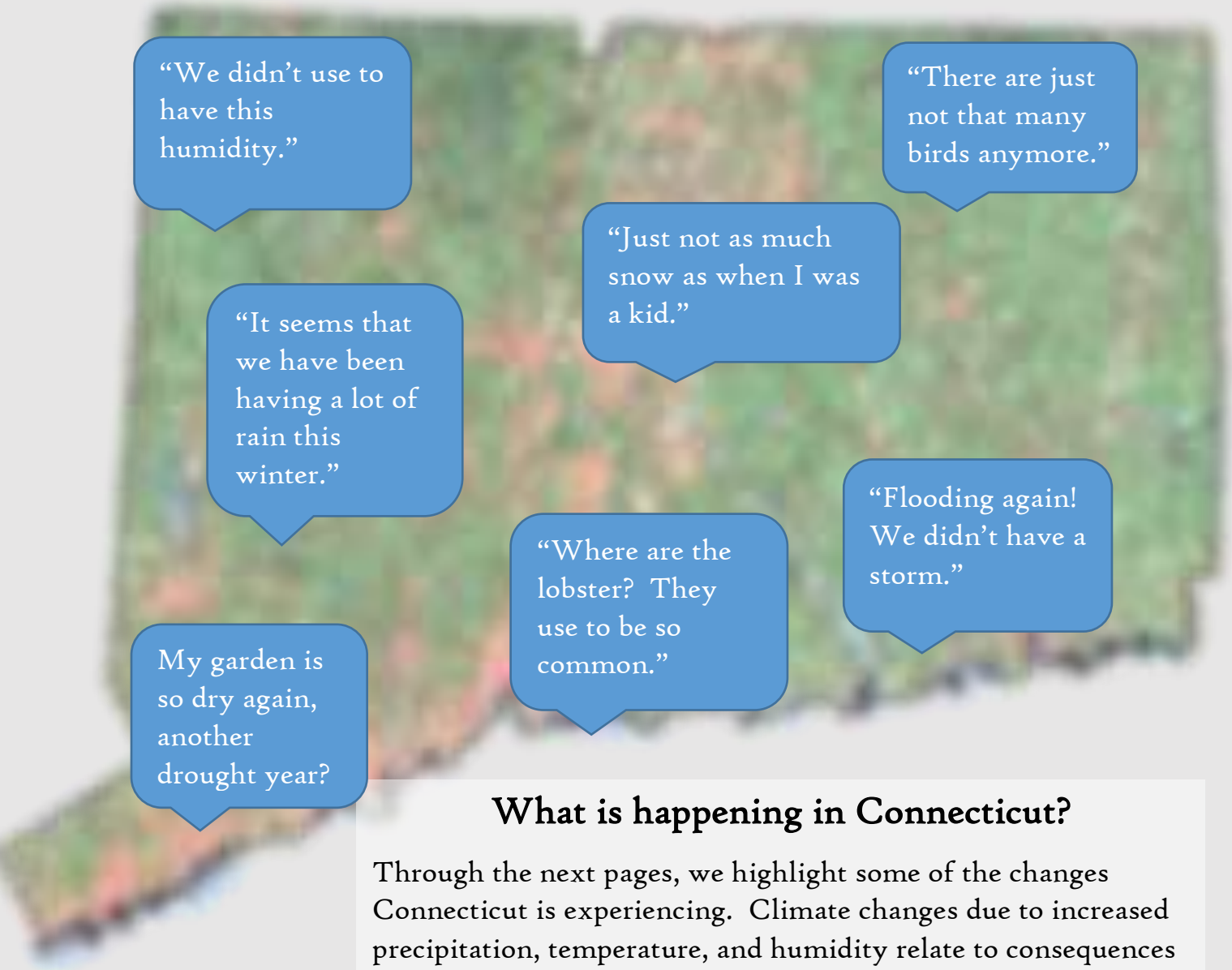
Climate is the average of weather patterns analyzed in 30-year blocks. Weather is what happens on a daily basis. In Connecticut, expectations are set to experience four seasons of weather with specific temperature ranges occurring in those seasons and levels of precipitation. Since 1950, Connecticut has been experiencing changes that differ from normal expectations. This region now has warmer seasons. The average annual air temperature in Connecticut has increased by 2.2 degrees Fahrenheit. Although it is not a large number, it is the difference between freezing and not freezing, snow or rain. Wet rainy winters come with drier summers, with higher heat indexes and humidity. Water and heat are fuel for weather leading to climate changes. New extremes are challenging us in how to use coastlines, provide for agriculture activities, and protect communities and habitats. Climate change in Connecticut has increased health concerns about diseases, clean air, and water quality. These challenges are offering opportunities for innovative and resilient actions that target protection of the environment.

The rampant burning of fossil fuels, since the Industrial Revolution, has added large amounts of carbon dioxide into the atmosphere; thickening the heat-trapping blanket that surrounds Earth. As the blanket thickens from tons of carbon dioxide and other greenhouse gases, temperatures increase. This added heat disrupts the climate, affecting communities and Earth's natural systems of the atmosphere, hydrosphere, and lithosphere.



Think Global, Act Local....

Changes in the atmosphere have a global effect. In extreme regions, climate impact is visually more dramatic, as seen in the loss of glaciers or homes overtaken by sea level rise. Connecticut's location in a temperate region with a diversity of habitats makes impacts not as visibly dramatic, but they are impactful, affecting many systems at once. Daily conversations often reflect the impacts that Connecticut is experiencing.



What is happening in Connecticut?

Through the next pages, we highlight some of the changes Connecticut is experiencing. Climate changes due to increased precipitation, temperature, and humidity relate to consequences in sea level rise, economic growth, biodiversity, food systems, natural resources, recreation, public health, and safety. Connecticut has developed plans addressing these changes to protect its resources and insure equitable actions to improve health and wellness for the environment and humans.

Water, Water, Water...

Sea Level Rise occurs as water levels increase due to glacial melt and thermal expansion. Increased heating has caused land ice to melt at a much faster rate, adding water directly into the ocean, as well as into the air. The ocean is the heart of the climate system circulating heat and moisture around the globe. The more water in the water cycle, the greater the impacts.

The thickening blanket of carbon dioxide increases atmospheric temperatures.

↓

Increased heat causes glaciers to melt adding water into oceans. Heat expands water, adding to ocean volume and water temperature. Combined, this leads to sea level rise.

↓

Higher sea levels add to high tide lines, pushing them back further into beaches, marshes, and developed areas. This increases flood zones.

↓

Higher sea levels and warmer water temperatures increase storm activity, increasing coastal flooding and storm surge levels.

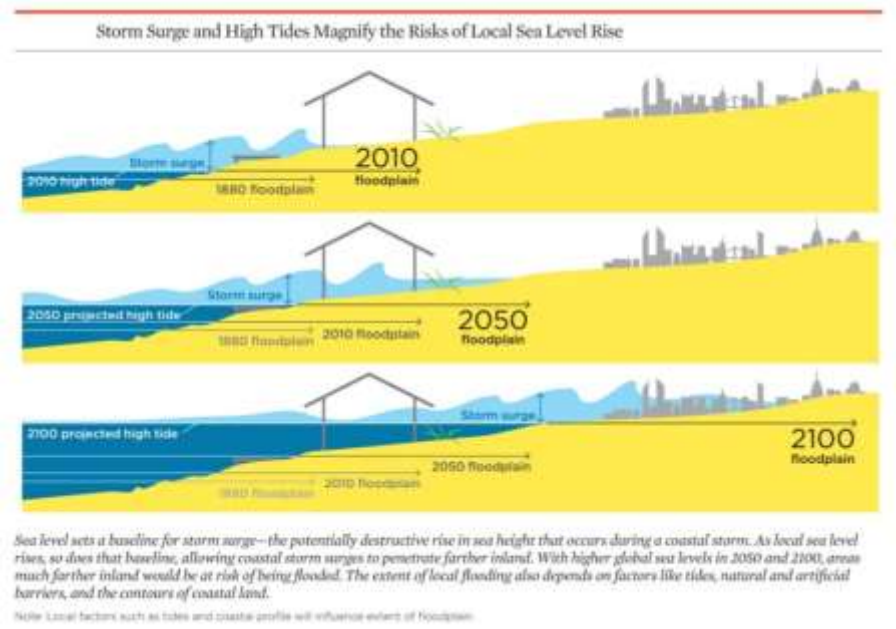
↓

More water in built areas and power outages result in millions of dollars in damage.

Local Facts:

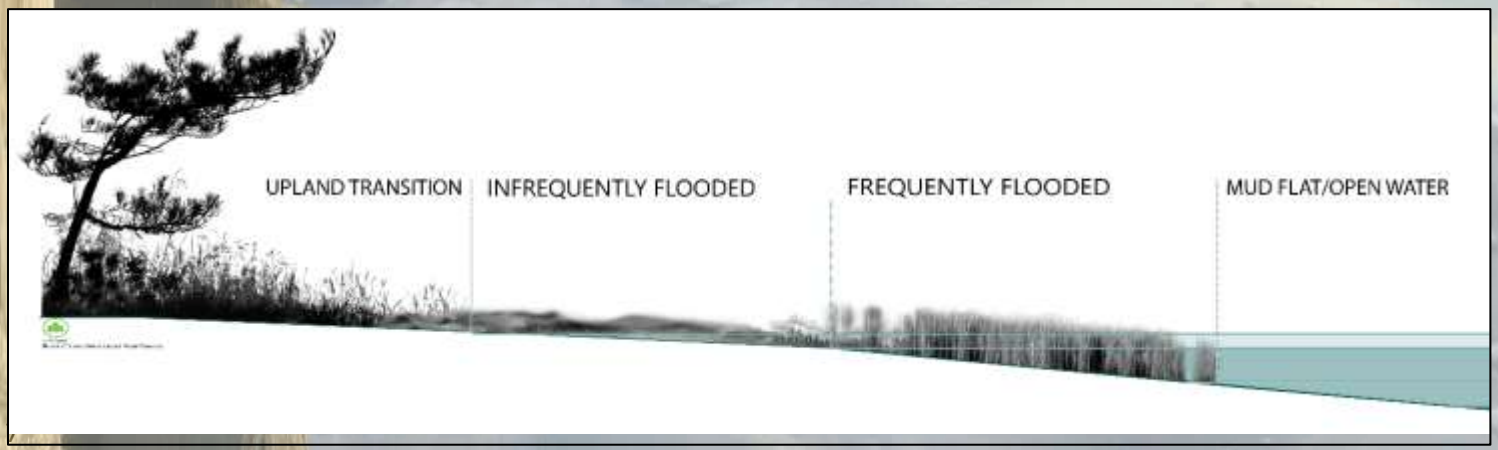
- 61% of Connecticut's 3.6 million people live in coastal communities prone to flooding.
- It is estimated that an additional 30% of Connecticut's population works in coastal areas.
- Projections show by 2080 Connecticut could lose up to 24,000 acres of land due to sea level rise.
- Portions of coastal communities and sections of I-95, rail lines, and local airports are expected to experience tidal flooding, without storm action, due to increased sea level.
- Bridgeport has currently experienced 6 inches of sea level rise since 1965, which is higher than current global rates.
- Predictions by CIRCA show Connecticut sea level rise could increase 1.5 feet by 2050 and up to 3 feet by 2100, based on the level of action taken today to reduce carbon emissions.

People at risk... Increased risk of flooding due to more water and higher temperatures challenge methods to "manage" water and our built environment.



"Research has shown that coastal marsh in United States provide approximately $23 billion annually in hurricane protection services. In Connecticut, reduction in storm damage costs by coastal wetlands is estimated at $13,000 per acre annually" (Costanza et al. 2008).

Town infrastructure for flood and storm protection often leads to a hybrid of green and bioengineered design combinations. Extreme weather has increased storm runoff increasing erosion, nutrient loading, and pollution of freshwater systems and extend into areas that were once not flooded. Conservation and re-establishment of wetlands along coastlines and river systems can address rising water lines. Increasing access to soil and ground systems while addressing impacts from rising water levels is a co-benefit for town water quality and quantity, as well as habitat conservation for wildlife. For examples of how towns are planning to meet climate change and adapt to its impacts, visit Coastal Resilience Connecticut, a planning tool to help stakeholders take steps to reduce the ecological and socio-economic risks of coastal and inland hazards.



Wildlife at risk... Like the polar bears of the Artic, the Saltmarsh Sparrow, Least Tern and other ground- nesting marsh and beach birds, are threatened by sea level rise.

Sea Level Rise Environmental Impacts

- Beaches erode away.
- Coastal wetlands become submerged.
- Salt marshes move landward.
- Flooded nesting sites and decreased spawning areas.
- More flooding increases human health risks for water- borne diseases and insect vectors.

Saltmarsh Sparrow

Least Tern

The Saltmarsh Sparrow is Connecticut's polar bear, showing the greatest impact from higher tides because it has specific nesting requirements limiting its ability to alter nesting locations and behaviors. Higher tides flood nests, drowning chicks and eggs reducing reproduction. Without conservation efforts and action to reduce carbon impacts, the Saltmarsh Sparrow is expected to be extinct by 2050.

Resilient Solutions Create Living Shorelines

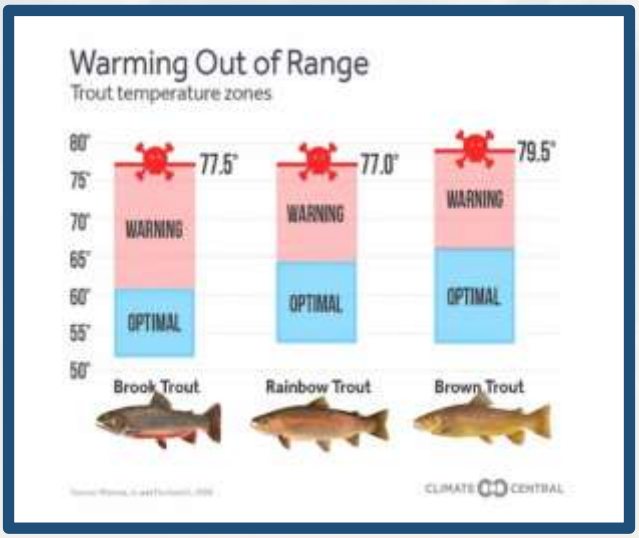
By using technology that mimics nature, Connecticut can adapt to climate impacts and Support growth of salt marshes, strengthening natural coastline buffers. Lines of reef balls placed in Stratford, Connecticut are monitored for effectiveness at breaking wave action and protecting restored marsh habitat. The reef balls and marshlands work together to absorb sea level rise, break wave action, and reduce threats from extreme weather. They extend habitats for aquatic life through mimicry of rock outcroppings, allowing expansion of food webs along the coastal shores. Protection from erosion helps establish wetlands, which naturally absorb more water.

Wildlife biologists specialize in a variety of species, researching populations and habitat health. Ruby Hammond is a wildlife biologist monitoring shore bird populations. She is banding a semi-palmated sandpiper, one of many species at risk from sea level rise.

One might think more precipitation in the environment would benefit fish, but rather the opposite can be true. Rising temperatures and increased precipitation have altered water chemistry, challenging life systems and seasonal phenology, the natural timings of events between the environment and living organisms.

Aquatic Habitats at High Risk Due to Climate Change

1. Cold Water Streams
2. Tidal Marsh
3. Open Water Marine
4. Beaches and Dunes
5. Freshwater Wetlands
6. Offshore Islands
7. Major Rivers
8. Forested Swamps



In freshwater communities, brook trout and aquatic insects are the "canaries in the coal mine" for their aquatic systems. They are sensitive indicators to water chemistry and quality. Both fish and insects are affected by the reduction of oxygen levels in water due to higher water temperature and erosion from storm water runoff. Increased precipitation due to extreme storms has expanded flood zones in riparian systems. Floods remove fish spawning habitat and decrease the water quality as storm runoff carries pollutants into the aquatic system.

Algae bloom as seen on Connecticut River, DEEP

These problems are increasing growth potential for toxic algal blooms in freshwater systems and marine coastal areas. These toxic conditions pose a health problem to both wildlife and humans.

Fisheries Biologists routinely monitor the makeup of fish communities to assist in identifying the diversity of the population and look for changes over time.

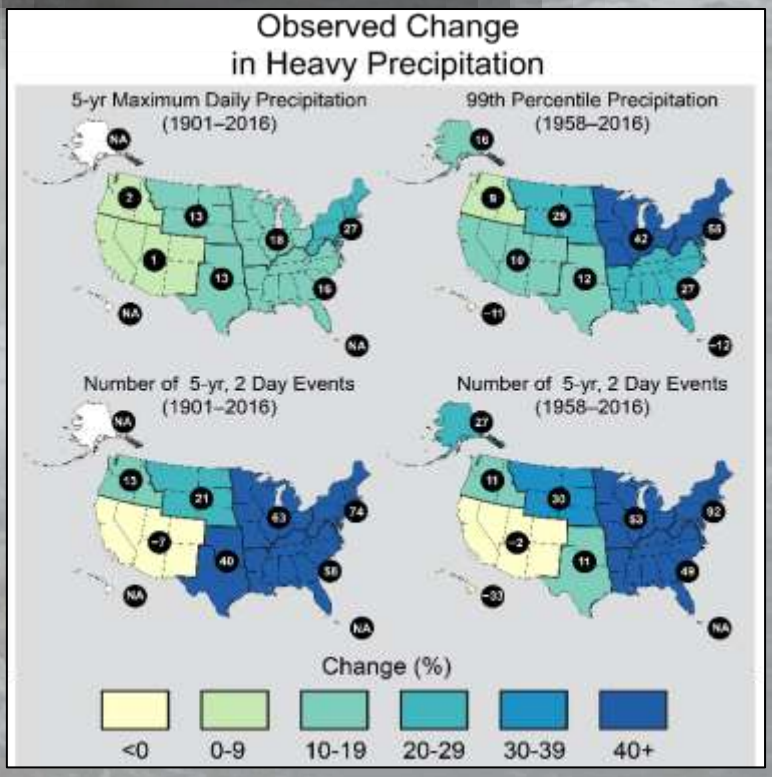
Mike Beauchene, Supervising Fisheries Biologist

Extreme weather in Connecticut has resulted in higher precipitation in the form of rain. According to NOAA, CT now sees an annual 38% increase in precipitation, which makes for new weather patterns and expectations. Storms are more intense, increasing in frequency and amount of water provided with each storm. Storms form and move faster and with greater strength, powered by heat and moisture. As more water quickly falls on hard surfaces, we see higher levels of erosion and greater movement of surface materials into waterways. This affects water quality, alters flood rates, and flood zones.

Super Storm Sandy pummeled the East Coast in 2012, affecting 24 states. Sandy was the fourth costliest storm in US history; damages amounted to over $71 billion. Sandy hit Connecticut as a tropical storm, hosting wind speeds estimated to be 81 mph damaging 3,000 shoreline homes. New England now experiences one of the highest increase in intense precipitation events across the United States.

What does this mean for Connecticut?

- Connecticut is meeting challenges from extreme weather by reviewing and altering development along coasts and requiring more use of natural barriers, (i.e. wetlands, reducing hard structures.) This reduces impacts and damage due to storm debris carried by wave action.
- Connecticut is re-evaluating storm surge lines and high tide zones for better reaction to storm impacts. This will also help address flooding from new levels of high tides with or without storms brought on by sea level rise.
- Towns are looking toward resilient erosion control to reduce storm impacts and increase water recharge into the ground, rather than flowing into streams and rivers.



The derecho or wall cloud, as it approached Sleeping Giant State Park, May 2018. This is a clear demonstration of how storm patterns are changing. In 2018, Connecticut saw ten tornadoes, plus multiple macro-bursts throughout Connecticut. These weather events were typically infrequent, but are now part of our spring/summer patterns.

This photo shows damage from straight-line winds from a macro burst in Sleeping Giant and three other State Parks. Damage from this single day of storms on May 15, 2018, which affected towns in Fairfield and Litchfield Counties and the town of New Milford, totaled over 13 million dollars to clean up. Sleeping Giant State Park was so damaged it closed for 13 months. Extreme weather is taking new forms with more damaging storms and longer seasons. Our winter snow events are less, but more damaging. Overall, Connecticut expects winters to have less snow, more rain, and more floods.

Since the beginning of the 20th Century, the temperature in Connecticut has increased by 2.2°F. This warming climate increases precipitation and humidity. Because warmer air holds more moisture, it fuels storms. Connecticut is seeing rain precipitation increase mostly in winter and early spring. This trend results in more short-term droughts during the summer months leading into fall. These frequent dry periods cause stress to forests and agriculture systems and increase the potential of fires.

Xiusheng (Harrison) Yang,
Professor
Director, Connecticut State Climate Center UCONN

Understanding how weather systems are reacting to new climate conditions helps provide us with better predictions for human safety.

Outdoor Recreation in the Face of Change

Warmer winters with less snowfall change how and where people play. It is often cold but not cold enough to form snow and ice. Snow and ice are necessary for plants and animals but also provide recreational opportunities. Winter recreation is seeing large changes. Skiing, skating, snowmobiling, snowshoeing, and ice fishing are declining options in Connecticut. People are going farther north to enjoy their sports that require more snow and ice.

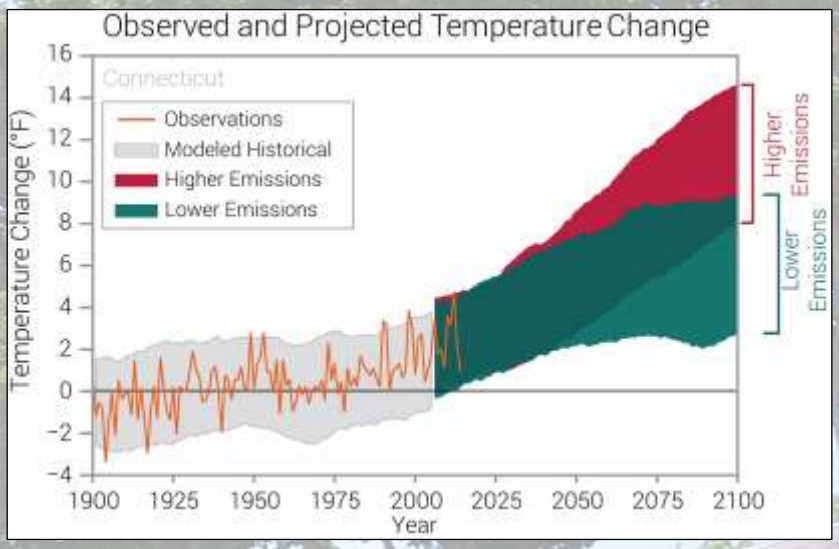
Recreational fishing faces new challenges from seasonal shifts in temperature and precipitation. Water quality issues brought on by flooding and increased storm runoff compound the challenges to provide recreational fishing. In addition, the lack of ice is altering lake chemistry by increasing levels of light and temperatures, stressing the wintering activity for fish.

Exotic species in Long Island Sound prefer the warmer waters and out-compete native fish for resources. Although a problem, they can offer new sport fishing options.
The exotic species include:

- Cobia
- Black Sea Bass
- Sand Shark

Long Island Sound native fish are on the decline due to increased water temperature, affecting egg development, spawning habitat, and food availability.
Declining native species include:

- Flounder
- Striped Bass
- Alewife
- Shad



Public health studies have shown that outdoor activity increases well-being and physical health. Being in nature can reduce blood pressure, heart rate, and stress. A healthy environment improves this effect. However, higher demands for access to outdoor recreation, especially for swimming and summer cooling, are increasing the impact on the land identified for recreation. Managing people and providing areas for all to relax and escape the heat, is a challenge for many communities and our state parks.

Both winter and summer are warmer. The summer season in contrast to winter has intense heat, increased humidity, and reduced precipitation events. With this, Connecticut is seeing a higher impact on shoreline parks. We all want to cool off in the water, but the impact is stressing habitats, economic resources, and the physical space in the parks for people to access them.

Decreased water quality from heat and erosion cause increases in algae blooms that hinder access to swimming areas, both inland and on our shores. This is a challenge when trying to offer swimming areas that are safe and healthy for visitors.

In 2018, Connecticut State Parks implemented The Passport to Parks Program. Through Connecticut vehicle registration, all residents of Connecticut have access to state parks with no parking fee. This provides an equitable solution for recreation access and escape to beaches at lakes, ponds, and the shore when the heat and humidity rise.

Green spaces provide cooling actions in the environment while protecting land and water from development. This offers benefits for humans and natural systems. Connecticut will have to look for increased land protection and access to meet health and recreational needs, as people are looking to escape the heat and promote emotional and physical well-being. Hiking, biking, birding, and fishing are some lower impact activities that are on the rise in Connecticut.

Osteoporosis of the sea... is growing as heat rises and our ocean absorbs more and more carbon. The ocean is a carbon sink -- a place that stores carbon at a higher rate than is used. However, due to such high levels in our atmosphere, the ocean is overloaded with carbon. This overload interferes with sea life's ability to absorb calcium for shell development and causes water to become more acidic for ocean life.

Estimates show the average pH of seawater has declined from 8.19 to 8.05. This equals a 30% increase in ocean acidity. Although the amount seems small, it is significant when young bivalves are trying to grow shells. They are unable to take in the calcium from the ocean water, stalling or in some cases, stopping shell development. Although not immediately seen in Long Island Sound, it is a potential impact that may be coming in the near future.

According to the National Oceanic and Atmospheric Administration (NOAA), Long Island Sound is a hot spot for the effect of ocean acidification.

Many harmful algae species produce more toxins and bloom faster in acidic waters. The cycle increases when algae die, releasing more CO_2, which increases acidity and increases more algae growth. In turn, toxins pose a health hazard to people in the water and those who may ingest contaminated shellfish.

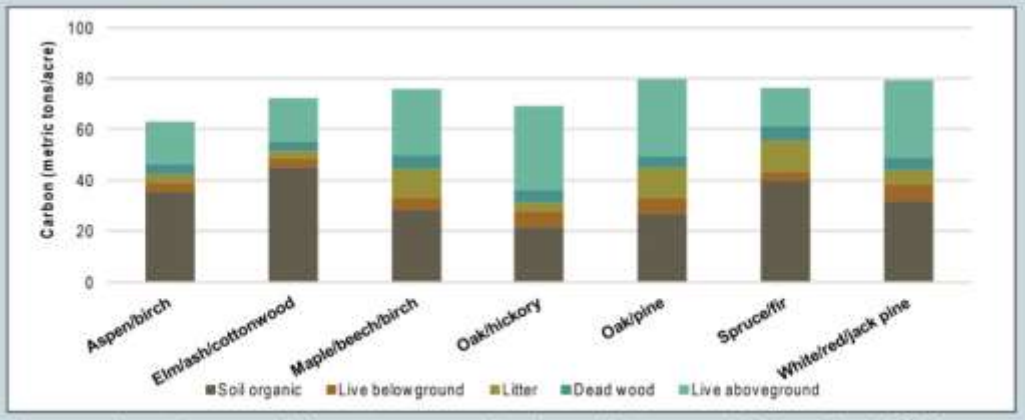
Why does this matter?

Shellfish aquaculture is a standard industry in Connecticut that will potentially face negative impacts from ocean acidification. Production of oysters, clams, and mussels is part of New England history. Flooded access areas plus changes in temperature, salinity, and acidity, affects the natural system of life in Long Island Sound, which may be putting commercial and recreational shell fishing at risk.

Tessa L. Getchis is an aquaculture extension specialist with the Connecticut Sea Grant and UConn Extension Program. Her focus is on shellfish husbandry, shellfisheries management, and the aquaculture permitting process. She offers industry consultations and training workshops, conducts collaborative research projects with industry and is engaged in public outreach. Education is key to understaning the human role in climate change.

Connecticut's Changing Forests .... Connecticut is one of the most densely populated states with over 3.6 million people living on 3.2 million acres of land, with 1.8 million acres forested. Changes in temperature and weather are altering how the forest ecosystem works. Forests, like the ocean, are carbon sinks, places that hold more carbon than is released.

Trees sequester carbon and store it in the soil, roots, and all woody structures. Different species sequester carbon at varying rates and store it in different amounts based on their growth, physical characteristics, forest structure and age. Connecticut forests are comprised predominately of oaks and hickories.



Average carbon stocks per acre by forest-type group and carbon pool. Data source: U.S. Forest Service (2015).

Impacts of Climate Change on our Forests

- Connecticut's climate is experiencing weather extremes. Warmer winters with increased rain has increased damage to roots from frost due to lack of snow pack. This interferes with a trees ability to store water, nutrients and carbon. It also reduces its ability to grow, adding to stress levels and increasing potential damage from insects, especially when summer droughts are increasing.
- Warming trends have shifted leaf out timings in the spring. Buds are opening 10-14 days earlier then past decades. This shift has altered the natural timings with pollinators effecting forest regeneration and regrowth.
- Increased heat days also provides increased opportunities for invasive plants, insect damage and disease. Introduced species favor the warmer conditions and take advantage of early starts in the growing season and warmer extensions in the fall out competing native species. This results in lower biodiversity in the ecosystem. Less biodiversity reduces a forest's ability to recover from human and natural disturbances.
- Coastal forests have added risks from sea level rise due to saltwater intrusion into water tables, which decreases water quality and increases salinity.
- Affects from extreme weather causes thousands of dollars in damage, but also activates growth of invasive plants and increases insect invasions.

What Is Connecticut Doing?

The Division of Forestry actively manages the state's 170,000 acres of state-owned forestland. It also supports municipal and private forest owners with education and outreach programs through partnerships with Connecticut Forest and Park Association, Connecticut Department of Agriculture, Connecticut Agriculture Experiment Station, UCONN Extension, and USDA.

Responsible Forest Management:

- Promote forest health.
- Restore wildlife habitat diversity.
- Promote forest resiliency and adaptability to change.
- Foster recreational and economic opportunities by keeping forest healthy, diverse, and accessible.
- Promote carbon sequestration and storage.

Carbon Sequestration and Storage is key. Reducing the amount of carbon in the air is critical. Trees are part of the solution by sequestering carbon through photosynthesis.. They also store carbon in their woody structures and in durable wood products.

- Keep forests as forests!
  Forests store half of their carbon underground and half in their living structure above ground.
- Sustainable yield combines harvest and conservation methods that encourage proper regrowth, while providing economic revenue, and recreational opportunities for public and private lands. It consists of:
  - Harvesting trees while maintaining and in many cases enhancing ecosystem's ability to function.
  - Promote structural complexity in forests making it more resilient and able to sequester and store carbon.

How to Help?

- Do not dispose of living decorative plants, fish, animals, or insects into ecosystems, such as water bodies or forest edge.
- Clean recreational gear after any outing to prevent the spread of invasive species; boats, clothes, boots, camping gear, tires etc.
- Respect recreational rules staying on trails and using appropriate equipment.
- Use local firewood only.
- Closely watch and control property for invasive plants, insects, and tree diseases/damage.
- Plant native species of trees, shrubs, and plants.

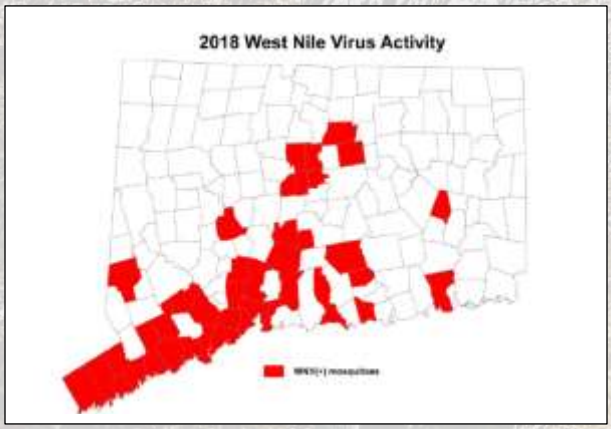
Eric Hammerling is Executive Director of Connecticut Forest & Park Association. CFPA, the oldest non-profit conservation organization in the state, connects people to forests, parks, and blue-blazed hiking trails to ensure these special places are protected and well managed for future generations. Non-profit organizations like CFPA work with DEEP and other state agencies to develop and improve environmental policies.

Public Health concerns around water security, heat exposure, insect vector-borne diseases, and air quality affect everyone and especially the underserved communities throughout Connecticut.

Mosquitoes

Wet conditions make the best situation for mosquitoes. Varieties of mosquito species carry agents that affect humans and animals alike. Rising temperatures and higher humidity work together to support expanded mosquito ranges, abundance, and reproductive abilities.

Entomologists and disease specialists are working together to understand how insects are reacting to changes in our climate. This requires work in labs and the field. Mosquito resting box for collecting *Culiseta melanura*, the principal vector of EEE .



Warming trends shorten larval developmental time and increase feeding rates of female mosquitoes. Warmer periods also allow for longer rates of exposure for humans and animals, thus increasing the number of illnesses. As temperature continues to rise in Connecticut, a northward expansion and population increase are expected for mosquitoes. For urban and underserved communities with little resources to protect against mosquito bites and prevent diseases, this puts many groups at risk for illness. Extra care needs to be taken to dump standing water, fix screens, and, in many cases alter human activities. As mosquitoes are more active in the early morning and evening, altering behavior to avoid these high activity times is a critical step toward protection.

Primary Diseases from Mosquitoes:

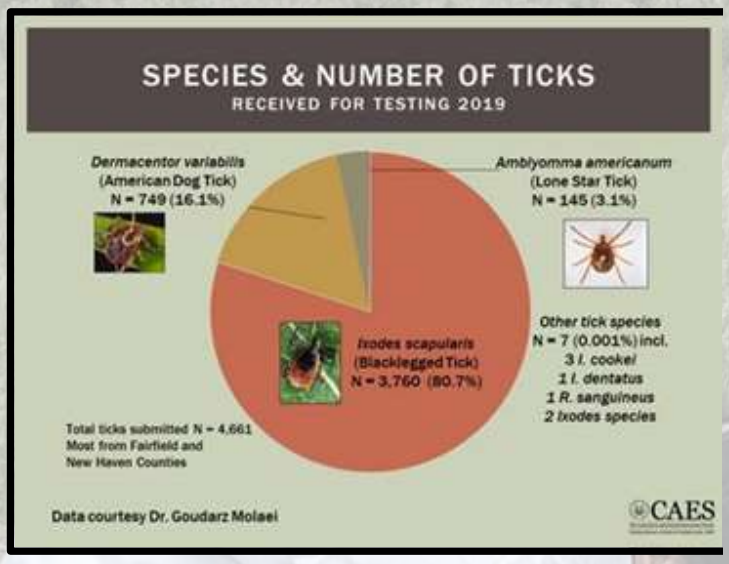
Eastern Equine Encephalitis (EEE): Eastern Equine Encephalitis Virus (EEEV):
Contracting EEE is rare in humans but increasing. Three deaths were reported in 2019. This virus has a higher impact on horses and birds resulting in greater instances of death.

West Nile Virus (WNV): Leading cause of mosquito-borne illness across the United States. There is no vaccine to prevent or medicine to treat WNV.

Black- legged Tick and **Lyme Disease**

Lyme disease is an infectious disease caused by the *Borrelia* bacterium, primarily spread by Black Legged Ticks, commonly known as deer ticks. Research has found 50% of deer ticks contain this bacterium.

According to the CDC, lyme disease is the most common vector borne disease in the USA.



New Ticks and New Diseases

As Connecticut increases in temperature and humidity, it becomes better suited for new pests to move in and stay. New tick species are emerging in Connecticut, posing new health risks.

Asian long-horned tick

- Invasive species that has the ability to reproduce rapidly without mating and poses more threat to livestock, although also attracted to humans.
- Research is ongoing to identify diseases transmitted by its bite.

Lone Star Tick

- Transmits ehrlichiosis, a bacterial illness with flu like symptoms.
- Due to warmer winters, this tick population is expanding north and is growing in Connectict.
- Aggressive tick that bite humans and most active in the spring.

- Lyme disease has a strong connection with temperature, precipitation, and humidity. Tick population and diversity rise with these climate elements.
- Warmer winters are not knocking the tick population back in winter months due to higher temperatures.
- High risk populations for Lyme disease are elderly, youth, and communities that are underserved due to language barriers and
- less access to information.

Lone Star Tick

Black-legged Tick

Asian Long-horned Tick

Connecticut Agriculture Experiment Station (CAES) is one of many agencies and offices that provide hands-on experience in research of plants and animals. Real experience is important for consistency and providing for the next generation of scientists.

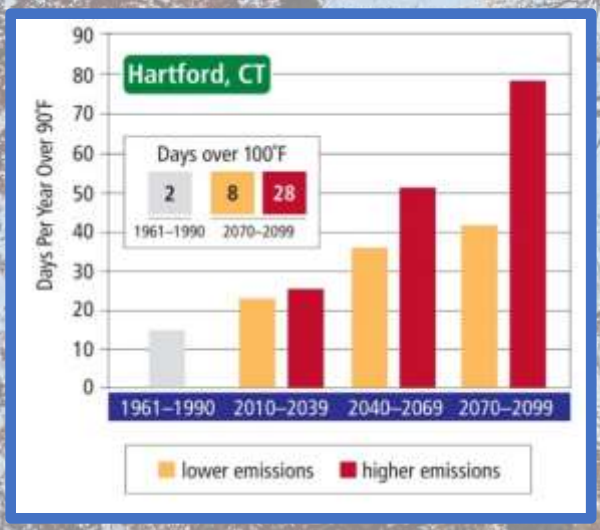
2019 Participants in the 3rd Plant Health Fellows internship program, CAES.

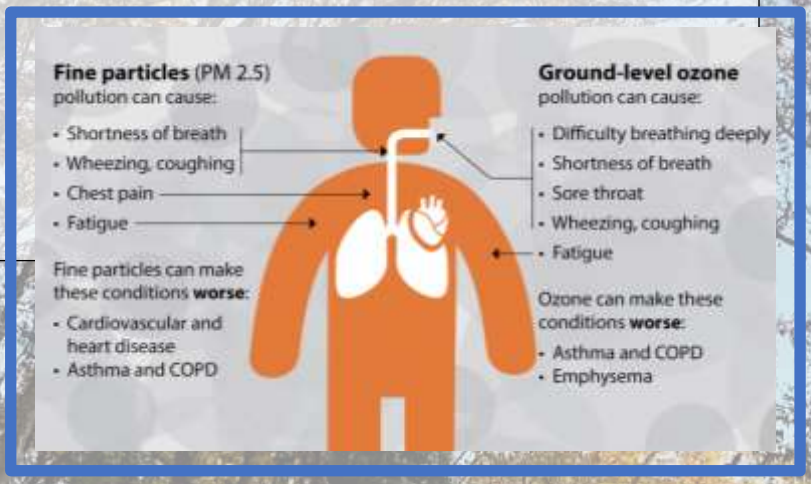
The 10 warmest years on record have all occurred since 1998... 9 of the 10 have occurred since 2005.

Heat and Air Quality are growing public health issues as we see more days with high temperatures each year. Rates of Emergency Department (ED) visits for heat-related illness are associated with annual rates of extreme heat days. Differences in ED visit rates for heat-related illness are evident between race/ethnicity groups in our state. High heat and poor air quality combine to magnify health issues related to pulmonary and cardiac systems.

Connecticut now uses more energy to cool than to heat homes and other buildings. Energy provided through the burning of fossil fuels results in higher carbon dioxide levels and other toxins emitted into the air. The toxins are precursors to the formation of ground level ozone, which is a big stress on the public's pulmonary health. With increasing temperatures, we use more energy to cool things off. This can create a spiraling cycle of carbon use and ground level ozone production that leads to human health impacts. Environmental justice issues magnify when applying the impacts of climate change in underserved communities, especially when addressing health issues, heat and air quality.

Orlando Velazco, with the Office of Health Equity in the CT Department of Public Health, works with municipalities and organizations planning for equal access to healthy environments for healthy people. Reducing disparities and achieving health equity in Connecticut requires addressing the impacts of climate change by addressing exposure, sensitivity, and the ability to adapt.





Climate Change is affecting agriculture ... Cows and trees both experience stress from increasing daytime temperatures and reduced nighttime cooling.

Increased precipitation in spring, winter and fall impacts herd management practices. Health risks for cattle increase with heat and humidity, bringing more ticks and pests, which challenge herd well-being. Increased precipitation also challenges manure management through increased water runoff from barns and fields, increasing methane levels and altering local water quality.

The heat and lack of cooling time depresses a cow's appetite and reduces milk production (lactation) and the ability to calf. The increased temperature leads to long-term poor animal health, reduced herd size, and lower income potential for local farmers.

Maple syrup production may be impossible in Connecticut by 2080...

Warm winter days and cold nights are necessary in the maple syrup process. This dichotomy induces sap flows. However, warmer temperatures challenge maple trees to maintain the slow flow for sap sugar levels. The season can come and go must faster and with less product.

The tapping season is starting 8 days earlier and ending 11 days earlier than 50 years ago. Higher temperatures also mean less sugar in the sap. This means it will take more sap to produce one gallon of syrup.

Connecticut will see positive and negative effects from climate change in the crop industry.

Higher temperatures for spring and fall lengthen the shoulder seasons, which can increase crop yields and diversity. Warmer winters can also decrease heating needs especially for greenhouse growers. However, warm moist winters bring increased opportunities for pathogens, pests, and disease increasing crop care costs. Crop care further increases in summer with high heat and frequent droughts demanding irrigation and new tolerant varieties.

Shifting Growing Seasons

Too much precipitation, especially in the spring, leads to increased fungal infections, and reduced pollen production. While drier summers are better for apples and pears, insect damage due to higher temperatures could lead to decreased fruit yield. Orchards are seeing apples and pears mature earlier. This could have a negative impact on pick-your-own farms since customers associate apples and pears with the fall.

Herb Virgo, Executive Director of Keney Park Sustainability Project, leads the way in creating new agriculture opportunities. The urban farm program supports the development and sustainability of community-based food systems, i.e., farmers markets, community gardens, school-based gardening, agricultural projects, and home gardens. Urban agriculture is an emerging option to reduce greenhouse gases by providing more green infrastructure that reduces heat reflection, adds to air cooling and water recharge of aquifers.

Opportunities for Growth!

Biofuel crops, (hops, hydroponic seaweed) could increase due to climate change projections. Biofuel crops are adapting to increased temperatures, precipitation, and surrounding CO_2 levels. Biofuel crops will likely play an important role in efforts to reduce greenhouse gas emissions by removing a portion of fossil fuel use.

Addressing Climate Change means addressing carbon emissions.

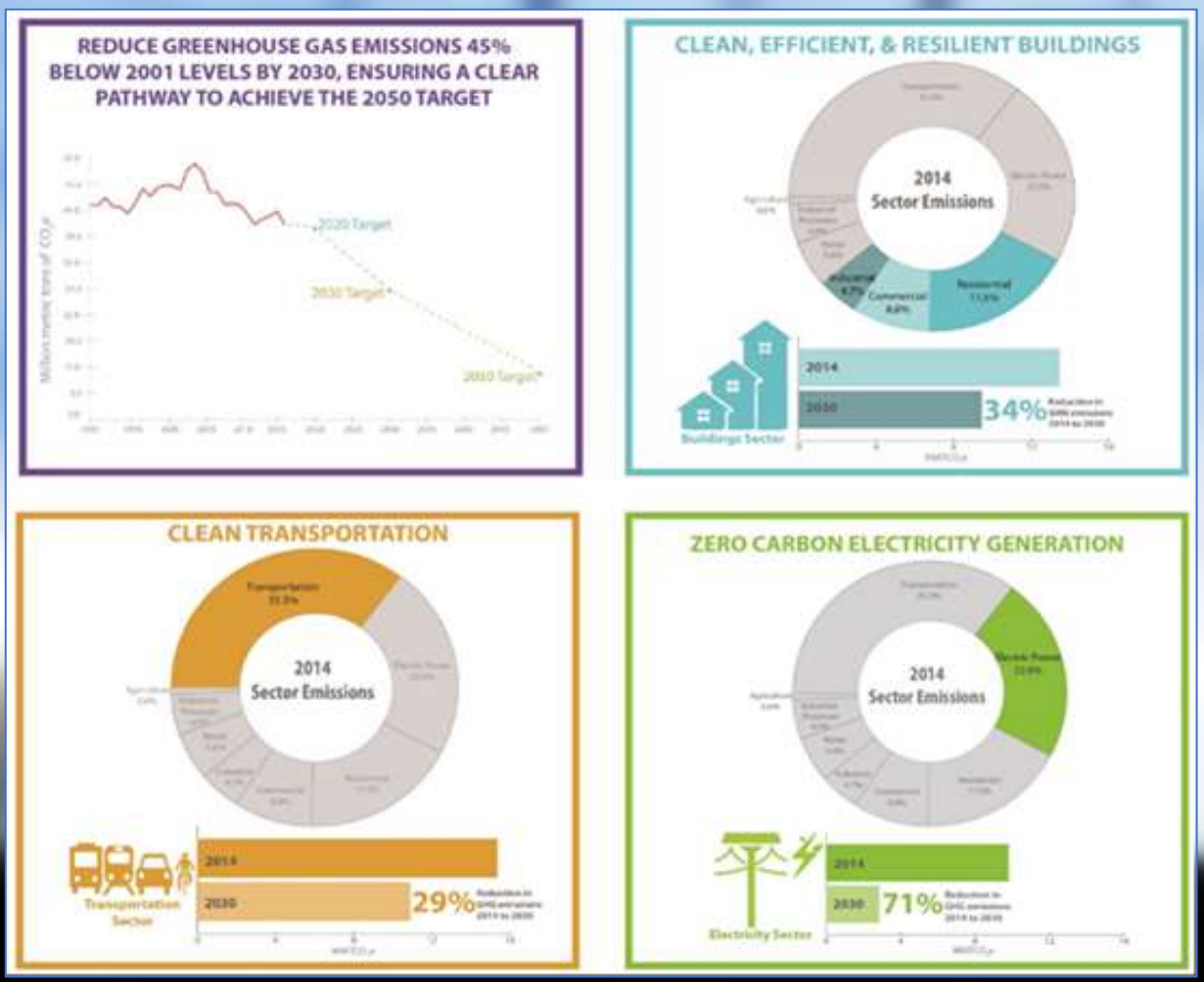
Connecticut has identified climate change action in residential, municipal, and individual areas.

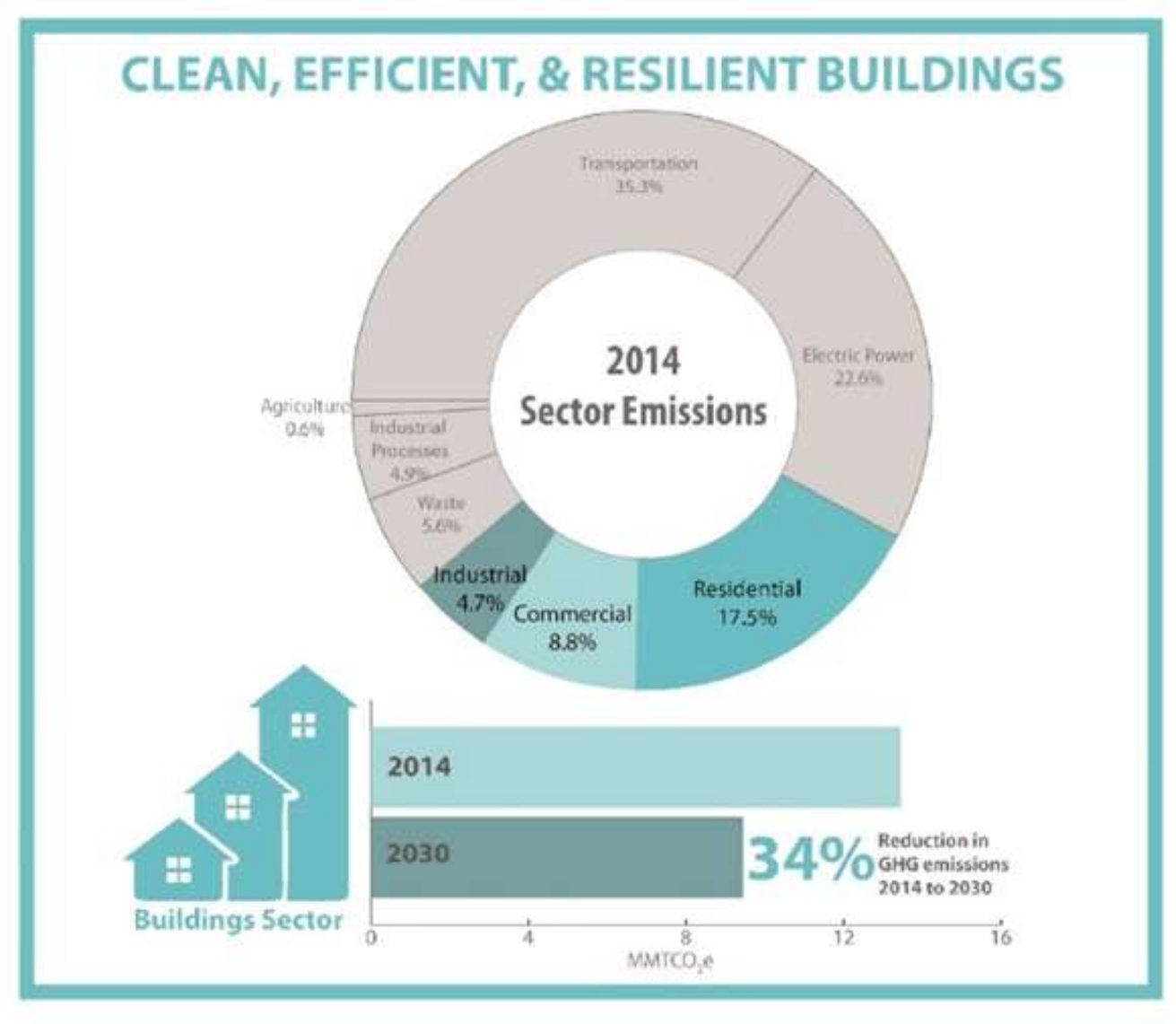
- Zero carbon electrical generation
- Clean transportation
- Clean, efficient, and resilient buildings

The source of energy for production of electricity, heat, and transportation is important when looking at a low carbon future. Oil and coal are carbon dense energy forms. Reducing carbon emissions by choosing less dense carbon options and renewable sources is just the start when addressing carbon levels. Renewable energy forms, like wind, geothermal, and solar along with nuclear power, offer cleaner carbon futures, but are not devoid of challenges. Smart choices and use of technology are necessary for a sustainable future.

To continue with business as usual, without action on carbon levels, Connecticut will face additional challenges. Steps taken today will slow changes, but the impacts are still going to be part of the adaptation process for years to come. Without actions to reduce carbon emissions, the expected temperature rise for Connecticut is 3 degrees more by 2050, sea level is expected to be 20 inches higher, with lower biodiversity.

Connecticut Low Carbon Future Consists of...



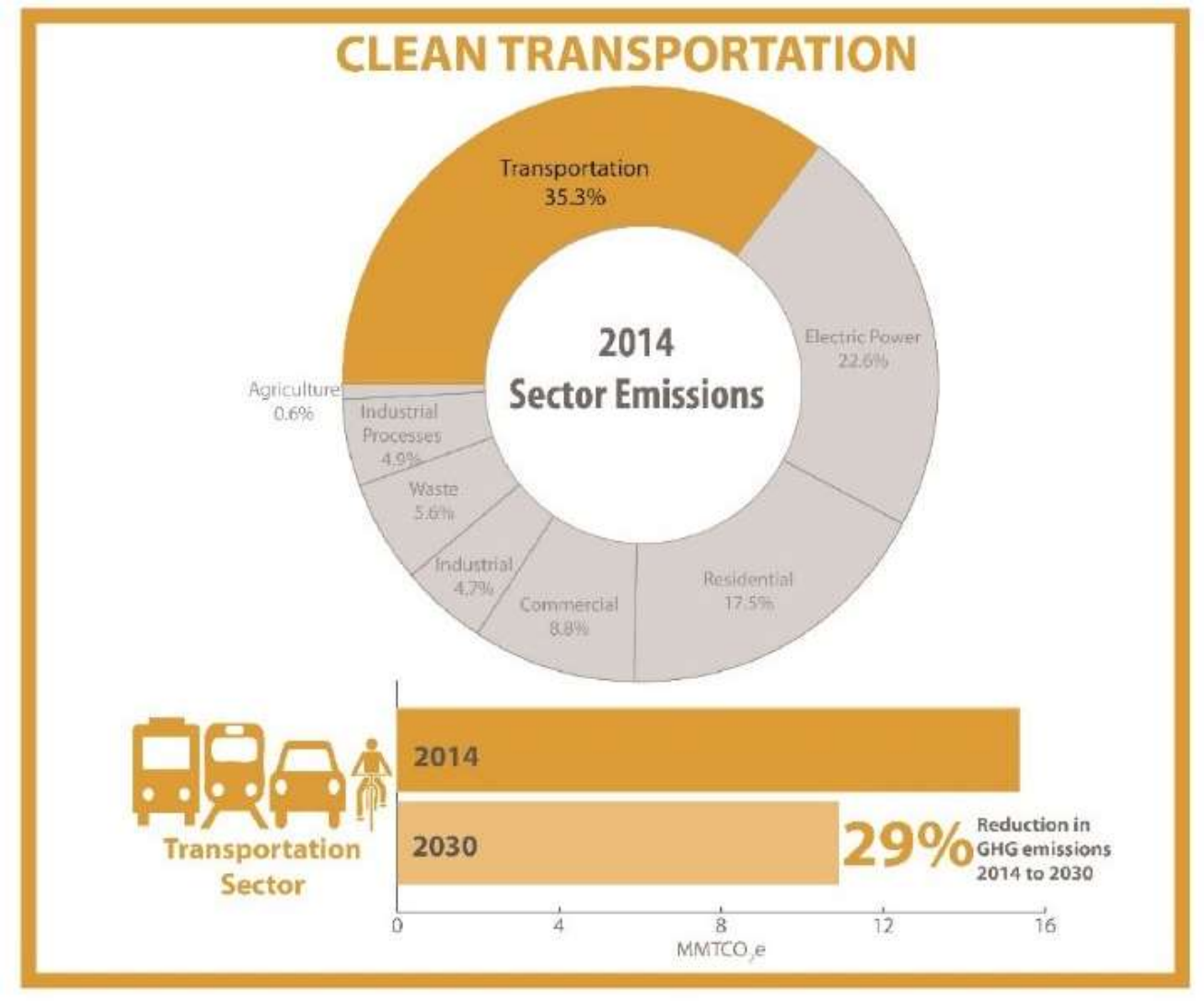


Residential use of energy accounts for more greenhouse gas (GHG) emissions than industry. Updating buildings and homes will improve efficiency and increase options for low carbon fuel options.

Programs to support access to upgrades in building health and operation are a priority for all in CT, but especially in our underserved communities. Access to programs and assistance in energy efficiency provides a co-benefit for both improved environmental health and human health.

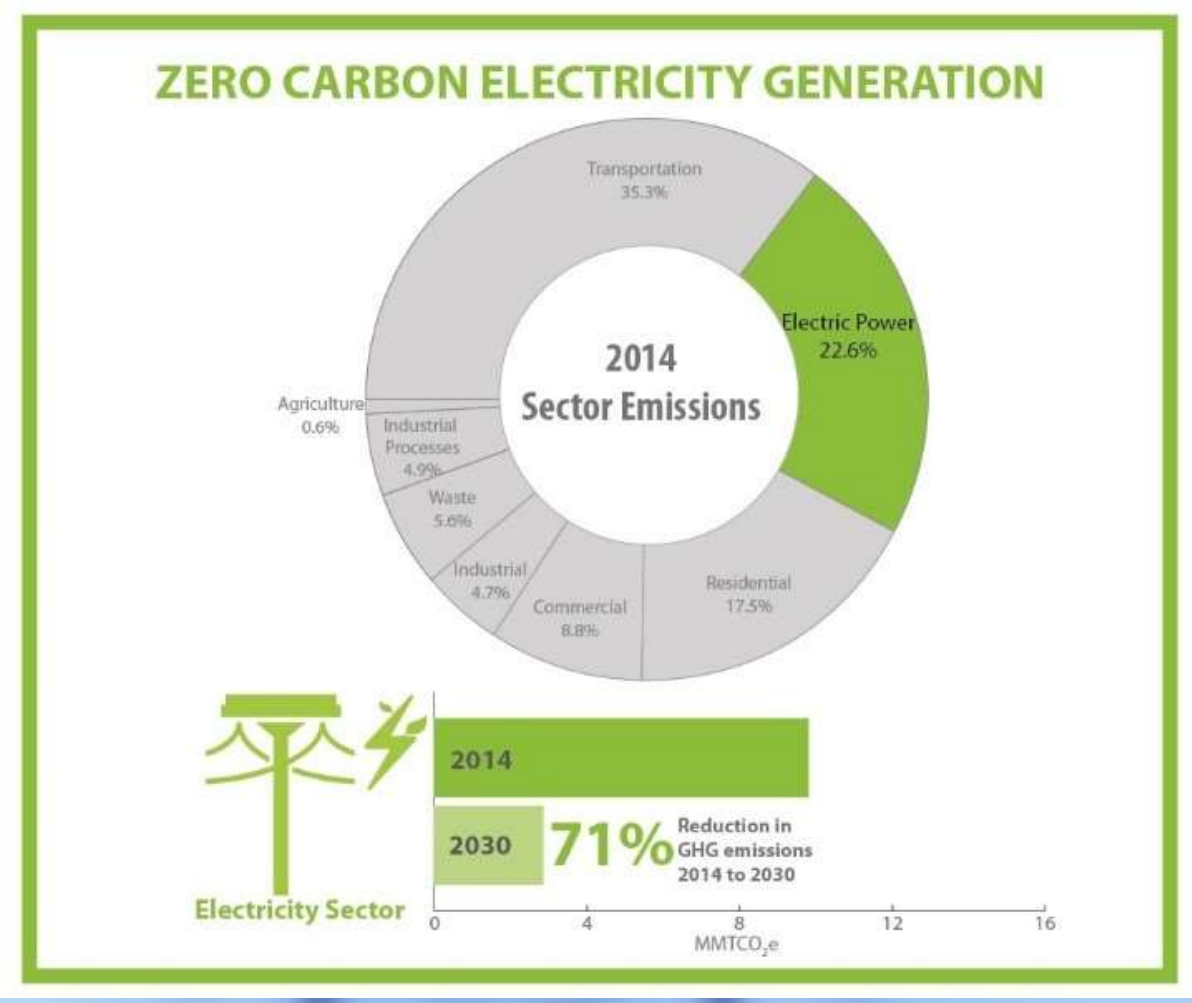
These simple energy-saving steps are a start to becoming part of a Zero Carbon Future by improving carbon and other GHG emissions:

- Be energy efficient; use only necessary lighting, insulate and do not waste energy.
- Make use of energy efficient products, such as LED lights and appliances.
- Use energy audits and make upgrades for homes.



The largest GHG emission sector for Connecticut is transportation. The burning of fossil fuels for cars, buses, and trains accounts for 35% of all GHG emissions.

Recent events with COVID-19 forced CT to park our cars more. Rethinking vehicle use, transportation, and vehicle choice are primary considerations when reducing fossil fuel consumption. Long-term results require optimizing schedules with a low carbon vehicle infrastructure for buses and trains and more charging stations for electric cars. Opportunities and incentives are necessary for low- and middle-income homes to make these choices. Rethinking urban and suburban design, more walkable and bikeable communities supports healthy lifestyles and encourages growth in green infrastructure and community design. Making these choices a financial priority during planning is necessary for rethinking the future and providing options for all.



Electrical generation is the second highest contributor to GHG emissions, about 23%. Connecticut uses a collection of fuels to create electricity on a daily basis.

In 2018, nuclear and natural gas sources generated 94% of our electricity. Trash to energy and renewable power sources provided the remaining 6%. To meet the goal of reducing GHG emissions by 71%, Connecticut is prioritizing the growth of renewable resources as fuel sources for electricity. It is placing a high emphasis on residential solar power sources adding to low carbon options. In 2019, the largest offshore wind project, Park City Wind, was approved for Connecticut. This will provide over 800 million dollars of economic benefit to Connecticut through green jobs and provide citizens with a reliable source of fixed price and renewable energy. Energy planning and its benefits take time to implement and their effect is often not seen for many years. The sooner we address low carbon energy sources, the faster GHG emission will come down and climate impacts will improve.

On a per capita basis, CT is the sixth lowest energy consuming state in the United States but one of the highest per capita of energy costs. To meet reduction goals and improve the affordability of power, CT has identified the need to incentivize renewable energy sources, and put a price on carbon.

Resources....The information contained in this document resulted from a variety of resources.

These resource and websites are listed below for your use. We encourage you to use them to learn details about impacts, adaptation and climate science.

Understanding Climate Change Impacts in Connecticut

- **Adapt CT, UCONN An Outreach Partnership of CT Sea Grant and Center for Land Use Education and Research (CLEAR);** https://climate.uconn.edu/
- **American Lung Association, State of the Air, Compare your Air;** http://www.stateoftheair.org/city- rankings/compare-your-air.html
- **Climate at a Glance. NOAA, National Center for Environmental Education, Climate Monitoring;** https://www.ncdc.noaa.gov/climate-monitoring/
- **Climate Central** https://www.climatecentral.org/
- **Climate Science Special Report, Fourth National Climate Assessment (NCA4) Vol. I;** https://science2017.globalchange.gov/
- **CT DEEP Climate Change Resources for Educators**; https://portal.ct.gov/DEEP/Climate-Change/Climate-Resources-for-Educators
- **Connecticut Department of Energy and Environmental Protection, Climate Change;** https://portal.ct.gov/DEEP/Climate-Change/Climate-Change
- **Connecticut Department of Public Health, Healthy Connecticut 2025 State Health Assessment;** https://portal.ct.gov/DPH/State-Health-Planning/Healthy-Connecticut/Healthy-Connecticut-2025#
- **Connecticut Institute for Resilience & Climate Adaptation (CIRCA)Connecticut Physical Climate Science Assessment Report;** https://circa.uconn.edu/ct-climate-science/
- **NOAA National Center for Environmental Information, State Climate Summaries, Connecticut;** https://statesummaries.ncics.org/chapter/ct/
- **NOAA Ocean Acidification Program** https://oceanacidification.noaa.gov/
- **Northeast Coastal Acidification Network** http://www.necan.org/references/
- **Union of Concerned Scientists, Climate Science;** https://www.ucsusa.org/climate/science
- **US Forest Service Climate Change Resource Center,** https://www.fs.usda.gov/ccrc/
- **U.S. Energy Information Administration Connecticut Profile;** https://www.eia.gov/state/analysis.php?sid=CT
- **What Climate Change Means for Connecticut, EPA, August 2016, EPA 430-F-16-009** https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-ct.pdf

Mapping Climate Change

- **CT Institute for Resilience and Climate Change** https://circa.uconn.edu/
- **CT Sea Level Rise and Storm Surge Viewer;** https://circa.uconn.edu/sea-level-rise/
- **Center for Land Use Education and Research, CLEAR;** http://clear.uconn.edu/
- **The Monitoring Acidification Project**; https://storymaps.arcgis.com/stories/fae30818a6164043a0d368ba0cd7bad3
- **USDA Northeast Climate Hub;** https://www.climatehubs.usda.gov/hubs/northeast

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BARRINGER, Lawrence/Pennsylvania Department of Agriculture: Spotted Lanternfly (15)

Center for Disease Contro (CDC)l: Open Source Image Library, Lone Star tick (18), Black-legged tick (18), Asian Long-horned tick (18), James Gathany photo numbers #22886, #8683, #1669 respectively.

Climate Central: "Optimal Temperature Ranges for Trout, Bass, and Salmon." climatecentral.org/gallery/graphics/optimal-temperature-ranges-for-trout-bass-and-salmon-2019 (9)

CT Agricultural Experiment Station: emerald ash borer damage (15) Graphic, species and number of tick collected (18), Plant Health Fellows program interns (18), Background photo, Tick Collection image Dr. Goudarz of the CAES.

CT Department of Agriculture: apples (21)

CT Department of Energy and Environmental Protection: Algae bloom (9), Photos of winter recreation (12), (13 background), Gypsy Moth (15), "2019 Eastern Equine Encephalitis Activity" (17), "2018 West Nile Virus Activity" (17), Four clean energy charts (22)

CT Mirror: (10 background)

DOMINGUEZ, Ricardo: tree-damaged car (11)

Fairfield Shellfish Commission: Annual Clam Clinic (14)

FRUMHOFF, P. C. et al. 2007. "Confronting climate change in the U.S. northeast: science, impacts, and solutions." Union of Concerned Scientists, Cambridge, Massachusetts, USA. https://www.nrc.gov/docs/ML1434/ML14345A554.pdf (19)

FUSCO, Paul J.: (Cover stripes # 3, 5), Marsh Encroachment (6), Saltmarsh Sparrow (7), Least Tern (7), oyster boat at sunset (14), Mussels (14)

JANOWIAK, Maria K. et al. "New England and northern New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework project." Gen. Tech. Rep. NRS-173. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 234 p. https://doi.org/10.2737/NRS-GTR-173 (15)

KUBIK, Evelyn (Cover stripes # 1, 2, 6, 7)

LAVITT, Mara/New Haven Register: Used with permission by Hearst Connecticut Media. (10)

Maple Syrup Producers Association: maple syrup sign (20)

Minnesota Pollution Control Agency: Diagram of health effects of particle pollution (19)

NASA/Goddard Space Flight Center: (4 background), NASA: "A Blanket Around the Earth" (4)

POUNDS, Brian A./Hearst Connecticut Media: Reef Balls (7), Storm-damaged houses (10)

PREPELKA, Ben: (21 background)

PRICHARD, Kara: (3 background), (6-9 backgrounds), (12 background), (15-19 backgrounds), (22-25 backgrounds)

PRYZBEK, Aaron. (14 background)

RUNKLE, J., et al. 2017: Connecticut State Climate Summary. *NOAA Technical Report NESDIS 149-CT* (13)

U.S. Global Change Research Program. U.S. Global Climate Change Research Program. NCA4 vol. 1 https://science2017.globalchange.gov/ (Figure source: updated Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC. (10)

UConn Department of Animal Science: "Dairy Cows on Horsebarn Hill, Storrs, CT" (20)

Union of Concerned Scientists: "Storm Surge and High Tides Magnify the Risks of Local Sea Level Rise." *Causes of Sea Level Rise.* April 2013. Retrieved from ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Causes-of-Sea-Level-Rise.pdf (8)

Warren Pinnacle Consulting; New York City Parks: "Salt Marsh Tide Levels" (8)

WEBER, Doug: Hops (21)

WILSON, Hailey: wall cloud at Sleeping Giant State Park (11)