

# Climate Action Plan



C A P E   C O D

## ACKNOWLEDGMENTS

The Cape Cod Commission would like to thank the organizations, agencies, and individuals who contributed to this plan. Their feedback and input shaped its contents, and their dedication and enthusiasm will serve the region well during its implementation.

## 2021 CAPE COD CLIMATE ACTION PLAN JULY 2021

**Prepared by Cape Cod Commission Staff**

The maps and graphics in this document are for planning purposes only. They are not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.



**CAPE COD  
COMMISSION**

P.O. Box 226 (3225 Main Street),  
Barnstable, Massachusetts 02630  
Phone: 508-362-3828  
Email: [frontdesk@capecodcommission.org](mailto:frontdesk@capecodcommission.org)  
[www.capecodcommission.org](http://www.capecodcommission.org)



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## CAPE COD CLIMATE INITIATIVE

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The Cape Cod Climate Action Plan is a major component of the Cape Cod Climate Initiative, a community-focused, information-based effort to inform a strategic framework and collaborative approach to address the region's contributions to and threats from climate change.

# Executive Summary



Climate change is an unprecedented challenge that is transforming Cape Cod. Rising seas and changes to the coastline are the most dramatic evidence of climate change, but it is impacting every facet of Cape Cod's natural, built, and community systems. By the end of the century, damage to Cape Cod's buildings and land lost to inundation could alone total over \$30 billion. Our land use patterns and way of living dictate our greenhouse gas (GHG) emissions, the leading cause of the climate crisis. Dedicated and immediate action is necessary to slow the effects of climate change and improve the region's resiliency to its impacts. The Cape Cod Climate Action Plan provides a framework for action to support a climate resilient region.

The Climate Action Plan was developed during a time of increasing concern about the changing global climate and potentially devastating local effects of widespread inaction. The Plan is the result of an intensive effort by the Cape Cod community to address a regional challenge of such significance that 79% of the region's residents believe it will impact their family's well-being. It was developed as the Commonwealth of Massachusetts took significant strides shifting the state toward a net-zero carbon emissions goal, issuing an update to the Massachusetts Clean Energy and Climate Plan and passing An Act Creating a Next-generation Roadmap for Massachusetts Climate Policy (Chapter 8 of the Acts of 2021).

In recognition that action must be taken to reduce GHG emissions and slow the rate of climate change, the Commonwealth's Next

Generation Roadmap for Climate Policy established a State-wide net zero carbon emissions target for 2050, with aggressive interim targets, including a 50% reduction in carbon emissions by 2030. The target of "net zero" emissions is defined as "a level of statewide greenhouse gas emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is 85% below the 1990 level."

Aligned with the Commonwealth's goals, the Climate Action Plan identifies strategies and actions to reduce GHG emissions and enhance local and regional resiliency to climate threats present today and increasing in severity and intensity. It was guided by

several principles that shaped the approach to identifying and prioritizing solutions. The principles recognize the urgency needed in taking action and reflect consideration for the long-held regional goals that have shaped Cape Cod's growth policies and planning decisions in recent decades, as well as the considered and deliberate nature of thoughtful and responsible planning.

## PURPOSE STATEMENT

To identify, study, and monitor the causes and consequences of climate change on Cape Cod as a basis to guide and develop science-based policies, strategies, and actions that governments, businesses, organizations, and individuals can pursue to:

- improve the region's resiliency to climate hazards; and
- mitigate climate change on Cape Cod through reducing net regional greenhouse gas emissions in support of the framework and targets established by the Commonwealth.

## PLANNING PRINCIPLES

- Reducing emissions and increasing resiliency to current and future hazards
- Taking actions that address GHG emissions from all sources, with emphasis placed on those targeting the region's highest emitting sectors
- Recognizing the relationship between climate change and other regional challenges, and prioritizing actions that provide co-benefits
- Considering economic impacts associated with implementation of actions, as well as the costs of inaction
- Prioritizing communication and engagement to convey the urgency of the challenge and gain support for the range of solutions.
- Incorporating equity considerations to ensure a successful implementation strategy

Successful climate action must be equitable. Vulnerable populations are often disproportionately impacted by the effects of climate change and typically have less access to the resources needed for recovery. These vulnerable populations are traditionally identified through existing designations, such as Environmental Justice (EJ) communities – areas with high minority, non-English speaking, and/or low-income populations. However, as the region moves forward with implementation of the Climate Action Plan, equity may be addressed in ways that vary by location and based on the characteristics of a community. Age, income, race, ethnicity, language barriers, mobility challenges, traditional industries, tribal interests and education level may all be factors, as well as location of homes or businesses in climate hazard areas. As the region moves forward with implementation, the ways in which equity is addressed may evolve and expand. Equity considerations must be integrated into planning for and implementing climate actions to ensure no one population is disproportionately affected by climate impacts, and that the solutions provide broad benefits without being overly burdensome to any particular population.

The Plan also leverages existing efforts at the local and regional scale. Towns have developed plans to adapt to climate impacts and have worked together at the subregional level to identify paths to greater coastal and climate resiliency. Each Cape Cod community has completed the Municipal Vulnerability Preparedness (MVP) Program planning process to earn MVP community designation. All Cape Cod communities have achieved, or are working toward, Green Community designation.

The core principles and goals that have defined the Cape Cod Regional Policy Plan since the Cape Cod Commission's establishment in 1990 continue to promote efficient use of land and resources, inherently protective of the climate. The regional growth policy aims to create vibrant community centers of activity, away from areas that need to be protected for ecological, historical, or other reasons, where reliance on vehicles is reduced and alternate modes of transportation are prioritized, and where the infrastructure needed to support human activities has a smaller footprint. In addition, the Commission has led efforts to develop targeted regional plans to advance

progress around specific issues of interest or concern relative to climate resiliency and mitigation. The Resilient Cape Cod Project led the development of a decision-support tool, the Cape Cod Coastal Planner, to aid in local discussions and decisions about climate adaptation strategies. For the first time, the Cape Cod Regional Transportation Plan

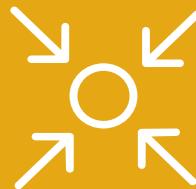
recommends dedicated funding for climate change mitigation and adaptation.

Other entities have also led the way in advancing climate-sensible solutions. The Cape Light Compact and Cape and Vineyard Electric Cooperative, have made significant contributions to address climate-responsible energy use and generation, and mitigate the region's contributions to GHG emissions. The Cape Cod Regional Transportation Authority has

worked to enhance services and increase ridership, reducing reliance on personal vehicles. A coalition of Cape and Islands-based organizations, businesses, and citizens came together to form the Cape Cod Climate Change Collaborative aimed at mitigating climate change impacts on Cape Cod, reducing GHG emissions, and working toward achieving net zero-based goals.

Stakeholders across the region are engaged in climate planning and implementation and are well-positioned and energized to further targeted adaptation and mitigations actions.





## THE NEED FOR TARGETED ACTION

With 586 miles of both naturally rich and heavily developed coastline, the most notable risks to the region are the destructive impacts of increasingly intense coastal storms, extreme precipitation, and associated flooding, and both flooding and erosion exacerbated by rising sea levels. Today, development within the floodplain places more than 15,000 properties at risk and more recent demand for development along the shoreline has exposed many homes to the threat of erosion. It is estimated that adapting the coast to sea level rise and storm surge could avoid a potential \$50 billion in losses resulting from damaged roads, residential real estate and economic assets, lost tax revenue, reduced beach tourism, and decreased land value through 2100.

The Climate Action Plan establishes a baseline of current climate impacts and GHG emissions. It characterizes the significant impacts caused by storm surge, sea level rise, erosion, and other coastal hazards, and identifies the major sources of greenhouse gas emissions in the region, providing the basis for a targeted approach to climate action.

Continued release of GHGs into the atmosphere will only increase the impacts already evident today and the predictions for future climate-induced conditions are concerning. The Cape is projected to experience higher average temperatures, more frequent and severe storms, and more rapidly rising sea levels. These changes will contribute to lengthier droughts, more intense precipitation events and inland flooding, and dramatic changes to the coast through expanded coastal flooding and erosion. The Cape's changing climate will likely result in increased heat-related illnesses, vector-borne diseases, and harmful algal blooms, more frequent and prolonged power outages, heightened threat of wildfires, and shifts in species distributions.

\$50 BILLION

**Damage and losses due to sea level rise and storm surge could exceed \$50 billion through 2100**

The region's ecosystems, and the services they provide, are also impacted. Over 12,000 acres of eelgrass and nearly 14,000 acres of salt marsh are at risk. Loss of these natural resources may result in millions of dollars in losses associated with nitrogen removal, carbon sequestration, and commercial fisheries. Industry impacts will be seen across other sectors, including an approximate \$80 million cumulative loss in revenue from

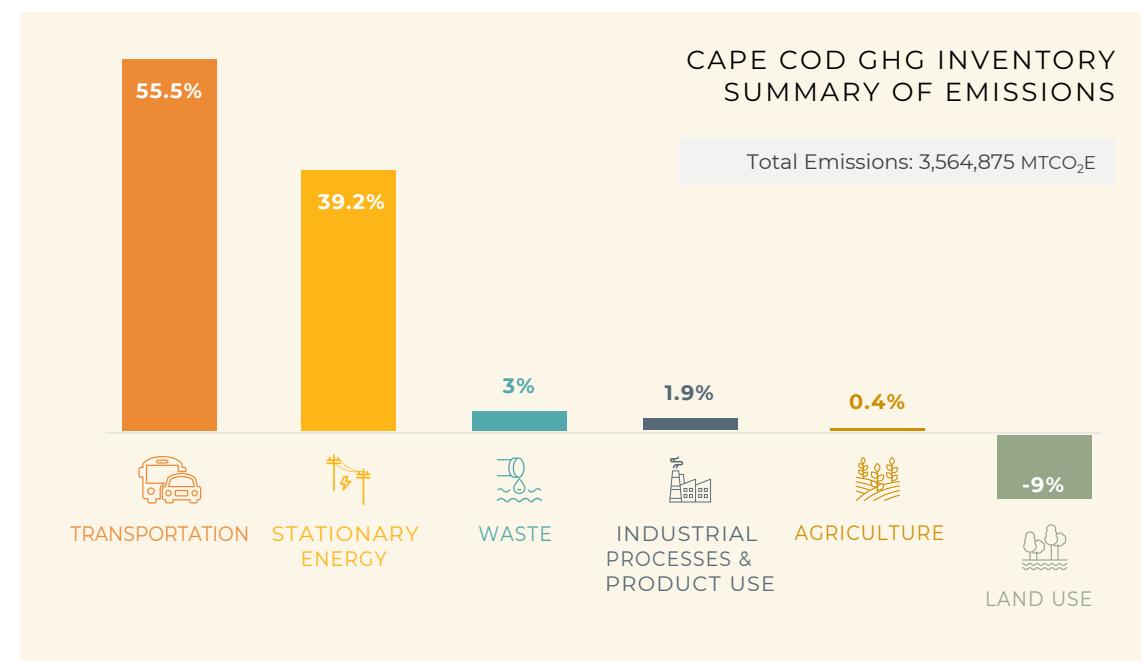
cranberry bogs inundated by sea level rise through the end of the century.

The Cape Cod GHG emissions inventory establishes a baseline of emissions from all man-made sources in the region. The vast majority of Cape Cod's GHGs are carbon dioxide. Cape Cod's emissions account for approximately 4-5% of Massachusetts state emissions. The transportation and stationary energy sectors account for nearly 95% of regional emissions. Transportation is the highest contributing sector, accounting for 55.5% of total Cape emissions. The second highest contributing sector is stationary energy use, responsible for

39% of emissions. The remaining

5% of emissions come

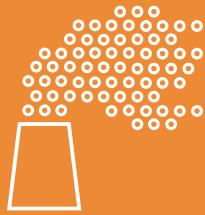
from the waste (3%),



industrial processes (2%), and agriculture (0.4%) sectors.

Land use and forestry (represented by forestland, grassland, and cropland) sequesters approximately 9% of the total inventoried emissions in the

region. On Cape Cod, the largest potential for sequestration comes from forestland. Salt marshes, freshwater wetlands, and other natural resources likely sequester significantly more carbon, but additional research is needed to develop a method for calculating that potential.



## EMISSIONS REDUCTION SCENARIOS

The sustained policy scenario fails to achieve the 2030 interim target and the 2050 net zero target in Barnstable County. Emissions are projected to decline through those time periods; however, total regional emissions in 2050 are projected to be approximately 1 million metric tons above the 2050 target.

**1 MILLION**  
METRIC TONS ABOVE TARGET

**Under the sustained policy scenario total regional emissions are projected to be nearly 1 million metric tons above the 2050 target**

To better understand how the region can support achievement of the Commonwealth's goals, the Climate Action Plan includes future emissions scenarios. Emissions were modeled from the transportation, building, and electricity sectors from 2021 through 2050 for five scenarios, including one sustained policy scenario that assumes current policies meet their intended goals , and four decarbonization scenarios which propose different paths for emissions reductions.

The transportation sector continues to be the largest source of emissions through 2050, representing 48% of economy-wide GHG emissions.

Four decarbonization scenarios were developed to understand what types of changes would be necessary to meet the Massachusetts GHG emissions reduction goals. All four scenarios show that significant growth in the share of new vehicle sales that are light-duty EVs and in the use of heat pump systems for both retrofits and whole home systems will be needed to meet emissions reductions goals. Due to the increased electricity use in both the transportation and building sectors,

which will result in increased electric load for the region, cleaner electricity sources will be critical to achieving GHG emissions reductions. Anticipated shifts to lower or no emissions electricity sources result in modeled emissions from the electric sector for the region to decrease from 2020 to 2050 in all five scenarios.

Together with the baseline GHG emissions inventory, the decarbonization scenarios informed identification of priority strategies, actors, and recommendations of the Climate Action Plan.

## DECARBONIZATION SCENARIOS

All four scenarios show that significant growth in the share of new vehicle sales that are light-duty EVs and in the use of heat pump systems for both retrofits and whole home systems will be needed to meet emissions reductions goals.

### Carbon Neutral Scenario (CEN)



The carbon emissions neutrality reduction scenario determines the level of beneficial electrification necessary to meet the goal of carbon neutrality—where all remaining emissions are offset by sequestration—in 2050 given baseline energy efficiency gains.

### Aggressive Electrification Scenario (SER1)



The state-level emissions reduction baseline scenario determines the level of beneficial electrification necessary given baseline energy efficiency gains to meet Massachusetts's GHG emissions reduction goals.

### Aggressive Efficiency Scenario (SER2)



The state-level emissions reduction aggressive efficiency scenario determines the level of beneficial electrification necessary to meet GHG emissions reduction goals for Massachusetts, assuming aggressive efficiency efforts. This includes targeted programs and policies on Cape Cod to aggressively reduce vehicle miles traveled and improve the energy performance of homes and businesses through weatherization

### Increased Year-round Population Scenario (SER3)



The state-level emissions reduction year-round residency sensitivity scenario determines the level of beneficial electrification necessary to meet GHG emissions reduction goals for Massachusetts, assuming 50 percent of seasonal residents convert to year-round residents relative to historic patterns

**EMISSIONS SCENARIO DETAILS** | More information on the emissions scenarios can be found at: [capecodcommission.org/ClimateActionPlan-AppendixB](http://capecodcommission.org/ClimateActionPlan-AppendixB)



## PRIORITIZING ACTION

The following mitigation and adaptation strategies emerged to broadly characterize the areas where the region should focus its climate action efforts, including those that target the region's highest emitting sectors:

Through the Climate Action Plan process, goals and strategies were developed to address the dual interests of climate change mitigation and adaptation. Cape Cod Commission staff compiled strategies, actions, and steps through a literature review of climate action plans from around the country; from the Pathways to Net Zero developed by the Cape Cod Climate Change Collaborative; from additional research; and through an iterative process of refinement with stakeholders.



Reduce energy consumption and strive towards Net Zero Energy Building



Promote efficient land use policies and development patterns that protect the nature and character of the region



Address vulnerabilities in public infrastructure and in the road network, including adapting critical transportation infrastructure for climate change impacts



Identify approaches to managing development in coastal resource areas region-wide



Address vulnerable buildings and structures threatened by flooding and erosion through retrofits and relocation



Generate and increase the use of safe, reliable, and clean energy



Reduce vehicle miles traveled and support low and no carbon transportation options



Accelerate the electrification of the transportation system



Reduce emissions by increasing protected open space, including enhancing carbon storage and sequestration in forests, wetlands, and soils



Increase education and communications about climate change mitigation and adaptation options



Support increases in municipal capacity and provide technical assistance

An economic analysis completed as part of the planning process helped to prioritize strategies and outlines considerations for implementation.

The strategies and actions identified through the Climate Action Plan process require the region to come together to implement. Partnerships within government, and with and between non-governmental organizations, researchers, and the business community will be critical for success. Partnerships must be forged and strengthened to advance the implementation of many actions. All those who live and work on Cape Cod, as well as those who visit, will need to engage in advancing climate action.





## IMPLEMENTING ACTIONS

The Climate Action Plan provides a roadmap for various actors to move priority strategies forward and outlines an implementation plan to tackle the first steps. It provides detail on existing funding opportunities to support implementation, as well as new and innovative funding and financing methods to further explore. Each strategy requires engagement of a variety of actors. Governments will need to work together, across town boundaries, and across levels of government. Some entities are uniquely qualified to address certain actions; many other actions will require partnerships to implement; yet others may present business opportunities. A committee or task force will guide and track implementation and foster partnerships and collaboration necessary to more aggressively pursue action.



### LOCAL GOVERNMENTAL ACTORS

Cape Cod communities have been actively pursuing climate change mitigation and adaption strategies, however, in some instances, technical assistance is needed for municipalities to implement actions. Many actions at the municipal level will require broad support from the community, as Town Meeting or Town Council approval will be needed. To accelerate action to address climate change in the region, Cape Cod communities should continue and expand their efforts, with support from local Climate Action Networks, regional entities, and non-governmental actors.

Community leadership is critical. The following are examples of actions that can be taken by local government actors:

- Pursue Green Communities Designation
- Adopt Complete Streets policies
- Complete a comprehensive review of local bylaws and regulations to identify opportunities to encourage and incentivize practices that lower emissions and increase resiliency
- Develop new procurement rules for new construction, new vehicle purchases, and purchase of other products and services that incorporate standards that reduce GHG emissions
- Inventory existing vulnerable infrastructure and develop plans for reducing vulnerabilities
- Integrate climate change into community visioning and local planning processes





## REGIONAL GOVERNMENTAL ACTORS

At the regional scale, there are opportunities for Barnstable County to assist municipalities by providing technical assistance and resources, coordinating with State and Federal agencies to access resources and address infrastructure, and promoting infrastructure to accelerate GHG reductions both in County-owned buildings and across the region.

To date, the County has served as a resource for communities and other regional partners. Both the Cape Cod Commission and Cooperative Extension staff advise on floodplain and coastal resiliency issues and provide resources, such as model bylaws, for

use by municipalities. To support Cape Cod communities and accelerate action to reduce GHG emissions, the County should continue and expand its efforts.

There are also opportunities for regional governmental entities outside of Barnstable County to further climate action. Entities such as the Cape Cod Regional Transit Authority, Cape Light Compact (CLC), and CVEC have opportunities to support infrastructure and services necessary to reduce reliance on fossil fuels and GHG reductions.

The following are examples of actions that can be taken by regional governmental actors:

- Develop new procurement rules for new construction, new vehicle purchases, and purchase of other products and

services that incorporate standards that reduce GHG emissions

- Complete a feasibility study on the potential for electrification of vehicle fleets
- Develop solar projects and install publicly available EV charging stations at appropriate County-owned buildings
- Facilitate completion of critical analyses, such as identification of storm-tide pathways
- Develop model bylaws and design guidelines
- Facilitate programs that assist residents and businesses in reducing their carbon footprint
- Pursue strategic investments that enhance public transportation, increase ridership, and reduce personal vehicle use





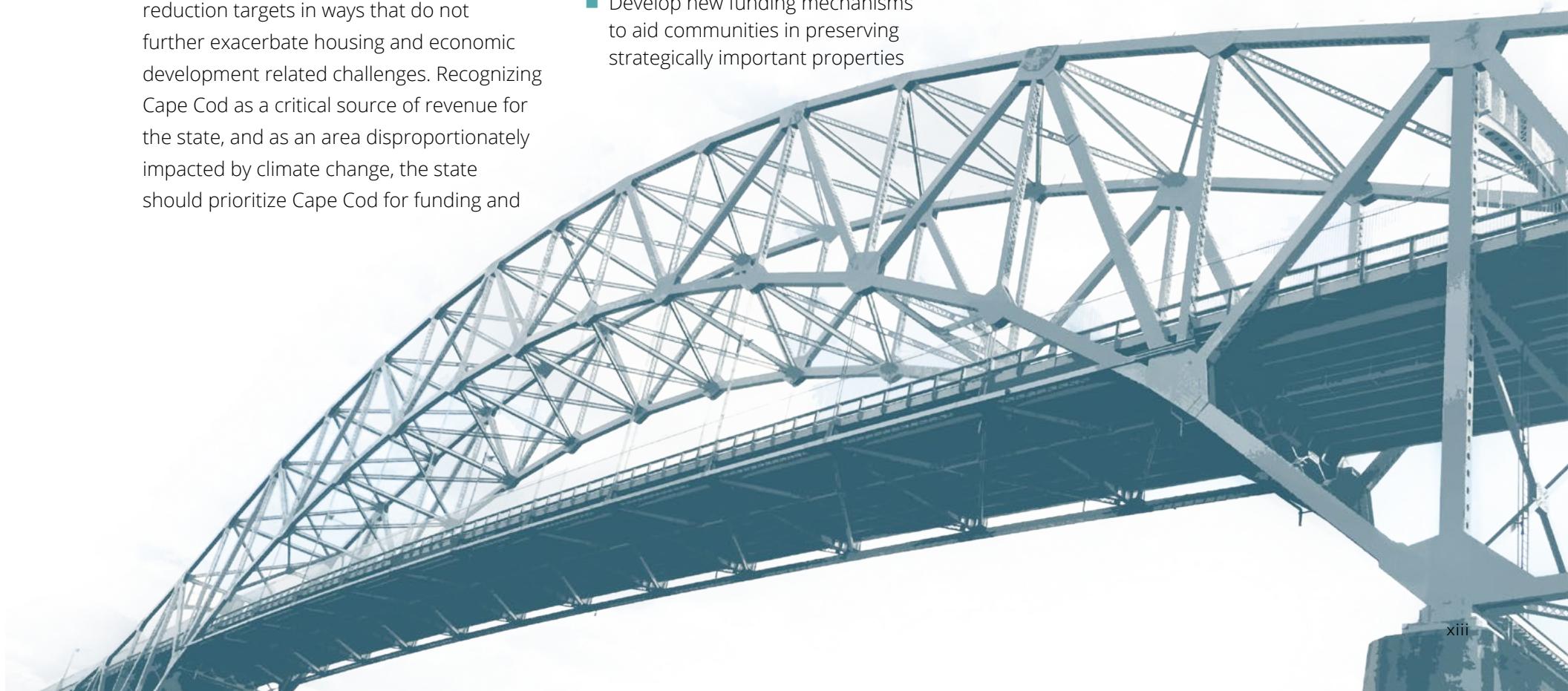
## STATE GOVERNMENTAL ACTORS

The administration has been a leader in establishing programs and providing resources to communities to facilitate adaptation and mitigation actions, and overall climate resiliency. The state must continue to expand opportunities for communities to achieve the state GHG emissions reduction targets in ways that do not further exacerbate housing and economic development related challenges. Recognizing Cape Cod as a critical source of revenue for the state, and as an area disproportionately impacted by climate change, the state should prioritize Cape Cod for funding and

technical assistance opportunities, such as those provided through the MVP Program and MA Coastal Zone Management.

The following are examples of actions that can be taken by state governmental actors:

- Expand eligibility of the MVP Program to include Regional Planning Agencies and other entities able to facilitate regional projects
- Develop new funding mechanisms to aid communities in preserving strategically important properties
- Incentivize infrastructure necessary to reduce GHG emissions, such as renewable energy installations and EV charging stations
- Promote continued remote work opportunities
- Amend the Massachusetts Open Meeting Law, permanently relaxing in-person quorum requirements to allow flexibility in holding in person or virtual public meetings





## FEDERAL GOVERNMENTAL ACTORS

Cape Cod is home to several federal entities. The Cape Cod National Seashore participates in the Climate Friendly Parks (CFP) program, and in alignment with the CFP has developed a GHG emissions inventory and a Climate Action Plan for the Seashore. A "Green Team" within the Seashore staff works to advance the park's Climate Action Plan. The Seashore should continue to work with surrounding communities and regional entities in partnerships and new initiatives to advance shared goals.

The United States Army Corps of Engineers' (USACE) primary presence on Cape Cod is in maintaining the Cape Cod Canal and bridges. Canal maintenance involves dredging and disposal of sediments trapped by the canal jetties, which have significant effects on the long-term viability of down-drift coastal neighborhoods in the Town of Sandwich. The USACE should be proactive in exploring, with the Town of Sandwich, ways to reduce the impacts of the canal infrastructure on the natural functions of coastal resources in this area.

Joint Base Cape Cod (JBCC) has a large presence on the Upper Cape, located within four towns, supporting diverse activities throughout the Base, and is responsible for stewardship of the Upper Cape Water Supply Reserve. Given JBCC's economic and environmental footprint on Cape Cod, the Services based there should strive to balance their essential activities (training, intelligence, and other military preparedness operations) with climate change planning, emissions reductions, and carbon sequestration.



## NON-GOVERNMENTAL ACTORS

The Cape Cod community has a history of active and engaged non-governmental organizations (NGOs), who have a significant role to play as the region takes action to address climate change. Non-governmental actors range from environmental advocacy organizations and housing advocates to civic organizations, business associations, land trusts and others. While each may have a different perspective and role, the region will benefit from a unified voice on the need for climate action. The following are examples

of actions that can be taken by all NGOs in the region:

- Provide educational resources, data, and fact-based information on the causes and impacts of climate change
- Encourage attendance at town meetings and elections where votes influence local climate action
- Develop and implement communications campaigns to encourage individual behavior change

NGOs engaged in housing, such as Housing Assistance Corporation, can support energy efficiency and climate-friendly building practices in affordable housing through their efforts to promote energy efficiency. Other organizations, such as the Cape Cod and Islands Association of Realtors, should continue to support collection and availability of data on energy efficiency and other climate-friendly home features. Land trusts should work with other regional organizations, such as the Association to Preserve Cape Cod, to identify, prioritize, and acquire areas for protection. Prioritization should, in part, consider areas where open space is lacking and where there is the greatest potential to provide public access.



## BUSINESSES

- Businesses can support climate action and contribute to reducing regional GHG emissions through their day-to-day operations. Certain sectors of the economy may benefit from climate action strategies, which have the potential to create additional jobs.
- Businesses should lead by example. The following are examples of actions businesses can take:
  - Invest in renewable energy for business operations
  - Provide EV charging station
  - Incorporate climate-friendly building products
  - Increase energy efficiency in their buildings

Organizations that support the region's business community, such as chambers of commerce, SCORE, Lower Cape Community Development Partnership, and others, should consider developing and hosting trainings to support implementation of climate-friendly business practices. The Homebuilders and

Remodelers Association of Cape Cod, along with other construction trade organizations, should consider opportunities to provide training and information on climate-friendly building practices and products.



## RESEARCHERS AND EDUCATIONAL INSTITUTIONS

Research and educational institutions have significant roles to play in planning for and implementing climate action.

The business community will need a highly trained workforce to support the transition to electrification. Technical high schools, Cape Cod Community College, the Cape Cod Homebuilders and Remodelers Association, Cape Light Compact, and other partners should work with the business community and organizations that provide business assistance to determine training needs and develop programming to support appropriate workforce development.

Local research organizations should play a significant role in providing data and information to support prioritization of

natural resource areas that contribute to reducing the impacts of climate change and mitigating GHG emissions. Woodwell Climate Research Center is well-positioned for this research and should be a key partner in efforts to better understand carbon sequestration in the region.

In addition, research institutions should analyze the costs and benefits of thin layer deposition to support salt marsh resilience, inventory salt marsh locations, and identify specific threats. These efforts should be in collaboration with NGOs, such as the Association to Preserve Cape Cod (APCC), and governmental entities, such as the Commission.





## RECOMMENDATIONS FOR SUPPORTING ACTION

The Cape Cod Climate Action Plan outlines 17 broad recommendations to support climate action



### DATA AND INFORMATION

Development of the Climate Action Plan relied on data, information, and analysis, all of which are critical to implementation. The collection of data, and development of tools that make data easier to use and understand, will support climate action and documentation of progress. Ongoing efforts to collect and analyze data should provide information necessary to support actions to reduce GHG emissions from the region's highest emitting sectors and to support and enhance carbon sequestration from natural resources. Data and information should be easily accessible to inform decision-making and advocacy efforts region-wide. The

Climate action will require support and participation by all. However, the recommendations section of the Climate Action Plan largely details efforts the Cape Cod Commission can lead to support local and regional climate action, while the preceding sections provide guidance for other actors. The recommendations are grouped into four categories: data and information, resources and technical support, funding, and continued engagement.

following recommendations fall within this category:

- Maintain aerial photography, planimetric data, and LIDAR data used to better understand vulnerabilities and track progress
- Complete the storm tide pathways analysis for the Nantucket Sound and Buzzards Bay shoreline, resulting in a regional data layer
- Create tools to track performance and make performance data accessible through a web-based application
- Calculate sequestration potential of natural resources in the region, to provide a more accurate estimation of regional carbon sequestration and support targeted investments in natural resource protection and restoration



## RESOURCES AND TECHNICAL SUPPORT

Much of the action to address climate adaptation and mitigation happens at the local scale, and requires support from a variety of other actors. Development of resources that can be applied locally, and more direct technical support, is necessary. Local guidance, identification of resource availability and funding opportunities, and model bylaws will support ongoing and future action at the local and regional scale. The following recommendations fall within this category:

- Maintain a legal and jurisdictional analysis that is evaluated as new state and federal policies and regulations are released
- Provide local guidance that includes elements such as incentives and funding opportunities for specific actions, and existing resources to support implementation

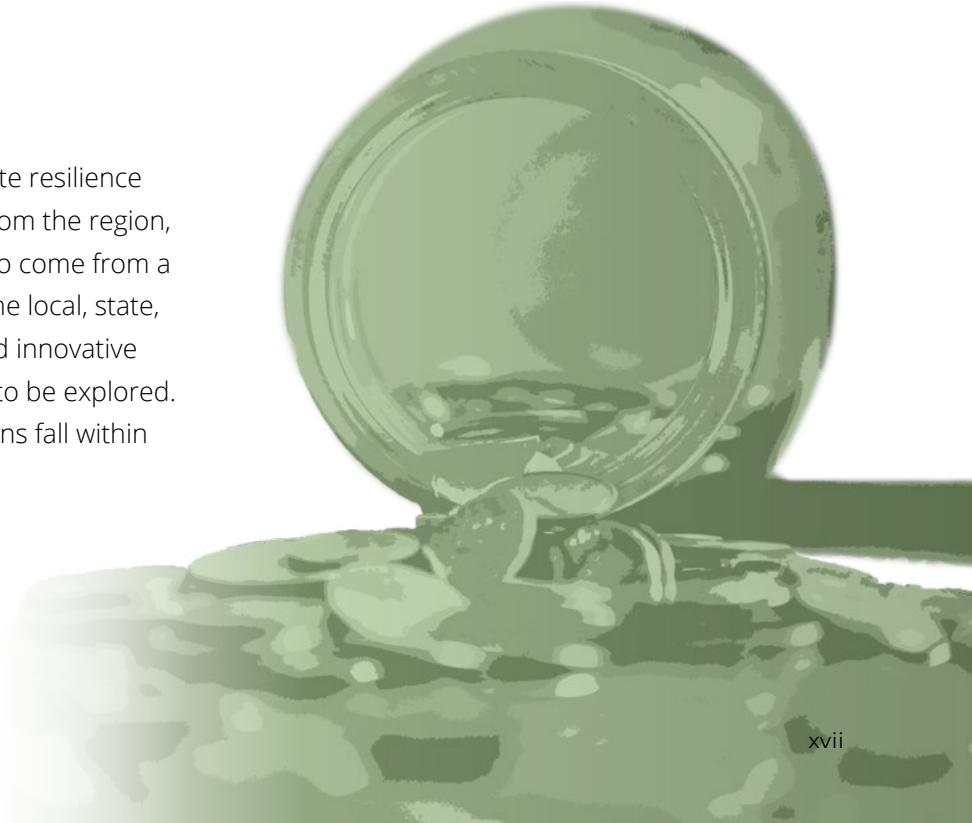
- Develop a model bylaw for siting large and small scale solar projects to aid towns in directing renewable energy opportunities to appropriate areas
- Develop design guidelines for solar projects that complement the area's historic and community character
- Develop a model bylaw for increasing energy efficiency in buildings
- Develop equity metrics to track integration of equity considerations into implementation of actions

- Identify local, state, and federal funding sources to support actions
- Increase accessibility of MVP Program Action Grants by supporting municipal applications and through state expansion of eligibility to other entities, such as Regional Planning Agencies
- Evaluate climate impact fees and other innovative funding mechanisms including an evaluation of the steps required to create, implement, and administer each mechanism



## FUNDING

To successfully increase climate resilience and reduce GHG emissions from the region, financial resources will need to come from a variety of sources, including the local, state, and federal level; and new and innovative financing strategies will need to be explored. The following recommendations fall within this category:



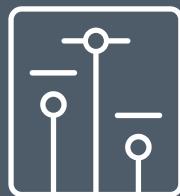


## CONTINUED ENGAGEMENT

Significant stakeholder engagement contributed to development of this Climate Action Plan. Implementation of the plan will require continued and expanded engagement, as actions will require broad community support. Perspectives of those that will be impacted by climate actions must be incorporated, particularly in situations

where climate action is anticipated to, or perceived to, exacerbate challenges associated with other critical local or regional needs. The following recommendations fall within this category:

- Establish a body to guide and track implementation that is representative of a variety of perspectives
- Engage an equity working group to provide feedback on potential disproportionate impacts and to help ensure that the implementation process incorporates all members of the Cape Cod community
- Convene stakeholder groups to further progress on overlapping priorities and opportunities
- Develop an online engagement tool that provides opportunity to gather feedback and input from participants
- Continue and expand the Student Climate Ambassador Program



## MEASURING PERFORMANCE

While the Climate Action Plan identifies nearly 50 metrics for measuring performance, successful implementation and achievement of its overarching goals can be communicated in terms of a set of key performance indicators that tie directly to high emitting regional GHG sectors, as well as the region's ability to sequester carbon and be resilient to the impacts of climate change.

### 50 METRICS

The Climate Action Plan identifies nearly 50 metrics for measuring performance, successful implementation and achievement of its overarching goals

Measuring progress towards meeting the goals of the Climate Action Plan will require both long-term regional performance measures and shorter-term tracking of implementation of specific strategies and actions. Updates to the regional greenhouse gas emissions inventory, tracking of regional performance measures, developing a strategy and metrics to advance equitable implementation, and communication of regional progress will be keys to effective implementation.

OF VEHICLES POWERED BY ELECTRICITY

OF HOMES/BUSINESSES HEATED BY ELECTRICITY

OF ELECTRICITY FROM RENEWABLE SOURCES

ACRES OF OPEN SPACE PRESERVED

DEVELOPMENT IN THE FLOODPLAIN

## ADVANCING REGIONAL CLIMATE ACTION

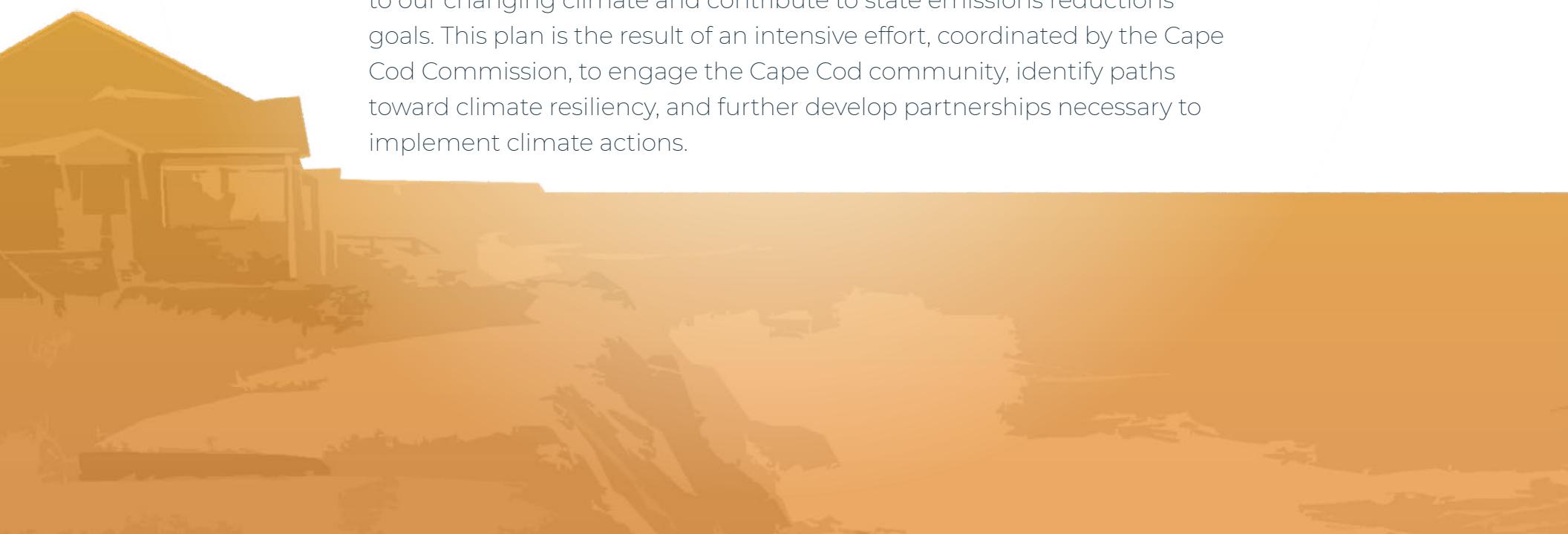
As the Climate Action Plan enters the implementation phase, and as regional performance measures are tracked, more will be learned about the effectiveness of individual actions and the region's ability to meet the challenges presented by climate change. Significant technological and societal changes may present new challenges and opportunities. The Plan must be implemented in a dynamic manner, informed by current research and changes in the metrics used to measure performance, with the ability to adjust the approach to proactively and successfully build a climate resilient region.

The Cape Cod Climate Action Plan is the first comprehensive plan to address the challenges Cape Cod faces from climate change. Working collaboratively, forging new partnerships and building on established ones, and with broad engagement and participation, the region will rise to meet these challenges.

# Introduction



Climate change is transforming Cape Cod. Though rising seas and changes to the coastline may be the most dramatic evidence of climate change, it is impacting every facet of Cape Cod's natural, built, and community systems. By the end of the century, damage to buildings and land lost to inundation on Cape Cod could alone total over \$30 billion. As a region, our land use patterns and way of living dictate our greenhouse gas (GHG) emissions, the leading cause of the global climate crisis. Climate action is necessary to slow the effects of climate change and improve the region's resilience to its impacts. The Cape Cod Climate Action Plan provides a way forward for the region to mitigate and adapt to our changing climate and contribute to state emissions reductions goals. This plan is the result of an intensive effort, coordinated by the Cape Cod Commission, to engage the Cape Cod community, identify paths toward climate resiliency, and further develop partnerships necessary to implement climate actions.



The Climate Action Plan was developed during a time of increasing concern about the changing global climate and the potentially devastating local effects that widespread inaction will have on the continued existence and functioning of Cape Cod's natural, built, and community systems. Seventy-nine percent (79%) of Cape Cod residents believe that the changing climate will impact their family's well-being. The Climate Action Plan process occurred during the height of the COVID-19 pandemic, when patterns of behavior were modified in both concrete and nuanced ways. Shifting attitudes about how we work, how we gather, what we consume and throw away, and values about community and staying connected may translate into longer term shifts in how we design, build, and function within our communities.

**The Climate Action Plan identifies strategies and actions that can reduce greenhouse gas emissions and enhance local resiliency to climate threats.**

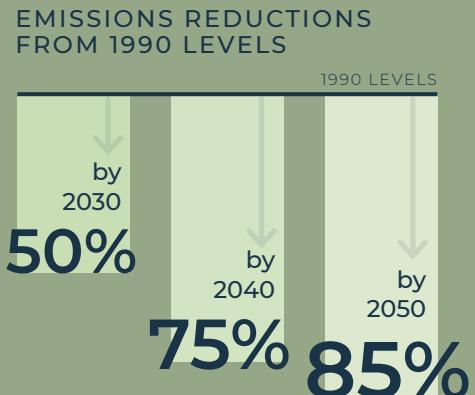
The Commonwealth of Massachusetts is taking significant strides in shifting the state toward a net-zero carbon emissions goal by 2050. On December 30, 2020, the state issued its latest update to the Clean Energy and Climate Plan, wherein the state identified targets for GHG emissions reductions, and pathways for achievement of those targets. On March 26, 2021, Massachusetts Governor Baker signed An Act Creating a Next-generation Roadmap for Massachusetts Climate Policy, which establishes a State-wide net zero carbon emissions target for 2050 with aggressive interim targets, authorizes implementation of a new, voluntary energy efficient build code, and allows the Commonwealth to procure an additional 2,400 megawatts of offshore wind energy. The Climate Action Plan

aligns with the Commonwealth's goal of reaching net-zero emissions by 2050, but with a more immediate focus on what Cape Cod can do over the near term, recognizing that technological and political changes will require updates to the plan to meet the evolving needs of the region. While many important actions, such as building code requirements, must take place at the state level, there are significant and diverse ways that regional, local, and non-government organizations (NGOs) can support and create incentives for businesses and individuals to shift operational choices, behaviors, and practices. The effectiveness of policies and actions to reduce Cape Cod's contribution to carbon emissions depends on the willingness of individuals and entities in the region to participate.

The Climate Action Plan identifies strategies and actions that can aid in reducing GHG emissions and enhancing

## MASSACHUSETTS NET-ZERO EMISSIONS GOAL

The Commonwealth established a 2050 target of “net zero” emissions, which is defined as “a level of statewide greenhouse gas emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is 85% below the 1990 level.” The Next Generation Climate legislation signed in March 2021 set an interim goal of 75% emissions by 2040.

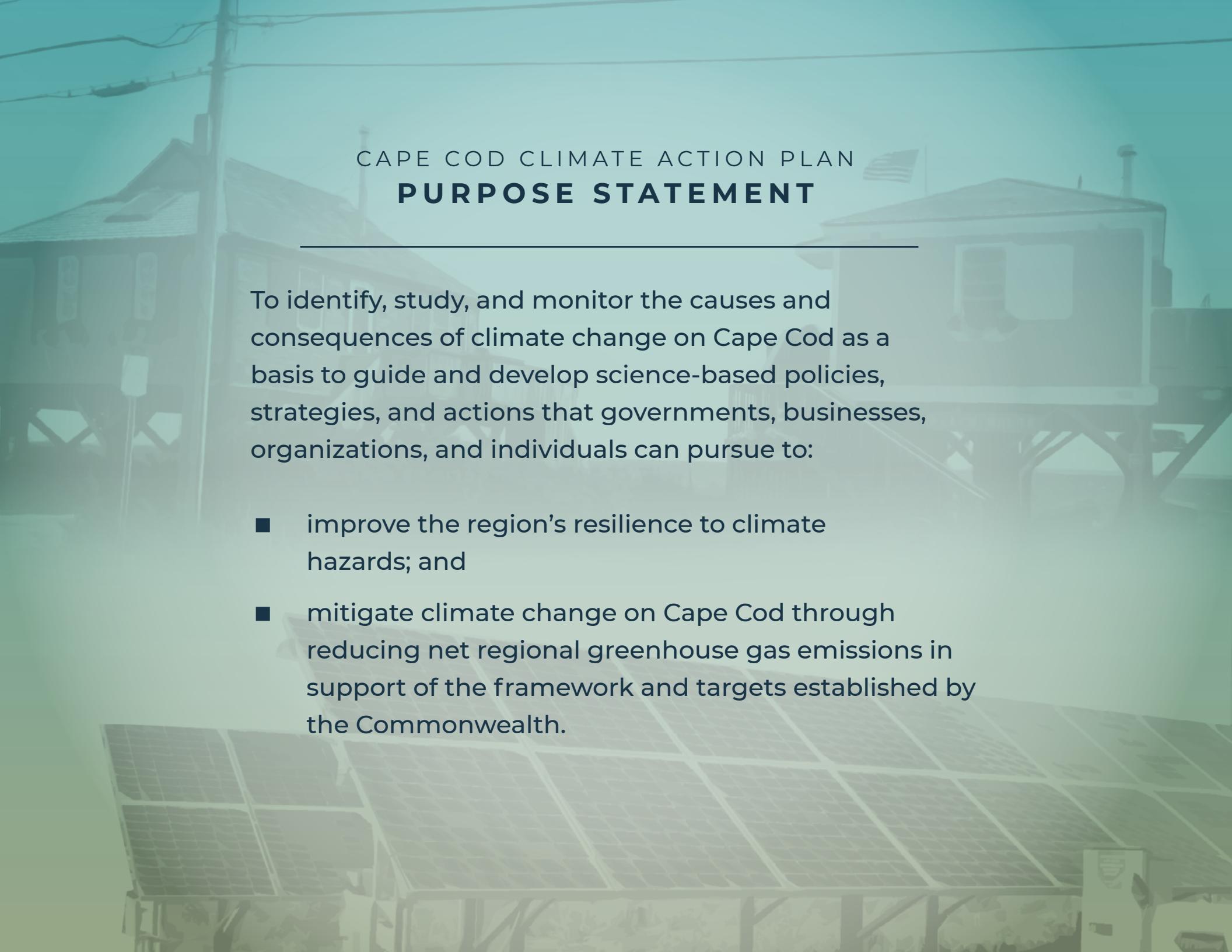


local resiliency to climate threats. The strategies and actions derive from goals aimed at reducing the region’s emissions of climate-warming gases and improving resiliency to risks and impacts from increased storm intensity, sea level rise, rising temperatures, and wildfires. The broad strategies and more specific actions are supported by steps that

organizations and individuals may take to conserve energy, switch to renewable energy sources, reduce transportation-related fossil fuel use, sustain our environment, and improve climate knowledge and collaboration. The actions and steps identify the types of actors who may play a role in advancing the region’s climate action goals.

The identified strategies and actions will require significant changes in how we build, rebuild, work, travel, and plan for and implement our infrastructural investments. Realizing long-term climate goals will require engaging the community broadly to shift approaches to both the mundane aspects of day-to-day living, and the larger scale community challenges. While some of these necessary changes in attitudes and actions may feel like losses, they also represent huge opportunities for our community’s health, well-being, economy, and resilience.

This plan is intended to foster collaborative, targeted action to address the global climate crisis on Cape Cod. This plan details the need for planning and action, stakeholder insight in content development, and strategies and actions that the region can take to both adapt to the impacts from and mitigate the Cape’s contributions to climate change.



## CAPE COD CLIMATE ACTION PLAN

# PURPOSE STATEMENT

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To identify, study, and monitor the causes and consequences of climate change on Cape Cod as a basis to guide and develop science-based policies, strategies, and actions that governments, businesses, organizations, and individuals can pursue to:

- improve the region's resilience to climate hazards; and
- mitigate climate change on Cape Cod through reducing net regional greenhouse gas emissions in support of the framework and targets established by the Commonwealth.



## BUILDING A FRAMEWORK FOR CLIMATE ACTION PLANNING

To aid the development of this climate action plan, Cape Cod Commission (Commission) staff compiled and reviewed climate action plans at the local, regional, and state levels from across the country to understand their considerations in climate action planning. The objective of this review was to provide a foundation of climate action plan best practices to help inform the Commission's climate action planning process.

Planning to mitigate and adapt to the causes and effects of climate change can take many forms based on the goals and desired outcomes of a community, region, or state. Examples of goals include reducing GHG emissions economy-wide by a certain percent and/or within a certain time period, reducing

GHG emissions from certain sectors, energy use reduction goals, or targets for renewable energy generation. A climate action plan provides a strategic framework that details the policies, measures, and activities that can be employed towards meeting those goals and desired outcomes. Common components can include:

- Regional and local climate risks and vulnerabilities
- Baseline GHG emissions
- Goals
- Adaptation and resiliency measures
- Policy options and mitigation actions
- Forecast impacts of mitigation actions
- Recommendations and strategies for implementation

## CLIMATE ACTION PLAN REVIEW

Commission staff collected 46 plans and selected 17 plans for further review. The plans reviewed represent seven

cities/towns, six regions, and four states, including Massachusetts. Plans reviewed are from locations similar and dissimilar to Cape Cod, and were chosen for their inclusion of both climate mitigation and adaptation strategies aimed at all levels (citizen, municipal or regional, and state action), and because those locations face climate risks similar to those of Cape Cod. Commission staff reviewed these plans in part to better understand and identify participating organizations, agencies, and stakeholders; climate related goals; strategies for action; and other plan elements. The complete literature review is available in [Appendix A](#).

All plans reviewed included, and were informed by, processes for robust public and private stakeholder outreach and engagement. Most towns and cities included staff from multiple local government departments and some had private consultants to support plan development. Similarly, most regional

and state plans were developed with public and private stakeholders, and with staff from regional or state government.

Some plans discuss the threats those locations face due to climate change, such as rising temperatures, sea level rise, and inland flooding from increased storm activity. Most plans provide an overview of current GHG emissions, some with “business as usual” projections for future emissions should no action be taken. All plans identify specific sectors to target for emissions reductions and typically have sector-specific goals, with strategies and actions to achieve the sector-specific goal or broad plan goal. Many plans provide emissions reduction scenarios based on the goal they have set or the strategies they have identified.

Implementation was handled differently from plan to plan. Only a few plans reviewed identify those people or groups best positioned to implement

the recommended strategies and actions. While most plans recognize the importance of implementation, some plans incorporate specific steps and actions for implementation while others acknowledge implementation more generally and that a separate implementation planning process will be needed. Some considerations for plan implementation include a timeline, barriers to implementation, resources and funding required, existing policies, complimentary policies that may be needed, cost-savings analyses, the priority of actions, investments that may be required to support action, and monitoring and reporting on progress.

Many regional and state plans provide information on steps taken to date to mitigate and adapt to the effects of climate change, and recognize that a climate action plan should provide for adaptive management to be allow for flexibility and adaptation in responding to the outcomes of implementation. Some

plans also include discussion on social equity considerations (particularly for plan implementation), economic impacts and job creation, and the co-benefits of how their climate action plan forwards other locational priorities.

## LESSONS LEARNED

The Commission used this review of plans from across the country to inform the planning process and identify components of the Cape Cod Climate Action Plan. The stakeholder process, component analyses, and plan content were developed simultaneously through the fall and winter of 2020-2021. Through this process, ideas and best practices were identified to include in, and enhance, the regional effort. Elements critical to a climate action plan for the region include reducing emissions, accelerating a shift to clean power, including actions to address both mitigation and adaptation, identifying paths toward climate goals

that pair with other regional priorities, avoiding the costs of delay or inaction, advancing equity, prioritizing co-benefits, and communicating the need for shifting goals.

Overall, review of these plans also showed the importance of other good planning practices, such as:

- Broad engagement and coalition building;
- Engaging experts and including local leaders;
- Setting achievable strategies and actions;
- Building on existing work; and,

- Committing to data collection and tracking progress towards achieving goals.

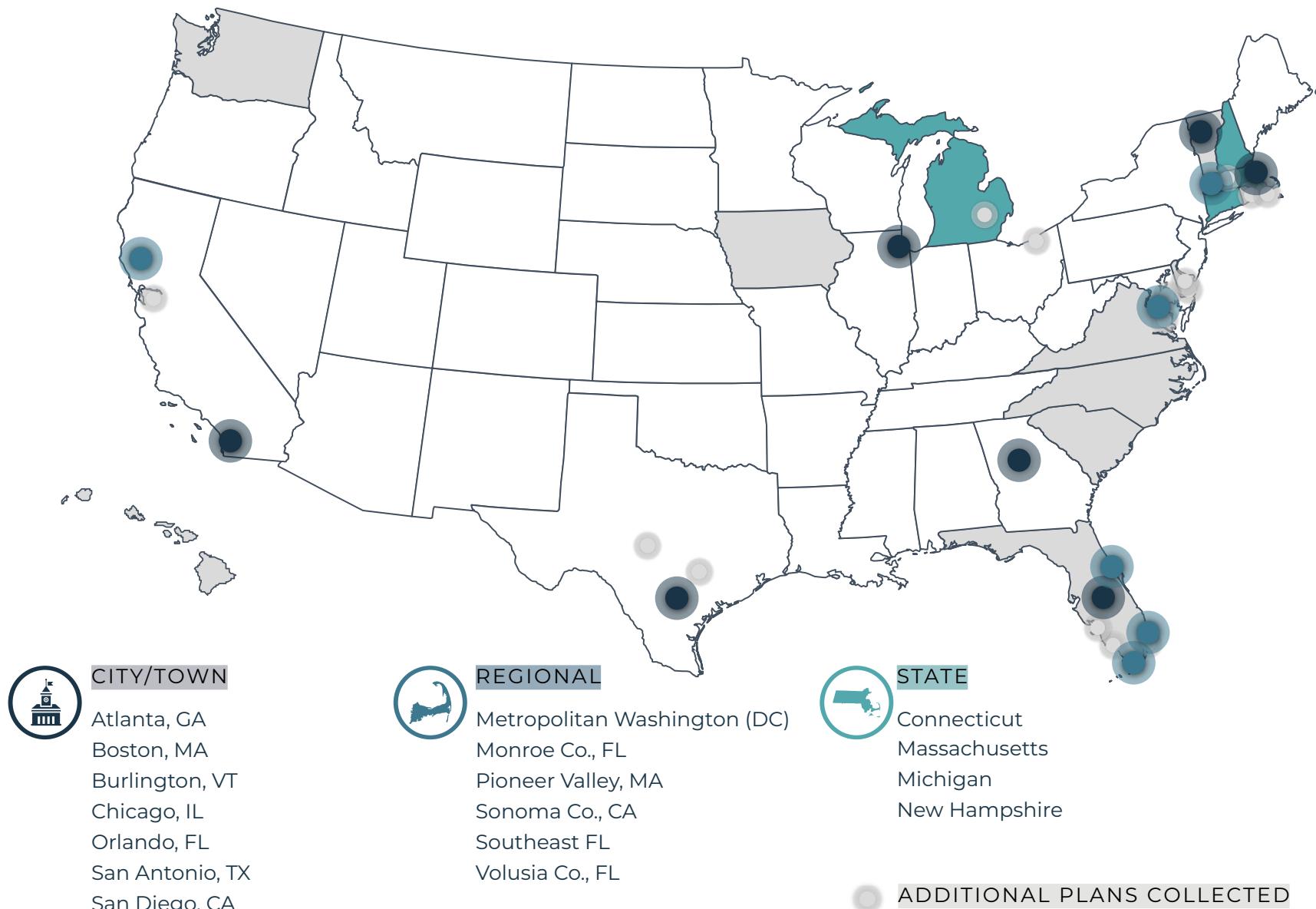
Plans from around the country also lent insight into additional considerations to take advantage of potential synergies between climate change planning and other social and environmental needs. Since the changes needed to address GHG emissions and improve resiliency affect all sectors of the built and social environment, changes to existing frameworks pose an opportunity to improve existing systems or expand opportunities for broader segments of the community. Importantly, as found through the review of plans from around the country and reinforced through the

regional stakeholder process, climate action needs to align with social equity considerations and the changes to buildings, transportation, jobs, and workforce training all require a deeper understanding of and commitment to inclusivity and equity.

Principles or directives gleaned from plans around the country helped inform the goals, strategies, actions, and steps in the Cape Cod Climate Action Plan. Development of the Cape Cod Climate Action Plan was further refined through additional analyses, such as an economic impact analysis, and the stakeholder engagement process.



## PLANS REVIEWED



# Planning Principles

The planning process was guided by several principles that shaped the approach to identifying solutions and prioritizing actions. These planning principles recognize the urgency in taking action but also reflect consideration for the long-held regional goals that have shaped the Cape's growth policies and planning decisions for decades as well as the considered and deliberate nature of thoughtful and responsible planning. The Climate Action Plan reflects a process guided by the following principles:

- Reducing emissions and increasing resiliency to current and future hazards
- Taking actions that address GHG emissions from all sources, with emphasis placed on those targeting the region's highest emitting sectors
- Recognizing the relationship between climate change and other regional challenges, and prioritizing actions that provide co-benefits
- Considering economic impacts associated with implementation of actions, as well as the costs of inaction
- Prioritizing communication and engagement to convey the urgency of the challenge and gain support for the range of solutions
- Incorporating equity considerations to ensure a successful implementation strategy



## ENVIRONMENTAL JUSTICE & VULNERABLE POPULATIONS

The concept of environmental justice is based on the principle that all people have a right to be protected from environmental pollution, and to live in and enjoy a clean and healthful environment. Massachusetts Office of Energy and Environmental Affairs (MA EOEEA) defines environmental justice as the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits.

Vulnerable populations are often disproportionately impacted by the effects of climate change and typically

have less access to the resources needed for recovery. It is imperative that equity considerations be integrated into implementation of climate actions to ensure that no one population is disproportionately impacted by existing climate impacts, and that the solutions provide broad benefits without being overly burdensome to any particular population. In Barnstable County, vulnerable populations transcend those areas defined as EJ communities, and include the aging population, those without connectivity, those lower to moderate income households proximate to wealthy, seasonal neighborhoods, and others.

Environmental Justice (EJ) communities identified by MA EOEEA, areas with high minority, non-English speaking, and/or low-income populations, are presented on the following page.

The way in which equity is addressed in the context of climate change may continue to evolve and expand as Cape Cod aggressively pursues climate action. To ensure equity considerations are defined and incorporated into each aspect of implementation, intentional outreach and engagement must contribute to defining vulnerabilities and developing solutions that meet the needs of all.

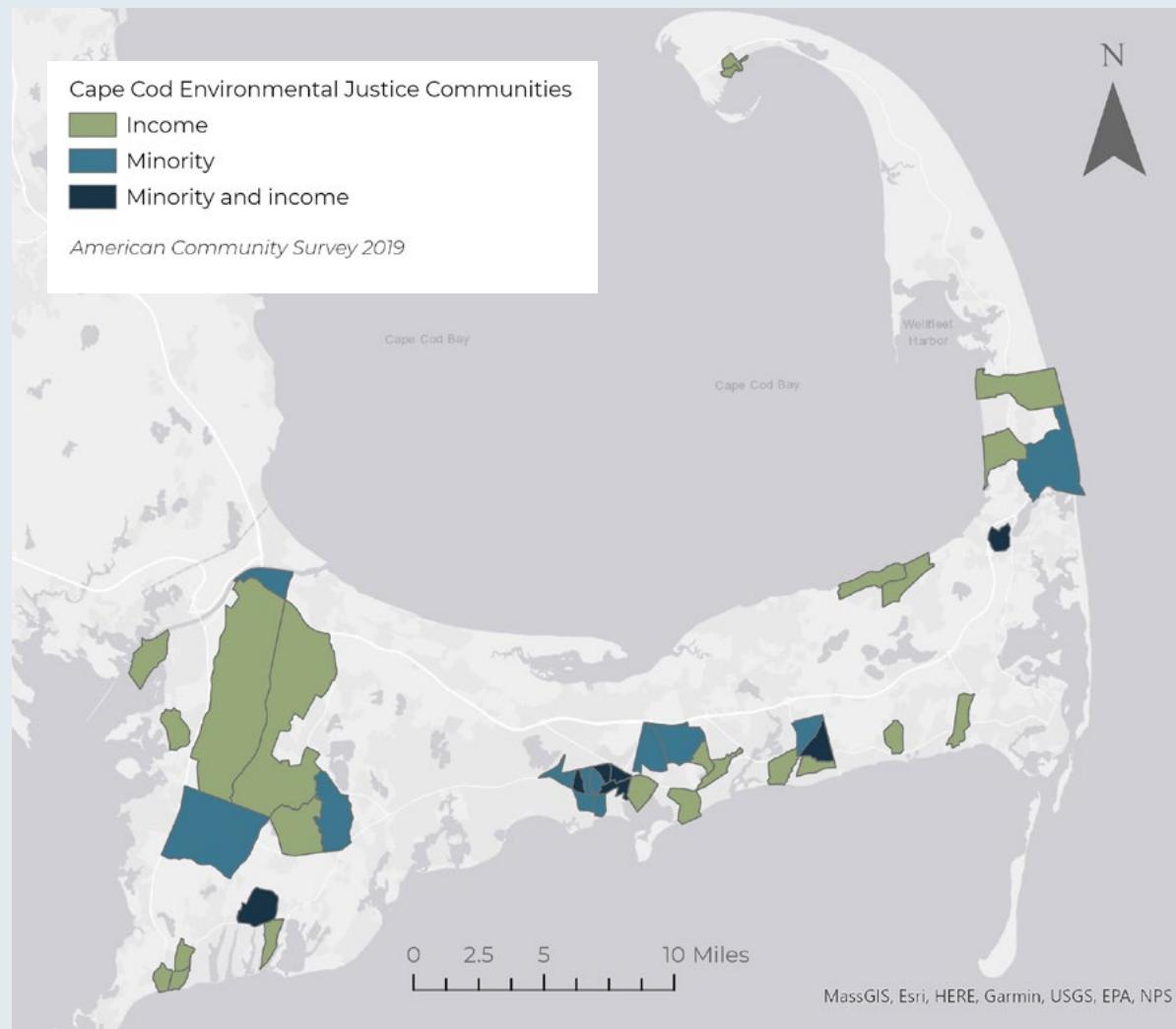


## ENVIRONMENTAL JUSTICE POPULATIONS ON CAPE COD

The Massachusetts Executive Office of Energy and Environmental Affairs defines environmental justice populations as neighborhoods that meet 1 or more of the following criteria:

- (i) the annual median household income is not more than 65% of the statewide annual median household income;
- (ii) minorities comprise 40% or more of the population;
- (iii) 25% or more of households lack English language proficiency; or
- (iv) minorities comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 10% of the statewide annual median household income.

Note: adjustments to this data layer may be made after the final 2020 census data are released.



In the chapters that follow, this plan characterizes the need for climate action and chronicles the regional process to engage stakeholders and develop actionable tasks for the community. Chapter 2 presents the ecological and economic case for taking action to address the region's vulnerabilities and contributions to climate change. Chapter 3 frames the legal and policy context within which the plan was

developed. Chapter 4 explains the process and results of the regional GHG emissions inventory. Chapter 5 provides a summary of climate planning that has already occurred on Cape Cod, at both the regional and local scale. Chapter 6 provides an overview of the stakeholder engagement process. Chapter 7 presents the priority strategies and actions that emerged through the stakeholder process. Chapter 8 lays out

a path for implementation and identifies possible funding resources. Chapter 9 presents immediate next steps and recommended actions. Chapter 10 identifies performance measures that will help track implementation and measure progress.

## Recommendation



Throughout the plan these boxes highlight recommendations for implementation of the Climate Action Plan





## The Need for Climate Action

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This chapter explores how Cape Cod's history of development has contributed to both the region's vulnerabilities and its contributions to greenhouse gas (GHG) emissions, and investigates the specific threats and related impacts the region may experience through the end of the century. A discussion of the economic impacts of inaction illustrates the potential costs of climate change to individuals, businesses, traditional industries, and municipal budgets.

With a heavily developed coastline, floodplains, and populations vulnerable to extreme storms and temperatures, action within all sectors of our society is needed to reduce risk, make communities more resilient, and shift behavior to reduce the region's contributions to the causes of global climate change.

## REGIONAL DEVELOPMENT PATTERNS

Cape Cod's built environment reflects its history. For more than 12,000 years, the Mashpee Wampanoag Tribe has inhabited present day Massachusetts, including Cape Cod. European settlers began arriving and living on the peninsula in the early 1600s and pursued farming and fishing in small settlements. Through much of the 1700s, development in the region concentrated around small village clusters with little or no residential or commercial development in outlying areas. The 1800s saw new development clustered around harbors in support of maritime industries, defining the historic character of many villages seen today. The late 1800s through the

turn of the century witnessed the slow transformation from a subsistence, resource-based economy to one increasingly tourism oriented, and attracting outside wealth. The advent of rail travel, automobiles, and the adoption of the interstate highway system added to the accessibility and the popularity of Cape Cod. Starting in the 1950s and continuing through the early 2000s, the population began to rise more rapidly as the Cape became a destination for second-home owners and retirees, resulting in the spread of development from the coast to the interior. Zoning and other regulations set the standard for large lot sizes and buildings set far back from the road, resulting in highly automobile-dependent land use patterns. Large lot requirements were self-reinforcing, making the relatively large 1-acre lot highly desirable, and shifting development away from dense village centers. Accompanying these land use patterns was the clearing of land to support roads and other infrastructure, and the removal of native vegetation to make way for lawns and manicured landscapes.

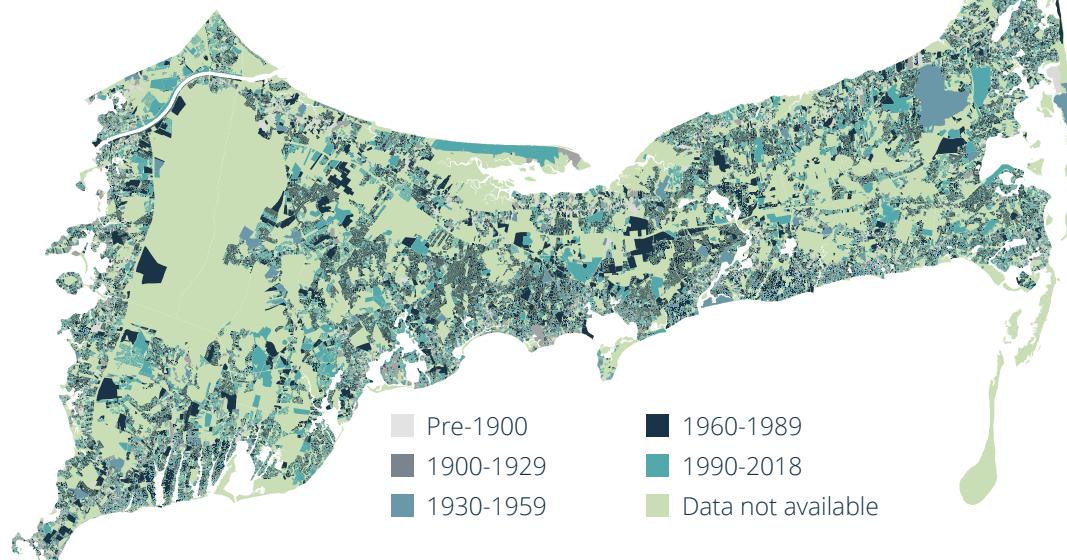
Much of the more recent development activity, including redevelopment of vacation cottages to larger second homes or year-

round homes, has occurred proximate to the coast. As the Cape considers its contributions to climate change, the region's patterns of land use and development that depend on automobiles for transportation play an outsized role in the generation of GHGs.

Recognizing the increasingly rapid loss of the Cape's natural woodlands and habitats, communities began to purchase and protect land, and establish local land use regulations that limited or prohibited development in areas of high ecological sensitivity and natural resource value. Some of these early efforts were directed at protecting water supplies, but later were broadened to ensure that significant habitats, culturally meaningful landscapes, recreation areas, and coastal resource areas were preserved for their intrinsic values. These protected lands contribute to the region's ability to mitigate GHG emissions and serve as a natural defense against coastal hazards. Hugely important in these efforts was the preservation of the Cape Cod National Seashore in 1961, incorporating a large percentage of the land area in the Outer Cape towns. Other significant land areas were set aside, including state parks and forests like Nickerson State Park and Sandy



Neck Park in Barnstable, and the Upper Cape Water Supply Reserve. Today, region-wide, approximately 40% of the Cape is permanently protected from development. The land preservation community has worked hard to prioritize their preservation work, making linkages between protected open space areas, identifying important habitats, and preserving buffers to wetlands and other sensitive lands. Despite incredible private contributions, the application of millions of dollars of local, state, and federal public funds, and the creation of dedicated funding sources, such as the Cape Cod Land Bank and Community Preservation Act, land development and loss of broad swaths of naturally vegetated land has continued.



Consequently, the region has few large properties left to be protected or developed.

## REGIONAL DEVELOPMENT PATTERNS

*Starting in the 1950s, development rapidly increased across the region, peaking in the 1980s. Since the 1970's, the region has seen the development of larger homes and more impervious surface per lot.*

### DEVELOPMENT BY DECADE

1900-1909	2,000
1910-1919	1,000
1920-1929	3,100
1930-1939	3,300
1940-1949	5,300
1950-1959	13,800
1960-1969	19,600
1970-1979	26,400
1980-1989	27,200
1990-1999	14,400
2000-2009	10,100
2010-2018	3,200

Source: Cape Cod Commission Parcel Data Set (2019) which uses individual town assessing data for development by decade; Year developed data is based on assessing records from the 15 individual towns. In some cases, the year developed date may not reflect the first year a parcel went into development, but subsequent significant redevelopment.

# The Threat of Climate Change

Cape Cod is impacted by climate-related hazards that present risks to life and property. With 586 miles of both naturally rich and heavily developed coastal resource areas, the most notable risks to the region are the destructive impacts of increasingly intense coastal storms, extreme precipitation and associated flooding, and both flooding and erosion exacerbated by rising sea levels. These hazards result in damaged buildings, roads, bridges, and infrastructure and adversely impact the Cape's natural systems from the debris, fuels, and other hazardous materials mobilized in the environment during a storm event.

Additionally, the Cape's future is projected to include more frequent heat waves and droughts, as well as changes to the form and ecology of coastal resource areas, with significant implications for the seasonal economy. These hazards threaten the region's population, buildings, infrastructure, landscapes, and ecosystem health.

Billions of dollars of residential real estate and economic assets are located in Cape Cod's vulnerable coastal zone. Development in large low-lying areas located within the floodplain goes back decades, placing more than 15,000 residential properties in harm's way, vulnerable to the threat of flooding damage. More recent demand for development along the shoreline has exposed many homes to the threat of erosion. The region's main hospital and supporting infrastructure, as well as the Cape's transportation hub for intra- and inter-regional transportation, along with regional businesses, road infrastructure, and hundreds of local critical facilities are located within areas vulnerable to flooding, sea level rise and extreme weather events. Many of the Cape's most expensive homes and properties are also in areas that are at risk from coastal flooding and sea level rise, and impacts to these properties could detrimentally affect the tax base of many Cape communities. This has the potential to

exacerbate the housing crisis and make living on Cape Cod more costly for all residents.

Tourism is the main driver of the Cape Cod economy. A longer summer season and warmer winters may extend the tourist season, which could have a positive economic impact. However, the potential negative impacts of climate change on the Cape's beaches, marshes, and other natural and recreational assets may outweigh any benefits of an extended tourist season. In addition, recreational infrastructure along the coast is vulnerable to sea level rise and coastal storms. Climate action is necessary to avoid negative impacts that could be detrimental on balance to the tourism sector.



# Climate Change Predictions and Effects for Cape Cod

Changes in Cape Cod's climate are already evident, and the predictions for future conditions are concerning. According to data compiled by the Commonwealth and available through [www.resilientma.org](http://www.resilientma.org), the Cape will experience higher average temperatures, more frequent and severe storms, and rising sea levels.

These changes will contribute to lengthier droughts, more intense precipitation events and inland flooding, and dramatic changes to the coast through expanded coastal flooding and erosion.

Additionally, the Cape's changing climate will likely result in increased heat-related illnesses, vector-borne diseases, and harmful algal blooms, more frequent and prolonged power outages, heightened threat of wildfires, and shifts in species distributions.





## TEMPERATURES

Climate scientists project that by mid-century, Massachusetts could have a climate that resembles that of southern US states today. Compared to an annual average temperature baseline of 49.9°F, by mid-century temperatures on Cape Cod are projected to increase by 3.4 to 4.6°F resulting in average annual temperatures of between 53.3 and 54.5°F. By the end of the century, Cape temperatures are projected to

### ANNUAL AVERAGE TEMPERATURE FOR CAPE COD

49.9°F  
current

mid-century  
53.3-  
54.5°F

↑ end of the century

54.5-  
58.1°F

increase by 4.6 to 8.2°F for average annual temperatures of between 54.5 and 58.1°F. Winter temperatures are expected to see an increase as well. Compared to a baseline average winter temperature just below freezing at 31.9°F, by mid-century winter temperatures on Cape Cod are projected to increase by 2.5 to 5.7°F and by the end of the century by 3.4 to 9.2°F. These increases will result in average winter temperatures above

freezing, leading to widespread ecological changes. In addition, the number of days with extreme temperatures (defined as those that are far outside the normal ranges) are expected to increase in the summer. Compared to a baseline of 0.8 extreme heat days, by mid-century summers on Cape Cod could include an additional 3-6 extreme heat days annually and, by the end of the century, an additional 6-22 days of extreme

**By the end of the century, average winter temperatures could be above freezing with widespread ecological changes.**



heat. Although these predicted changes in average and extreme temperatures suggest there would be fewer days Cape residents require heating in the winter, there would be a greater number of days air-conditioning is needed in the summer to be comfortable. This increased use of air conditioners to keep cool indoors during heat waves may put stress on the local utility grid and result in power interruptions or losses resulting in increased exposure to extreme heat.

Higher average and extreme temperatures will also likely increase the risk of people experiencing heat-related illnesses. The number of heat illness cases and associated health care costs are expected to grow under changing conditions.

Changes in temperatures may also increase the incidence and prevalence of certain vector-borne diseases because warmer temperatures allow disease-carrying insects, animals, and microbes to expand their ranges northward. For example, increases in temperatures may contribute to an increase

in tick abundance through higher rates of tick survival and better tick host availability throughout the year resulting in rising cases of Lyme disease.<sup>1</sup> In 2019, there were 107 emergency department visits due to tick-borne disease in Barnstable County.<sup>2</sup> While these visits may have resulted in a diagnosis of Lyme disease or other tick-borne illnesses, Lyme makes up most of the diagnoses in the state. Studies show the total annual medical cost per Lyme disease case was \$12,209 (2019\$). Assuming 107 tick-borne disease visits in 2019 were diagnosed as Lyme disease, the total cost associated with infections from that year is approximately \$1.7 million.<sup>3</sup> This does not take into account the potential lingering health effects, and associated costs, that may result.

Higher average and extreme temperatures are also likely to impact agriculture, aquaculture, fisheries, wildlife, and recreation. Species that exist in an area are designed to survive within a specific temperature regime; therefore, higher average or extreme temperatures can place significant stress on

individual species and ecosystems. Warming temperatures place stress on colder-weather species and force species poleward. Species that cannot relocate fast enough or find suitable habitat face local extinction, which may allow for invasive species (non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health) to spread. These species have biological traits that provide them with



#### MASSACHUSETTS OBSERVED CLIMATE CHANGES

**2.9°F**  
increase in average  
temperature  
since 1895

**15 day**  
increase in growing  
season since 1950

<sup>1</sup> (PDF) "Tickling Bomb": The Impact of Climate Change on the Incidence of Lyme Disease: [https://www.researchgate.net/publication/328509886\\_Ticking\\_Bomb\\_The\\_Impact\\_of\\_Climate\\_Change\\_on\\_the\\_Incidence\\_of\\_Lyme\\_Disease](https://www.researchgate.net/publication/328509886_Ticking_Bomb_The_Impact_of_Climate_Change_on_the_Incidence_of_Lyme_Disease)

<sup>2</sup> Monthly Tickborne Disease Reports | Mass.Gov, n.d.

<sup>3</sup> "Economic Impacts of Climate Change on Cape Cod, Technical Report" by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateAction-Plan-AppendixB](http://www.capecodcommission.org/ClimateAction-Plan-AppendixB)

competitive advantages over native species, allowing invasive species to monopolize natural communities, displace native species, and cause widespread economic and environmental damage. Warmer temperatures also contribute to more frequent and intense harmful algal blooms in freshwater and marine environments, endangering human health, the environment, and economies.

In agricultural systems, while rising temperatures will lengthen the growing season, key crops such as cranberries may disappear due to their dependence on specific temperature regimes and other climate-related factors.<sup>4</sup> The most economically valuable crop in Massachusetts is the cranberry, and Cape Cod's climate and geology has historically provided ideal conditions for cranberries to grow.<sup>5</sup> They are native to the region and represent an

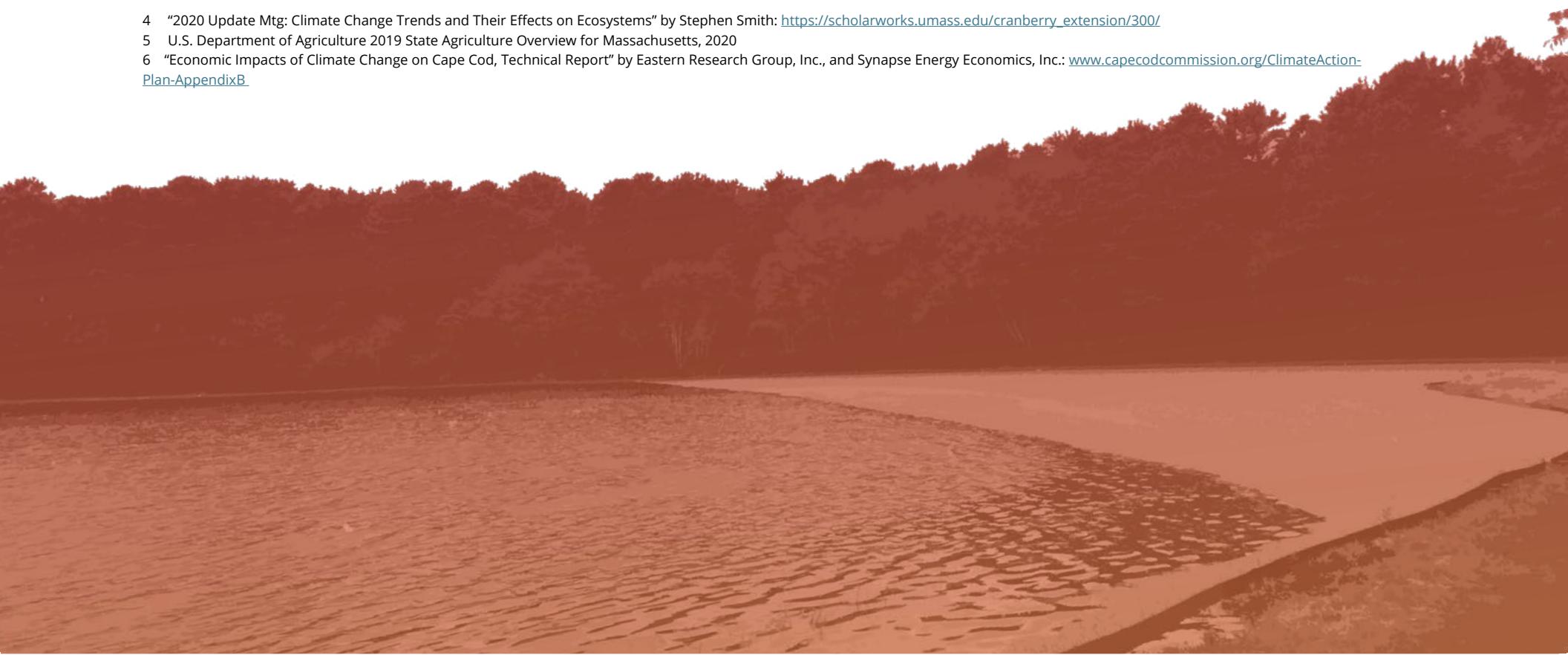
important part of Cape Cod's history, culture, and economy. As of May 2013, 127 cranberry bogs covered over 1,200 acres on Cape Cod. These cranberry bogs collectively produce \$6.3 million in revenue per year. Climate change puts this multimillion-dollar sector of the economy at risk, threatening the livelihoods of many county residents.<sup>6</sup>

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4 "2020 Update Mtg: Climate Change Trends and Their Effects on Ecosystems" by Stephen Smith: [https://scholarworks.umass.edu/cranberry\\_extension/300/](https://scholarworks.umass.edu/cranberry_extension/300/)

5 U.S. Department of Agriculture 2019 State Agriculture Overview for Massachusetts, 2020

6 "Economic Impacts of Climate Change on Cape Cod, Technical Report" by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateAction-Plan-AppendixB](http://www.capecodcommission.org/ClimateAction-Plan-AppendixB)





## MARINE HEATWAVES

In addition to land-based temperature changes, marine ecosystems around the world are experiencing unusually high ocean temperatures more frequently than researchers previously expected. Globally, marine heatwaves – periods of extremely high ocean temperatures in specific regions – have become more than 20 times more frequent over the past 40 years due to human activity and the release of GHGs.<sup>7</sup>



### WARMING OCEANS

The Northwest Atlantic waters are warming at 3 times the global average rate



### SUMMER 2020

The waters on the continental shelf were 2 to 5°F warmer than usual

Marine heatwaves have become much longer, hotter, and more frequent. Marine heatwaves that occurred only once every hundreds to thousands of years in the preindustrial climate are projected to become decadal to centennial events under 1.5°C (2.7°F) warming conditions and annual to decadal events under 3°C (5.4°F) global warming conditions.

In the Northwest Atlantic, recent high-resolution climate projections show the waters warming at three times the global

average rate<sup>8</sup> and marine heatwaves have become the norm in the Gulf of Maine over the last decade.<sup>9</sup> Scientists are also investigating the effects of a marine heatwave on ocean life off southern New England.<sup>10</sup> The waters on the continental shelf - extending from the coast to about 100 miles offshore - were 2 to 5°F warmer than usual during the summer of 2020. Scientists think these marine heatwaves will happen more frequently in the future.

<sup>7</sup> Human Activity is Increasing Severity and Frequency of Major Marine Heatwaves - Yale E360: <https://e360.yale.edu/digest/human-activity-is-increasing-severity-and-frequency-of-major-marine-heatwaves>

<sup>8</sup> Enhanced warming of the Northwest Atlantic Ocean under climate change – Geophysical Fluid Dynamics Laboratory: [https://www.gfdl.noaa.gov/research\\_highlight/enhanced-warming-of-the-northwest-atlantic-ocean-under-climate-change/](https://www.gfdl.noaa.gov/research_highlight/enhanced-warming-of-the-northwest-atlantic-ocean-under-climate-change/)

<sup>9</sup> 2020 Gulf of Maine Warming Update - Gulf of Maine Research Institute: <https://gmri.org/stories/2020-gulf-maine-warming-update/#:~:text=Sure,%20the%20last%20point%20is%20not%20exactly%20good,defined%20as%20five%20or%20more%20consecutive%20heatwave%20days.>

<sup>10</sup> University of Rhode Island scientists investigate effects of marine heat wave on ocean life off southern New England – URI Today: <https://today.uri.edu/news/uri-scientists-investigate-effects-of-marine-heat-wave-on-ocean-life-off-southern-new-england/>

Marine heatwaves have the potential to disrupt marine ecosystems and the people who depend on them. Marine heatwaves can have lasting impacts on marine species, ecosystems, and economies. The high temperatures can trigger algal blooms, impact nutrient availability, and alter fish migration patterns.

For example, the Northeast Pacific Ocean experienced a marine heat wave from 2014 to 2016, when what was described as a "blob"

of warm water spread offshore from Alaska to California, resulting in major die-offs of fish and seabirds and closures of fisheries.<sup>11</sup> Locally, populations of copepods, a key food source for endangered Northern Right Whales, may be moving with the changing conditions.<sup>12</sup> Warming ocean waters may also be causing valuable fisheries resources, such as lobster<sup>13</sup> and cod,<sup>14</sup> to shift their distributions farther north or experience reduced productivity.

Warming ocean waters also affects oxygen content. Warmer waters may result in low oxygen zones and harmful algal blooms that can lead to fish and other marine life die-offs. For example, research is being conducted on an area of Cape Cod Bay between Scorton Creek in Sandwich and Barnstable Harbor, where de-oxygenated water is killing lobster and fish.<sup>15</sup> Ocean warming due to climate change is thought to be a factor in the formation and expansion of this dead zone.

11 So what are marine heat waves? - Welcome to National Oceanic and Atmospheric Administration (NOAA) Research: <https://research.noaa.gov/article/ArtMID/587/ArticleID/2559/So-what-are-marine-heat-waves>

12 Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales | Oceanography: <https://tos.org/oceanography/article/rapid-climate-driven-circulation-changes-threaten-conservation-of-endangere>

13 Climate vulnerability and resilience in the most valuable North American fishery | Proceedings of the National Academy of Sciences (PNAS): <https://www.pnas.org/content/115/8/1831>

14 Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery | Science: [https://science.sciencemag.org/content/350/6262/809?ijkey=a9f5045f92b746f9982a1b-2324ccbd02c3a81b20&keytype2=tf\\_ipsecsha](https://science.sciencemag.org/content/350/6262/809?ijkey=a9f5045f92b746f9982a1b-2324ccbd02c3a81b20&keytype2=tf_ipsecsha)

15 'The Blob': Low-oxygen water killing lobsters, fish in Cape Cod Bay: <https://www.capecodtimes.com/story/news/environment/2020/09/29/the-blob-low-oxygen-water-killing-lobsters-fish-in-cape-cod-bay/114160298/>





## OCEAN ACIDIFICATION

Increasing carbon dioxide levels in the atmosphere and oceans are resulting in chemical changes known as “ocean acidification.”<sup>16</sup> These changes may pose risks for some marine species and ecosystems, as well as for the coastal communities that rely on them for food and commerce.<sup>17</sup> The group of species most at risk are some of the most important to the Cape’s coastal economy: oysters, scallops, lobsters, and other shellfish. In more acidic waters, these species may need to use more energy to form or keep

their shells, negatively impacting their growth and survival.

Fisheries and aquaculture are important parts of Barnstable County’s economy and heritage. They support local seafood processing businesses, markets, and restaurants. Additionally, fresh seafood and healthy fisheries support tourism and recreational fishing off the Cape. Rising ocean temperatures and increasing ocean acidification threaten to change the health, distribution, and population of these fisheries, making this economic

sector particularly vulnerable. In 2017, fishing, aquaculture, seafood processing, and seafood markets in Barnstable County employed 1,175 people, of whom more than 822 were self-employed. These industries contributed \$14.9 million in annual wages and \$34.2 million in annual gross domestic product to the region’s economy. Climate change puts this multimillion-dollar sector of the economy at risk, threatening the livelihoods of over a thousand county residents.<sup>18</sup>

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16 Ocean Acidification | Smithsonian Ocean: <https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification>

17 Vulnerability assessment: <https://www.oceanfdn.org/sites/default/files/Vulnerability%20assessment.pdf>

18 “Economic Impacts of Climate Change on Cape Cod, Technical Report” by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateAction-Plan-AppendixB](http://www.capecodcommission.org/ClimateAction-Plan-AppendixB)





## SEVERE STORMS AND HIGH-WIND EVENTS

Research has found that increasing water temperatures and reduced sea ice extent in the Arctic are producing atmospheric circulation patterns that favor the development of winter storms in the eastern United States. In addition, warmer air currents moving north over the Atlantic Ocean hold more moisture than in the past. With these conditions, it is expected that Cape Cod will experience more frequent and intense blizzards, nor'easters, and other winter storm events in the future.

The hurricane season in New England runs from June through November. Hurricanes begin as tropical storms near the equator and can grow and thrive, generating enormous amounts of energy, which is



### WINTER STORMS

It is expected that Cape Cod will experience more frequent and intense winter storm events



### TROPICAL STORMS

Larger and stronger tropical storms and hurricanes with increased rainfall rates are predicted

released in the form of thunderstorms, flooding, rainfall, and damaging winds. These winds help create a dangerous storm surge in which the water rises above the normal astronomical tide. Cape Cod is vulnerable to hurricanes and tropical storms, depending on the storm track. Coastal areas are

more susceptible to damage due to the combination of both high winds and tidal surge. As warmer oceans provide more energy for storms, it is predicted that larger and stronger tropical storms and hurricanes will occur, accompanied by increased rainfall

### WINTER STORMS

Severe winter storms include blizzards, nor'easters, ice storms, heavy snow, blowing snow, and other extreme forms of winter precipitation. A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 mph or more, accompanied by falling or blowing snow that reduces visibility to or below a quarter of a mile. A nor'easter is a storm that gets its name from its continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas. East-facing coastal areas on Cape Cod experience nor'easters most acutely.



rates due to warmer air holding more water vapor.

Storms may produce strong winds, torrential rain, blowing and drifting snow, high waves, damaging storm surge, and associated inland and coastal flooding and coastal erosion. Tropical storms may also produce tornadoes and winter storms may also produce ice, sleet, and freezing rain, and sudden and severe drops in temperature. The most common problem associated with severe weather is loss of utilities.

Strong winds may occur outside of notable storm events. While the entire Commonwealth is at risk from strong winds, the coastal zone is most frequently impacted by high-wind events.

Storms and high winds may lead to downed and damaged power and communication infrastructure resulting in loss of utilities, interruption of transportation corridors, loss of business function, and isolation and reduced access to critical services. Exposed power lines present an electrocution risk. Wind-borne and waterborne debris due to storms and high winds also pose a risk to individuals and properties.

Release of contaminants, chemicals, and

pathogens into the environment and water systems is also a concern during severe storms.

Power outages can be life-threatening to those dependent on electricity for life support. Power outages may also result in inappropriate use of combustion heaters, cooking appliances and generators in indoor or poorly ventilated areas, leading to increased risks of carbon monoxide poisoning. Loss of power and refrigeration can also cause food contamination.

Estuarine habitats are particularly susceptible to storms, both because they also experience coastal storm surge and because altering the salinity of these systems can cause widespread effects to the many inhabitant species.



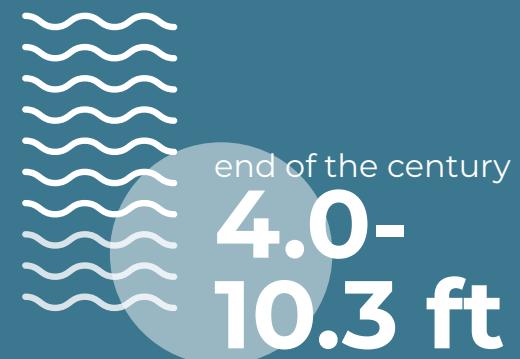


## SEA LEVEL RISE AND COASTAL FLOODING AND EROSION

The entire Cape Cod coastline is exposed to the hazards of coastal flooding and erosion. According to the Massachusetts Office of Coastal Zone Management Shoreline Change Project, the Outer Cape Cod shoreline has experienced the highest rates of erosion in the state over the short- (1970 – 2000s) and long- (mid-1900s to 2000s) terms.

Given its 586 miles of tidal shoreline and development within coastal hazard areas, Cape Cod is most at-risk from sea level rise and coastal flooding and erosion. Severe coastal flooding is associated with beach erosion; loss or submergence of wetlands; saltwater intrusion into drinking water, wastewater, and irrigation infrastructure; higher water tables and decreased

### PROJECTED SEA LEVEL RISE FOR CAPE COD



separation distance between septic systems and groundwater; loss of coastal recreation areas, beaches, protective sand dunes, parks, and open space; and damage or loss of coastal structures (sea walls, piers, bulkheads, and bridges) and buildings.

Sea level rise driven by climate change will exacerbate existing coastal flooding and erosion. Sea level rise projections provide estimates that can be used for detailed, site-specific modeling to map storm surge impacts and influences of localized processes along the coast. Based on information from an established tide gauge station with long-term records at Woods Hole, future sea levels on the Cape's coastline are projected to rise between 1.3 and 3.1 feet by mid-

century and 4.0 and 10.3 feet by the end of the century, depending on different GHG emissions scenarios. While these are not site-specific projections of mean higher high water levels for the entire Cape Cod coastline, these projections provide insight to overall trends in rising sea levels on Cape Cod.

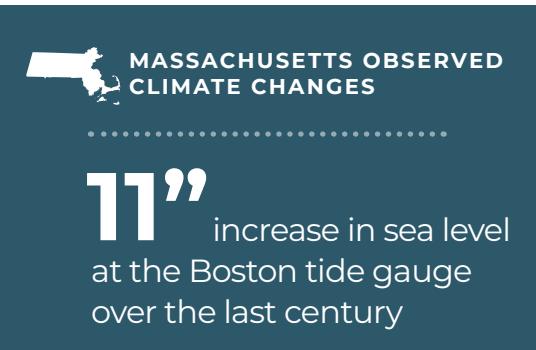
There are two primary types of coastal flooding: routine tidal flooding and flooding caused by storm events. The former is caused by regular tidal cycles, while the latter can result from precipitation, storm surge, or a combination of the two. Coastal flooding is often characterized based on the magnitude (elevation), duration, and frequency of the flooding that is experienced. Sea level rise



will increase the frequency and severity of both routine tidal flooding and storm-related flooding; the combination of sea level rise with wind-driven storm surges may pose even greater threats. Climate change is likely to increase the frequency of severe storm events, including hurricanes and nor'easters. As a result, storm surge sufficient to cause coastal flooding is likely to occur more often.

Coastal shorelines change constantly in response to wind, waves, tides, sea level fluctuation, seasonal and climatic variations, human alteration, and other factors that influence the movement of sand and material within a shoreline system. As the sea level rises, wave action moves higher onto the beach. Rising waves, tides, and currents erode beaches, dunes, and banks,

resulting in landward retreat (migration) of these landforms and reducing the buffer they provide to existing development. As a rule-of-thumb, a sandy shoreline retreats landward (erodes) about 100 feet for every 1-foot rise in sea level. Therefore, based on local sea level rise projections, the Cape may experience between 400 to 1,000 feet of shoreline retreat by the end of the century. According to a report by the Massachusetts Coastal Erosion Commission, the highest erosion rates in the state occur on Cape Cod in Eastham, Orleans, and Yarmouth. Sea



level rise will happen slowly over time, but severe impacts on properties will happen unpredictably over time with extreme storm events.

Direct impacts of coastal erosion are likely to include loss of and/or damage to residential, commercial, and public properties; loss of the contribution of high-value properties

The Cape may experience between 400 to 1,000 feet of shoreline retreat by the end of the century



to the local tax base; loss of roads and emergency access routes; loss of and damage to cultural and historic structures; and structural damage from one property damaging adjacent properties. Historic and archeological sites that are within current and future coastal flood zones are also vulnerable to sea level rise and coastal flooding and erosion. By 2100, median cumulative damages to buildings in the region from sea level rise and storm surge are projected to total \$15.3 billion and total lost tax revenue is projected to total \$8.6 billion. By the end of the century, sea level rise is also expected to result in inundation of over 200 miles of roads and isolation of over 700 miles of roads, and damage to roads of approximately \$1.5 billion.<sup>19</sup>

Rising sea levels and storm surges also erode beaches, dunes, and banks, resulting in landward retreat of these landforms and reducing the buffer they provide to existing development. Coastal landforms such as coastal banks are essential to maintaining a supply of sediment to beaches and dunes. Where engineered structures are used to stabilize shorelines, the natural process of sediment transport is interrupted, decreasing the amount of sediment available to maintain dry, sandy beaches and dunes. Under conditions of reduced sediment, the ability of coastal resource areas such as dunes and beaches to provide storm damage prevention, flood control benefits, and recreational opportunities is continually reduced. Cape Cod's economy currently benefits significantly from beach recreation, but sea level rise will likely have a large impact on the available beach area and ultimately

decrease the value of Cape Cod beaches. The annual value of beach recreation on Cape Cod for National Seashore beaches alone is currently estimated to be over \$246.5 million. As sea levels rise, the beaches will narrow. With less beach area available, the economic value from beach recreation will decrease. Assuming sea level rise causes beach width loss of 0.30 meters/year (~1 foot/year), the Cape is projected to lose \$9.7 billion in economic value from National Seashore beaches alone from 2021 to 2100; the potential losses when considering all of the region's beaches would be significantly more.<sup>20</sup>

As sea level rises, coastal habitats such as salt marshes that are contingent on specific inundation frequencies may move further and further landward as inundation becomes more frequent, and eventually permanent, in seaward areas. In coastal wetland areas with surrounding undeveloped transitional and upland habitat, these coastal habitats can migrate and persist. However, in areas where development or unsuitable upland conditions

19 "Economic Impacts of Climate Change on Cape Cod, Technical Report" by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateActionPlan-AppendixB](http://www.capecodcommission.org/ClimateActionPlan-AppendixB)

20 Ibid.



## CAPE COD COASTAL PLANNER

The Cape Cod Coastal Planner is a map-based communication and decision-support tool built by the Commission and its partners to help residents and decision makers understand the relative environmental and socio-economic effects of implementing adaptation strategies to address sea level rise, erosion, and storm surge. The tool includes a database of information on 41 strategies to increase resiliency on Cape Cod. Available at [capecodcoast.org](http://capecodcoast.org).



**SEA LEVEL RISE (4') AND DISCONNECTED ROADS**

Blue area represents a modeled projection of 4 feet of sea level rise, green areas reflect low lying areas, and the red lines represent streets disconnected due to inundated roadways.



**SLOSH LAYERS SHOWING POTENTIAL HURRICANE STORM SURGE FLOODING**

Pink areas represent modeled projections of areas flooded during a hurricane with the severity of the hurricane category increasing with darker shades.



**SEDIMENT TRANSPORT DIRECTION AND 40 YEAR EROSION IMPACTS**

Orange arrows represent the direction of sediment movement. The yellow areas indicate areas of accretion.

prevent migration, these habitats will disappear. Loss of coastal wetland habitats may result in the loss of nursery habitat for ecologically and economically important fish species as well as the loss of ecosystem services such as buffering against sea level rise and storm surge. By 2040, nearly 14,000

acres of salt marsh may be lost to sea level rise (assuming no migration). This would result in annual losses of \$34 to \$62 million from reductions in nitrogen removal, \$0.9 to \$1.6 million from lost carbon sequestration, and \$3.2 million from lost biomass for commercial fisheries. Over 12,000 acres of

eelgrass—which provide an estimated annual value of \$50 million in nitrogen removal and \$21 million in enhancing commercial fisheries—are also at risk.<sup>21</sup>

<sup>21</sup> "Economic Impacts of Climate Change on Cape Cod, Technical Report" by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateAction-Plan-AppendixB](http://www.capecodcommission.org/ClimateAction-Plan-AppendixB)



## PRECIPITATION AND INLAND FLOODING

Inland flooding on the Cape may result from moderate precipitation over several days or intense precipitation over a shorter period. Developed, impervious areas can contribute to inland flooding. Climate change is expected to result in an increased frequency of severe storm events. This would directly increase the frequency of flooding events and could increase the chance that subsequent precipitation will cause flooding if water stages are still elevated.

Of all the regions in the United States, the Northeast has seen the most dramatic increase in the intensity of rainfall events, and this trend is expected to continue. The United States National Climate Assessment

### PROJECTED INCREASE IN 1" OR GREATER PRECIPITATION DAYS FOR CAPE COD



reports that between 1958 and 2010, the Northeast saw more than a 70% increase in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events).<sup>22</sup>

On Cape Cod, compared to a baseline annual total precipitation of 44.95 inches and 7 average annual days with precipitation greater than one inch, by mid-century the Cape can expect to experience an additional 1.4 to 1.9 inches of rain and 1 additional day of greater than one inch of precipitation. By the end of the century, up to an additional 2.1 inches of rain and 2.5 additional days of extreme precipitation events could be expected on the Cape. Most of the additional

precipitation is projected to occur in the winter and spring, whereas the summer is projected to be drier.

Intense precipitation and inland flooding may cause damage to critical facilities and infrastructure in or near floodplain areas. Failure of wastewater treatment plants from overflow can occur during floods, releasing



MASSACHUSETTS OBSERVED CLIMATE CHANGES

**55%** increase  
in heavy precipitation  
since 1958

22 Northeast | National Climate Assessment: <https://nca2014.globalchange.gov/highlights/regions/northeast>



untreated wastewater directly into storm sewers, rivers, or the ocean. Flooding can also impact public water supplies and the power grid. Roads, bridges, and culverts

may be washed out due to flooding, isolating residents, endangering vulnerable populations, and disrupting transportation and emergency services.

According to the U.S. Environmental Protection Agency, floodwater often contains a wide range of infectious organisms from raw sewage.

Floodwaters may also contain debris, pollutants, chemicals, and other hazardous objects and materials. Additionally, flooded areas that do not drain properly can become breeding grounds for mosquitos, which can transmit vector-borne diseases.

Inland flooding is likely to cause soil erosion, soil loss, and habitat loss or alteration. Transported and deposited sediment can disrupt water supplies to downstream habitats and, if high levels of nutrients are present in the soil, this can lead to eutrophication (degradation of ecosystem health) in downstream ponds and estuaries.

**Roads, bridges, and culverts may be washed out due to flooding, isolating residents and disrupting transportation.**





## DROUGHT AND WILDFIRES

Droughts can be defined as periods of deficient precipitation and vary widely in duration, severity, and local impact. The frequency and intensity of drought are projected to increase on Cape Cod as higher temperatures lead to greater evaporation and earlier snowmelt, and precipitation patterns become more variable and extreme. Compared to an annual baseline of 18.72 consecutive dry days, annual consecutive dry days on Cape Cod are projected to increase by 1.0 to 2.2 days by the end of the century. Droughts contribute to conditions that can be conducive to wildfire by causing forested areas to dry out and become more flammable. The ecosystems most susceptible to fire are pitch pine, scrub oak, and oak forests. According to a U.S. Forest Service study, Barnstable and Plymouth Counties are the most fire-prone in the state due to their vegetation, sandy soil, and the presence of a



### FIRE PRONE AREAS

Cape Cod is one of the most fire-prone areas due to vegetation, sandy soil, and the presence of a drying wind



### MORE DRY DAYS

Projected increase of consecutive dry days from 18.72 to 20.92 on Cape Cod by the end of the century

drying wind. Droughts may put stress on public and private water supplies and may require water conservation or restriction measures. During severe droughts, deeper water supply wells may be needed, or alternate supplies found for emergency backup. Drier summers and intermittent droughts may also strain irrigation water supplies and stress crops.

Higher and extreme temperatures, high winds, and droughts contribute to conditions that can be conducive to wildfires. Vegetation killed or dried out by heat, wind, and drought provides fuel for fires. Wildfires result in smoke, poor air quality, and risk of damage to homes, businesses, and critical facilities. Residents may be isolated, and power and communications lost, due to fires. Firefighting can be hampered by drought-induced water shortages. Common reed (*Phragmites australis*) is an aggressive

invader of tidal marshes on Cape Cod and often becomes the sole dominant plant in these marshes.<sup>23</sup> It presents a potential fire hazard as it grows rapidly and, each fall, plant material dies back creating large concentrations of dry vegetation that increase the potential for fast-spreading fires in the marsh and surrounding uplands. Higher temperatures, wind, and drought may exacerbate this hazard. Prolonged droughts can have severe impacts on water-dependent species and ecosystems.<sup>24</sup> For example, drought conditions may result in vernal pools remaining dry or drying earlier resulting in mortality or decreased productivity of vernal-pool dependent species. Wildfire is both a symptom of and contributor to climate change.

<sup>23</sup> Salt-Marsh-Phragmites-Tiner-English: <https://www.massaudubon.org/content/download/9330/155607/file/Salt-Marsh-Phragmites-Tiner-English.pdf>

<sup>24</sup> Precipitation changes | Massachusetts Wildlife Climate Action Tool: <http://climateactiontool.org/content/precipitation-changes>



# Costs of Doing Nothing

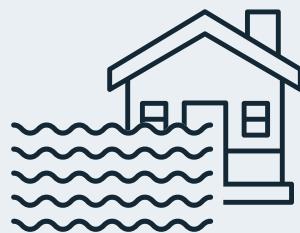
As illustrated in the previous discussion, the cost of not adapting to and slowing the rate of climate change is high and will accelerate over time. Sea level rise and coastal flooding are the greatest overall threats. The Commission contracted the Eastern Research Group, Inc. (ERG) to conduct a suite of analyses to estimate the costs of not taking action to address the threats the region faces, as well as to

identify several scenarios for reducing the region's contributions to GHG emissions. The analyses were selected based on available data and research and are meant to illustrate the threats the region faces. The full technical report of ERG's findings is available in Appendix B, and can be found [here](#).

A summary of the key findings of the potential costs to the region due to the hazards of climate change follows.



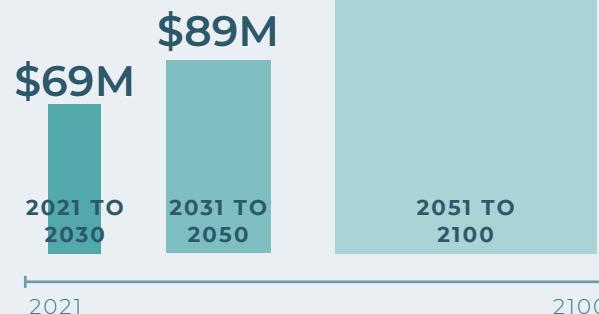
Damage and losses due to sea level rise  
and storm surge could exceed  
\$50 billion through 2100



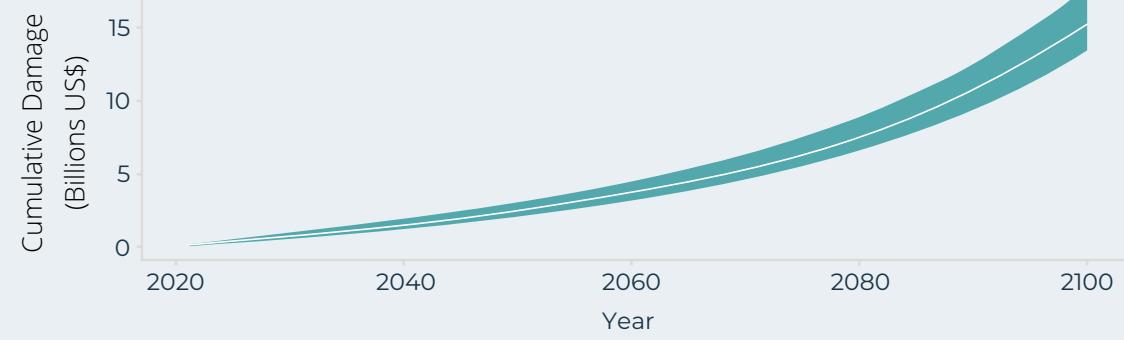
## BUILDING DAMAGE FROM SEA LEVEL RISE AND STORM SURGE

### AVERAGE ANNUAL DAMAGE

The average annual damage will be approximately \$69 million per year in Barnstable County between 2021 and 2030, \$89 million between 2031 and 2050, and \$256 million between 2051 and 2100.



\$13.4 to \$17.8 BILLION

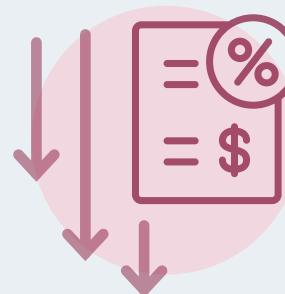


ERG estimates that between 2021 and 2100, private, commercial, and public buildings will incur between \$13.4 and \$17.8 billion in damage as a result of sea level rise and storm surge combined.



\$14.5 BILLION

This estimate does not include the lost value of another \$14.5 billion in land that will be at least partially inundated by 2100.



\$8.6 BILLION  
LESS TAX REVENUE

## REDUCED TAX REVENUE FROM VULNERABLE PROPERTIES

2021 - 2030 \$13M

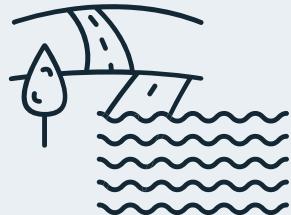
2031 - 2050 \$81M

2051 - 2100

\$330M

### ANNUAL AVERAGE TAX REVENUE LOSS FROM AFFECTED PROPERTIES

<sup>25</sup> The 2018 Cape Cod Regional Policy Plan identifies areas with similar natural and built characteristics as distinct "Placetypes," which serve as a conceptual framework for regional planning and regulation. One such Placetype is CACs. These areas have a concentration of business activity, community activity, and a compact built environment. The vision for these areas is to accommodate mixed use and multifamily residential development in a walkable, vibrant area; to preserve historic buildings; and to provide diverse services, shopping, recreation, civic spaces, housing, and job opportunities at a scale of growth and development desired by the community, with adequate infrastructure and pedestrian amenities to support development.

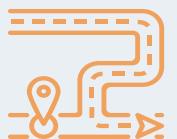


## IMPACTS TO ROADS FROM SEA LEVEL RISE

Economic losses go far beyond the damage to roads. They also include losses associated with:



**Isolated houses**  
(captured under "Reduced tax revenue from vulnerable properties")



Increased driving times due to the need to take alternative routes



Slower emergency response time

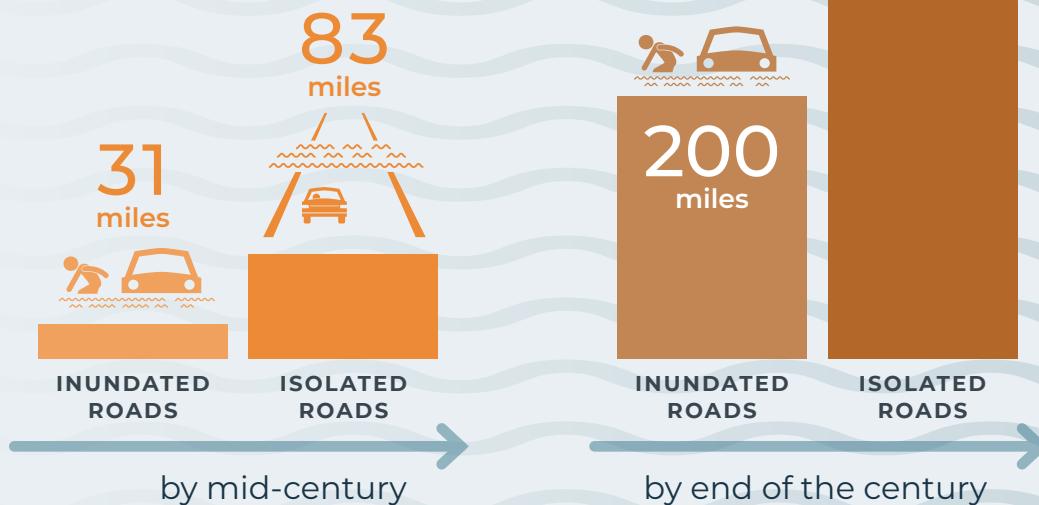
**\$1.5 BILLION**

in resulting damage based on the cost of road construction per mile.



**700 miles**

By 2050, sea level rise is expected to inundate approximately 31 miles of road and isolate another 83 miles of road. By 2100, these figures will increase to over 200 miles of road inundated and 700 miles of road isolated.





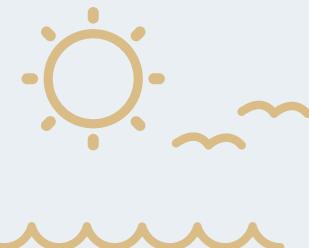
## LOST ECONOMIC VALUE TO BEACHGOERS

Climate change impacts to Cape Cod beaches could result in decreased beach visitation, which translates to lost tourism dollars.



\$246  
MILLION

YEARLY ECONOMIC  
VALUE OF BEACH  
USE AT CAPE  
COD NATIONAL  
SEASHORE\*



The value of beach use in the Cape Cod National Seashore (CCNS) is estimated to be more than \$246 million each year, based on visitation data from the CCNS and a literature review of willingness to pay for beach visitation.

\$9.7  
BILLION



CUMULATIVE LOSS IN  
ECONOMIC VALUE OF  
CAPE COD NATIONAL  
SEASHORE BEACH  
VISITATION (2021-2100)\*

As the sea level rises, the beach width will decrease and lower the value that these beachgoers place on their experience.



ANNUAL  
LOST VALUE\*

This annual loss is a non-market value—that is, no money changes hands from the degraded experience. However, because the beachgoing experience is an important driver for tourism in Barnstable County, this lost value will likely translate into significant losses in tourism-related revenue.

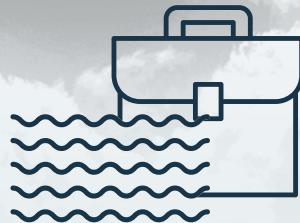
\$188M

\$113M

BY MID  
CENTURY

BY END OF  
CENTURY

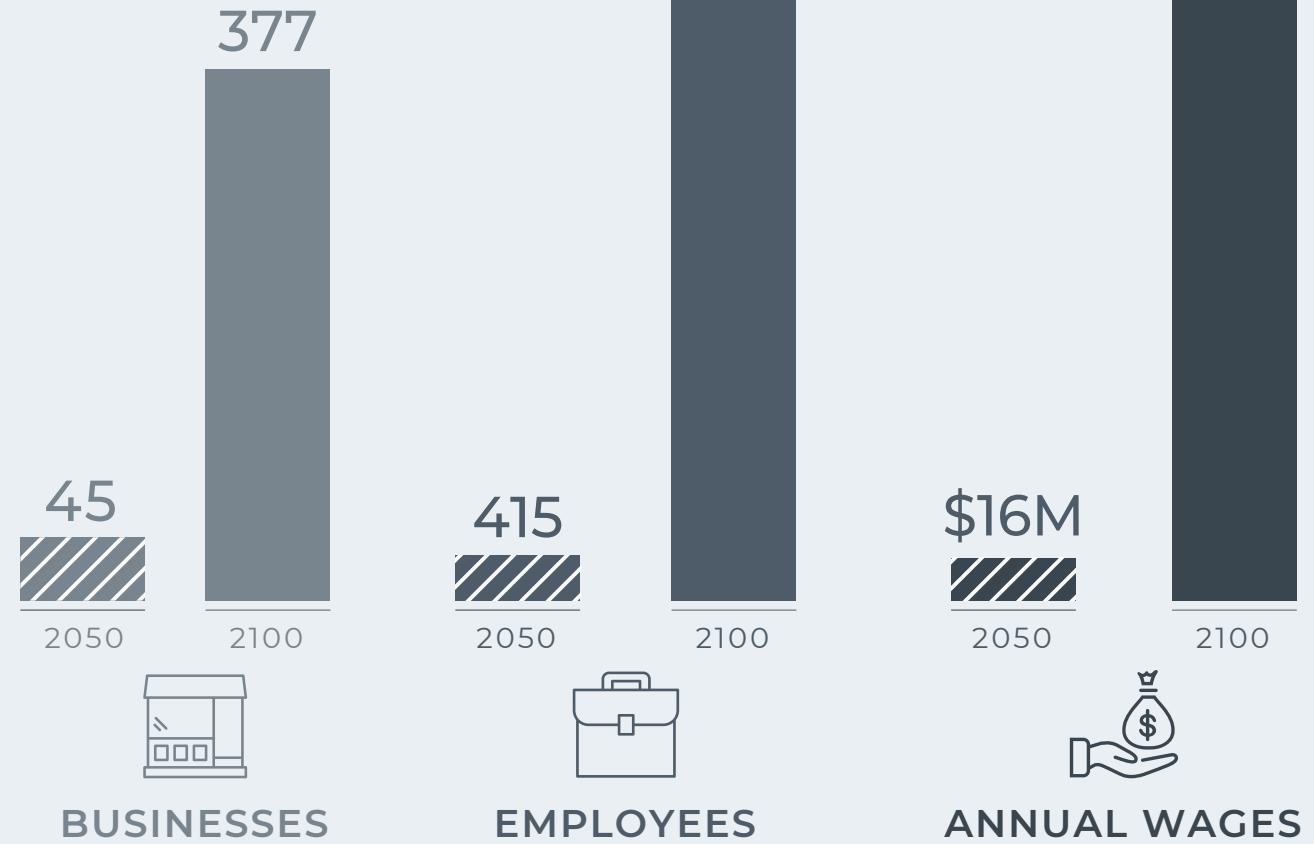
\* ERG focused this analysis on Cape Cod National Seashore beaches only because it represents the most complete and reliable visitation data reported by Opaluch and Hwang (2018).

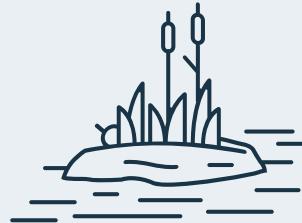


## JOB IMPACTS FROM SEA LEVEL RISE

! These losses underestimate the likely overall impacts from flooding, as they only consider business locations flooded by sea level rise and do not consider the temporary loss of business from single flooding events (e.g., storm surge) or the loss of access to businesses from inundated/isolated roads.

ERG estimates that by 2050, approximately 45 businesses, 415 jobs, and \$16 million in annual wages will be impacted by inundation due to sea level rise. By 2100, inundated establishments will include 377 businesses, over 6,600 employees, and \$271 million in annual wages.





## ECOSYSTEM SERVICE VALUE LOSSES TO MARSHES AND EELGRASS

OVER  
12,000 ACRES  
OF EEL GRASS AT RISK

which provide an annual value of nearly \$50 million in nitrogen removal and \$21 million in enhancing commercial fisheries



14,000 ACRES  
SALT MARSH LOSS BY 2040

Salt marshes are complex ecosystems that support the wellbeing of communities and wildlife throughout the Cape. ERG projects that by 2040, nearly 14,000 acres of salt marsh will be lost to sea level rise (assuming no migration of salt marshes landward).

Loss of these salt marshes will result in annual losses of:



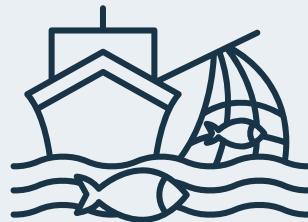
\$34 to \$62 million  
from reductions in nitrogen removal



\$0.9 to \$1.6 million  
from lost carbon sequestration



\$3.2 million  
from lost biomass for commercial fisheries



## COMMERCIAL FISHERIES AT RISK

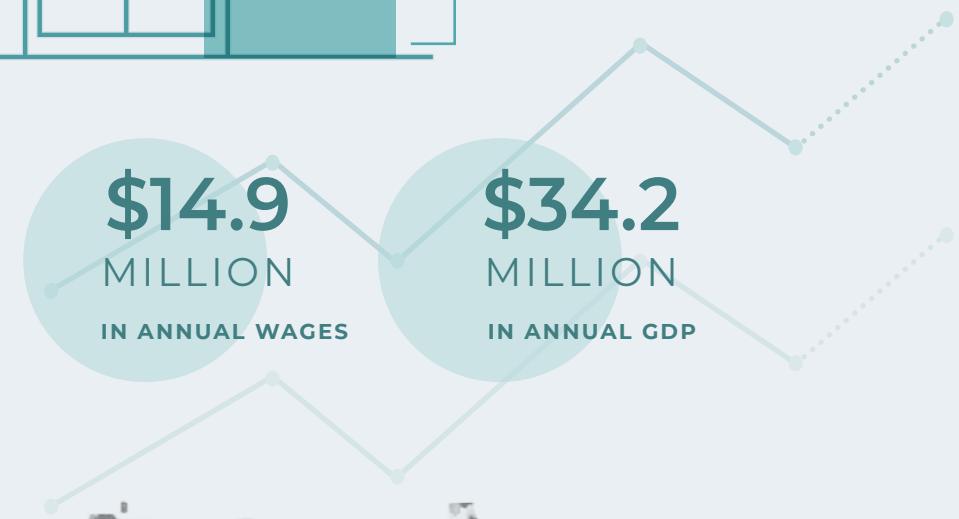


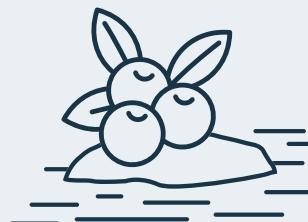
Climate change puts this multimillion-dollar sector of the economy at risk, threatening the livelihoods of over 1,000 county residents. Because of the uncertainty in projecting how climate change will impact fisheries, ERG did not project what portion of this vulnerable sector would be lost by year.

In 2017, fishing, aquaculture, seafood processing, and seafood markets in Barnstable County employed 1,175 people, of whom more than 822 were self-employed.



These industries contributed \$14.9 million in annual wages and \$34.2 million in annual gross domestic product to the region's economy.





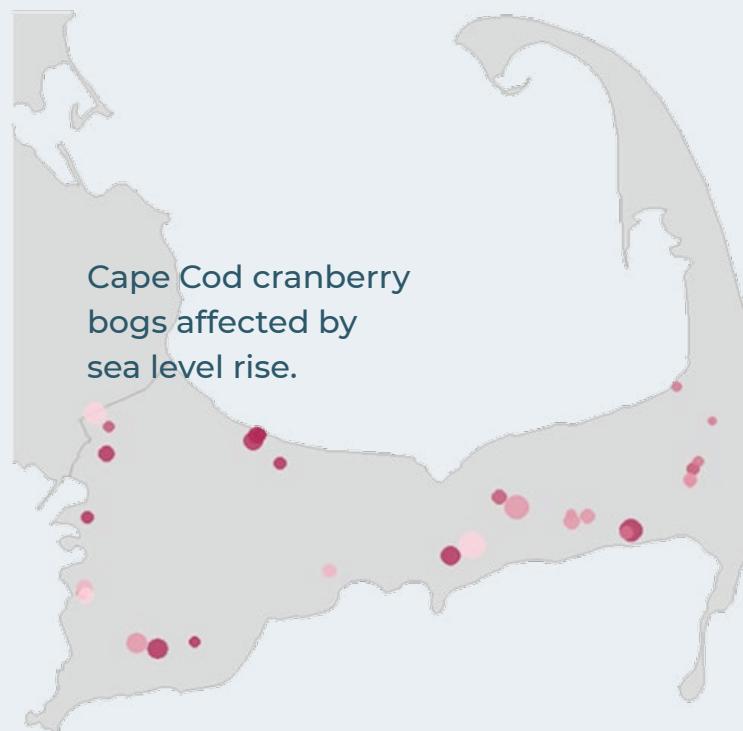
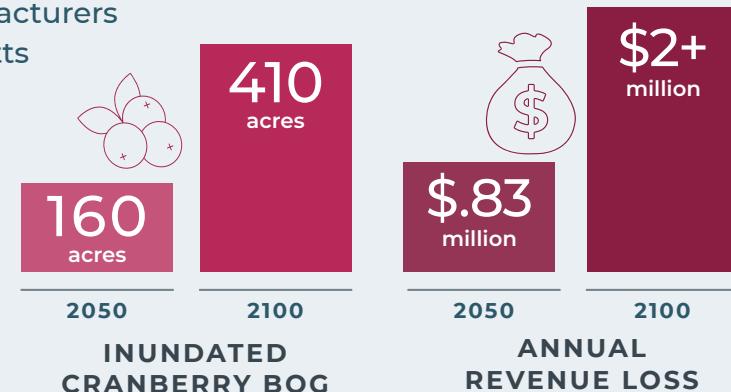
## ECONOMIC IMPACT FROM CRANBERRY BOG LOSS DUE TO SEA LEVEL RISE

Cranberries are native to the region and represent an important part of Cape Cod's history, culture, and economy. Salt water from sea level rise is projected to impact these cranberry bogs.

# \$80 MILLION

Approximate cumulative loss in revenue between 2021 and 2100

ERG estimates that over 160 acres of bogs will be inundated by about 2050 with an annual revenue loss of \$830,000, and 410 acres of bogs will be inundated by about 2100 with an annual revenue loss of over \$2 million. In addition, many manufacturers throughout Massachusetts rely on these cranberries to produce cranberry-based products, so the overall economic impact would expand beyond directly lost revenue.



While there are costs associated with taking action to mitigate GHG emissions and adapt to climate-related hazards, inaction will result in devastating losses for Cape Cod. As a region, it is critical to support efforts to slow the rate of climate change and reduce projected impacts to our natural, built, and community systems. The following chapters

identify and discuss the legal framework within which Cape Cod communities can act; define a baseline of GHG emissions for the region, including identification of the region's highest emitting sectors; and outline a series of strategies for reducing GHG emissions and adapting to existing hazards to promote climate resilience.



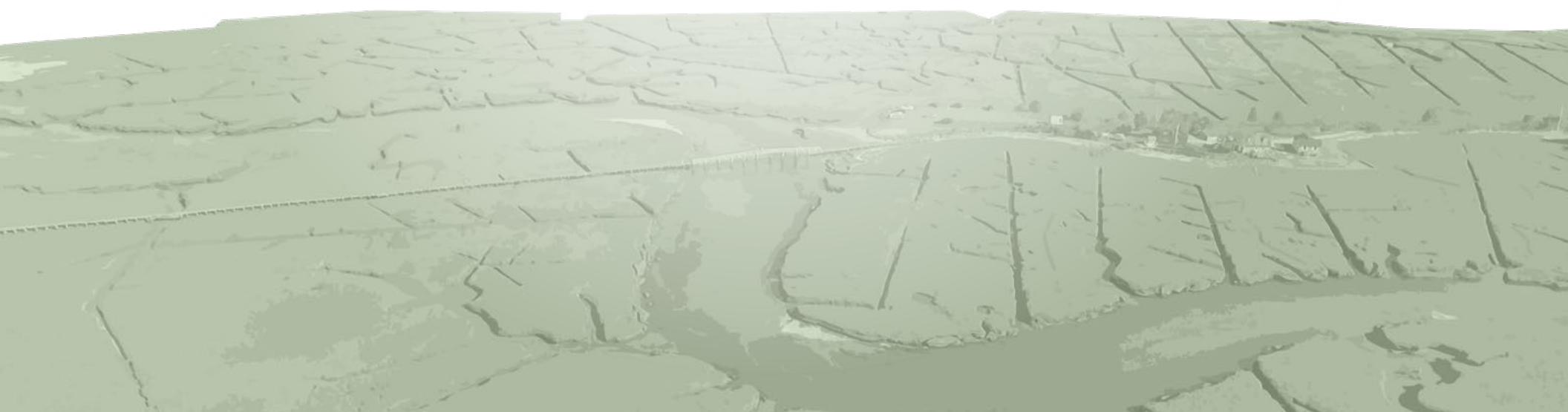
As a region, it is critical to support efforts to slow the rate of climate change and reduce projected impacts to our natural, built, and community systems.

# 3

## Policy Context

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Effective local and regional action requires a clear understanding of the federal and state laws and initiatives within which communities may act, including both the limits and opportunities for local action. This chapter provides an overview of the Commonwealth's most recent climate legislation and the additional opportunities for climate adaptation and mitigation that will become available under this new law. The remaining sections of the chapter discuss the framework of federal and state laws within which municipal and regional government may shape a more refined plan of action, customized for the town and/or region.



## RECENT LEGISLATION: MASSACHUSETTS' 2050 ROADMAP AND STATE TARGETS

In March of 2021, Massachusetts Governor Charlie Baker signed into law a comprehensive piece of legislation updating the 2008 Global Warming Solutions Act (GWSA) entitled An Act Creating a Next-generation Roadmap for Massachusetts Climate Policy ([Chapter 8 of the Acts of 2021](#)).

As its title suggests, the recent Massachusetts climate legislation establishes a path to achieve economy-wide, net carbon neutrality in the Commonwealth over the

next few decades. The legislature's intent in the Next Generation Roadmap is far-reaching in terms of its time horizon and breadth of subject matter.

It is noteworthy that state-level regulation in the Commonwealth, like building and energy codes, can have great effect on municipal governance and administration. To this end, the Next Generation Roadmap's changes to state building and energy code regulations regarding energy efficiency will have some effect as and when the codes are applied and implemented locally.

Further, though the Next Generation Roadmap clearly centers on advancing the deployment of renewable energy technologies, it recognizes the realities and necessities of the transition away from a fossil fuel-based economy. The Commonwealth may need to support traditional heating and cooling systems and transportation options while the transition to cleaner fuel sources is more broadly implemented.

The Next-generation Roadmap for Massachusetts Climate Policy establishes a path to achieve economy-wide, net carbon neutrality in the Commonwealth over the next few decades.



## AN ACT CREATING A NEXT-GENERATION ROADMAP FOR MASSACHUSETTS CLIMATE POLICY

Signed by Governor Baker March 26, 2021, the overarching primary themes in the legislation include:

- Establishes as law a State-wide net zero carbon emissions target for 2050, with aggressive interim carbon targets
- Requires the establishment of emissions sector sub-limits and reduction plans for the sectors that are the primary contributors to emissions in the Commonwealth, including electric power, transportation, commercial and industrial heating and cooling, residential heating and cooling, industrial processes, and natural gas distribution and service
- Requires that the Governor's 'roadmap' state how carbon targets will be achieved and that the administration adopt regulations necessary to achieve carbon targets
- Integrates environmental justice and equity into climate change concerns
- Establishes new commercial and residential appliance and fixture energy efficiency standards
- Establishes State-wide benchmarks for adoption of clean technologies like EVs and air source heat pumps
- Increases the amount of retail electricity that needs to come from renewable sources
- Creates greater incentives for distributed solar and off-shore wind energy deployment
- Broadens net metering eligibility
- Creates incentives for 'pilot' renewable projects involving hydrogen-based energy and thermal energy
- Requires the Massachusetts Department of Public Utilities, in its regulation of electric and natural gas utilities and corresponding infrastructure in the Commonwealth, consider GHG emissions reductions in addition to existing statutory considerations for safety, reliability, affordability, etc.
- Requires the Massachusetts Department of Environmental Protection to propose regulations to include a cumulative impact analysis for defined categories of air quality permits
- Requires the establishment of a 'net zero' stretch energy code as a municipal option

## FEDERAL AND STATE LAWS AND INITIATIVES SUPPORTING CLIMATE ACTION

The Commission engaged outside counsel from the Harvard Law School Emmett Environmental Law and Policy Clinic to provide an overview of federal and Massachusetts law specific to the reduction of GHG emissions, with a focus on the building, energy, and transportation sectors (see [Appendix C](#)).

While not a comprehensive review of all laws relevant to all sectors, the analysis aligns with the results of the region's GHG emissions baseline inventory which identifies energy and transportation as the highest emitting sectors in the region.

### FEDERAL CLIMATE ACTION

At the time of drafting this Climate Action Plan, newly inaugurated President Biden has signaled, through his early executive actions and appointments, a strong commitment to addressing climate change at the federal level. It is still early into the new Administration and Congress to know how these presidential climate communications will translate into laws, initiatives, and funding for implementation. However, the pace and focus of executive action on greenhouse gas (GHG) emissions reductions, advancing renewable energy technologies while transitioning away from a fossil fuel-based economy and towards a green-jobs based economy indicate that federal support and programming may soon reinforce state and local climate planning and action.

There are a variety of ways in which federal and state laws either require or support action to reduce emissions. The

legal analysis, which is summarized below, provides context for local and regional action. It recognizes that the system of





existing federal and state laws leaves room for local and regional efforts to reduce GHG emissions. This analysis should be evaluated as new state and federal policies and regulations are released, and up-to-date understanding of the roles of government actors should be maintained.

## REPORTING GREENHOUSE GAS EMISSIONS

Data on GHG emissions supports tracking progress toward emissions reduction. At the federal scale, the Greenhouse Gas Reporting Program requires certain large emitters (generally, those whose emissions exceed 25,000 metric tons of carbon dioxide

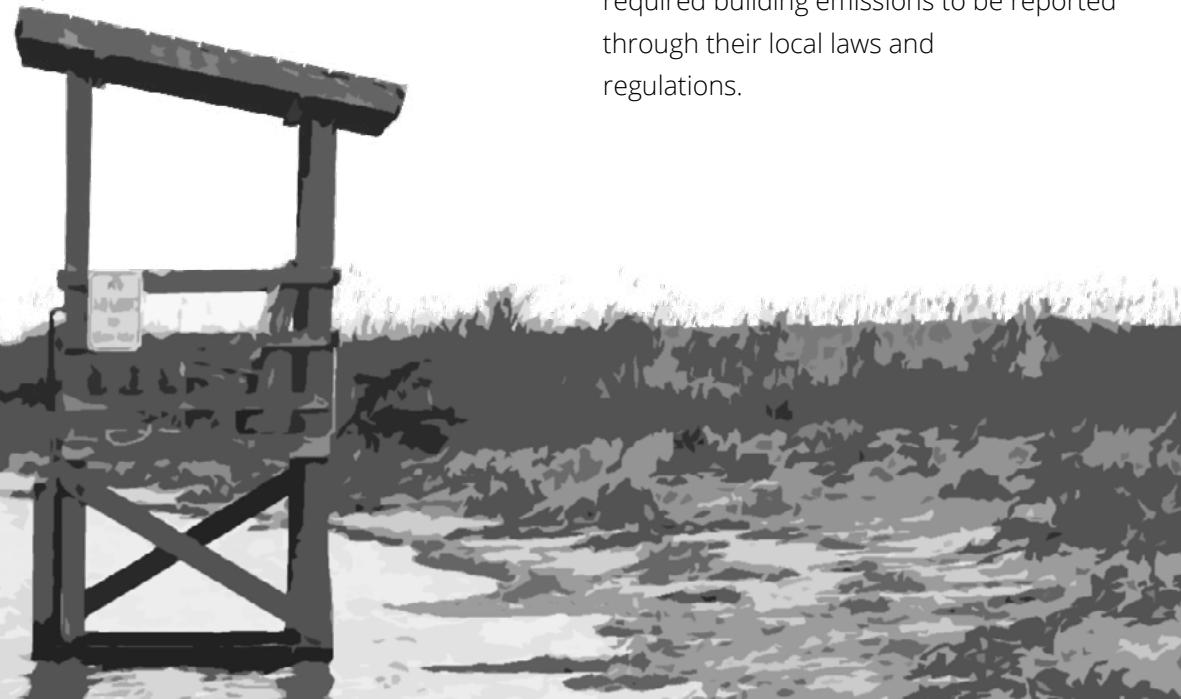
equivalent, or MTCO<sub>2</sub>E, per year) to report emissions data on an annual basis. Approximately 8,000 facilities nation-wide are currently required to report their emissions, only one of which is located on Cape Cod (Canal Station Power Plant, Sandwich). The Massachusetts Global Warming Solutions Act requires additional reporting at the state level. The Massachusetts Department of Environmental Protection (MassDEP) collects emissions data from all facilities that emit more than 5,000 MTCO<sub>2</sub>E per year and those regulated under 310 CMR 7.71 of the Massachusetts Air Pollution Control Regulations. While not mandated by any federal or state law, some communities have required building emissions to be reported through their local laws and regulations.

## LIMITING GREENHOUSE GAS EMISSIONS

While federal law requires GHG emissions reductions from certain activities, it does not require a cap on, or reduction of, GHG emissions on an economy-wide scale. In Massachusetts, the GWSA set a state-wide GHG emissions target. At the time of passage of the GWSA, emissions limits were set at a 25% reduction in emissions by 2020 (from the 1990 baseline emissions level) and an 80% reduction by 2050. The Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) and MassDEP are responsible for setting emissions limits.

### Recommendation

Evaluate new state and federal policies and regulations as they are released, and maintain an up to date understanding of the roles of government actors



In 2020, the 2050 target was revised to “net zero,” which is defined as “a level of statewide GHG emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is 85% below the 1990 level.” In December 2020, EOEEA set an interim 2030 target of a 45% reduction from 1990 levels, and released the Massachusetts 2050 Decarbonization Roadmap that addresses “pillars” of decarbonization. Subsequently, the Next Generation Roadmap Legislation was signed into law, as previously described,

with an official interim 2030 target of a 50% reduction in GHG emissions from 1990 levels. The GWSA did not create independent authority for municipalities to take action that would otherwise be prohibited by state law. Communities may choose to adopt local emissions reduction goals or targets; however, they may not take any action to reduce emissions that is prohibited by a state law. For example, the law establishing the Building Code prohibits local or regional laws that would mandate more stringent actions than those required by the Building Code. While communities can regulate building design aspects, such as height and setbacks, via local construction laws, they cannot regulate the use of materials or method of

construction regulated by the Building Code. However, there is an optional stretch building code that communities may adopt, which has higher standards for energy efficiency and environmental protection. Local emissions reduction goals are often non-binding and several Massachusetts communities, including Somerville, Cambridge, Boston, and Lexington, have adopted local goals consistent with the state’s goals.

## LAWS IMPACTING SPECIFIC SECTORS

Certain federal, state, and local laws present opportunities to review and address emissions from specific sectors. The following

## MASSACHUSETTS PILLARS OF DECARBONIZATION

The Massachusetts 2050 Decarbonization Roadmap identifies four pillars that are key for decarbonization for the state.



### END USE ENERGY

Transitioning buildings, vehicles, and other end uses away from consuming fossil fuels



### ENERGY EFFICIENCY AND FLEXIBILITY

Aggressively pursuing energy efficiency and flexibility to enable cost-effective decarbonization



### DECARBONIZING ENERGY SUPPLY

Producing zero and low-carbon energy supplies to power our energy system



### CARBON SEQUESTRATION

Balancing remaining emissions by facilitating carbon dioxide removal from the atmosphere



provides examples of such laws, as well as opportunities for municipal action.

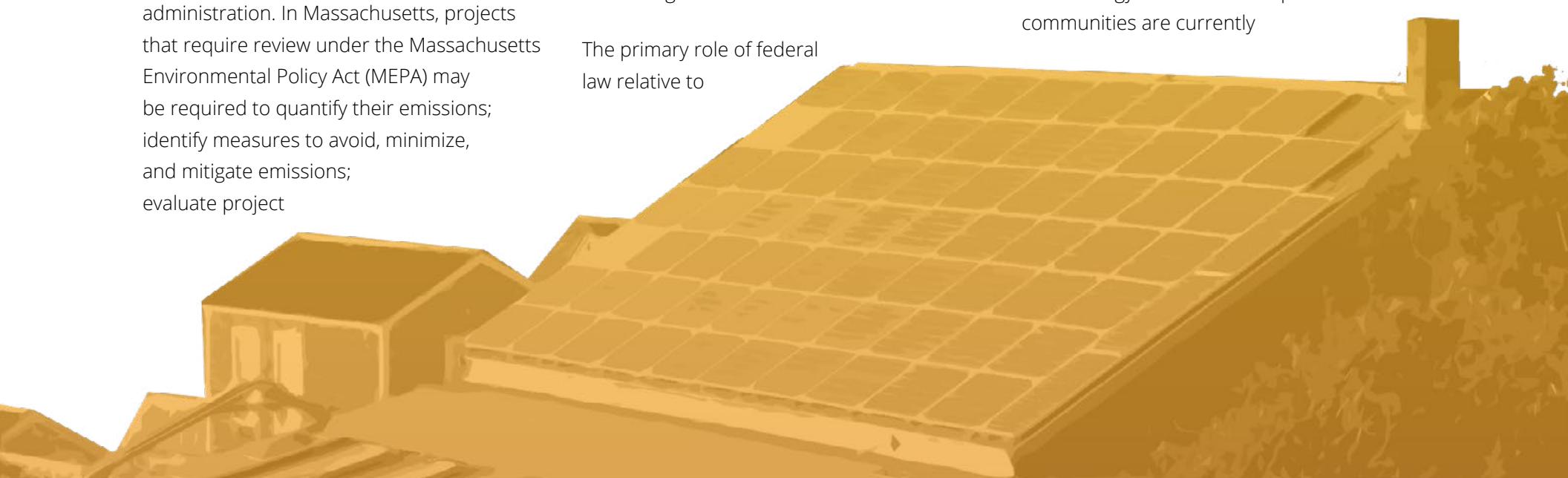
## Building Sector

There are opportunities to consider GHG emissions and alternative building designs to reduce climate-related impacts during project review. The Federal National Environmental Policy Act (NEPA) requires an analysis of a project's direct, indirect, and cumulative environmental effects. NEPA implementing regulations issued prior to July 2020 provided guidance clarifying that the analysis must consider GHG emissions and climate change. This was rescinded in July 2020 and, while it is currently being challenged in several courts, it is subject to change by the new federal administration. In Massachusetts, projects that require review under the Massachusetts Environmental Policy Act (MEPA) may be required to quantify their emissions; identify measures to avoid, minimize, and mitigate emissions; evaluate project

alternatives that could lower emissions; and quantify the impact of any proposed mitigation measures in terms of emissions and energy savings. Developments before the Cape Cod Commission that have been required to analyze emissions and develop alternatives through MEPA will have that information as part of the record for review. There are opportunities for local and regional project review to consider climate change as well. For example, through zoning, communities may require certain proposed buildings to demonstrate compliance with the Leadership in Energy and Environmental Design (LEED) green building rating system, or complete a Climate Resiliency Checklist which may incorporate a protocol for calculating emissions.

The primary role of federal law relative to

project construction is to set energy efficiency requirements for appliances. Perhaps the most impactful laws on this issue are at the state level. The Massachusetts Building Code regulates construction of buildings and incorporates the Energy Conservation and Gas Codes. Local or regional laws may not be more stringent than the state code; however, communities may choose to adopt the Stretch Code, which provides for more stringent energy standards for new buildings and renovations. Adoption of the Stretch Code is recommended by the Massachusetts Department of Energy Resources for communities wishing to participate in the Green Communities Program, which encourages and incentivizes clean energy decisions. All Cape Cod communities are currently



designated, or are seeking designation, as a Green Community.

## Transportation Sector

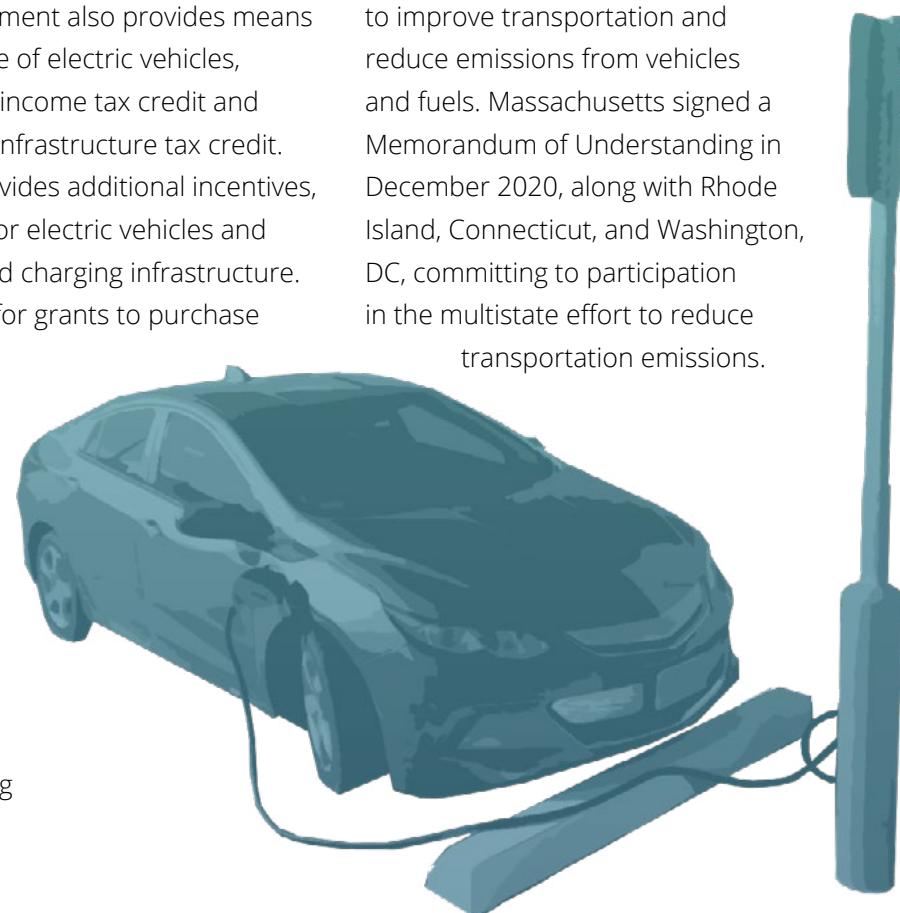
The federal government first established fuel efficiency standards in 1975, through the Energy Policy and Conservation Act. Standards established in the 1970s were subsequently raised in 2007, upon passage of the Energy Independence and Securities Act. Through the Clean Air Act, the EPA also sets pollution standards for new light-duty vehicles, including global warming pollution standards for vehicles. In 2019, the EPA and the National Highway Traffic Safety Administration issued regulations that relaxed the prior fuel economy standards for cars and light trucks; these relaxed standards have been challenged in court and could be subject to change by the new administration. At the state level, Massachusetts had adopted standards established by California - a state authorized through a waiver granted by EPA to set vehicle emissions standards more stringent than federal requirements. However, when EPA withdrew California's waiver in 2019, it effectively eliminated

Massachusetts' ability to use the standards as well. While this is also an issue to be challenged in court, it is subject to change by the new administration. Pursuant to the federal Clean Air Act, EPA also sets Renewable Fuel Standards for the amount of renewable fuels that must be blended into gasoline and diesel.

The federal government also provides means for incentivizing use of electric vehicles, including a federal income tax credit and an alternative fuel infrastructure tax credit. Massachusetts provides additional incentives, including rebates for electric vehicles and grants for fleets and charging infrastructure. Towns are eligible for grants to purchase electric vehicles, and some have adopted local targets or requirements for their use. Some towns have incentivized electric vehicles through zoning, by adjusting parking

requirements based on voluntary inclusion of electric vehicle spaces and/or charging infrastructure beyond what is required by the Massachusetts Building Code.

Massachusetts also participates in the Transportation and Climate Initiative, a regional collaboration of Northeast and Mid-Atlantic states working together to improve transportation and reduce emissions from vehicles and fuels. Massachusetts signed a Memorandum of Understanding in December 2020, along with Rhode Island, Connecticut, and Washington, DC, committing to participation in the multistate effort to reduce transportation emissions.





## Electric Generation Facilities and Retail Electric Suppliers

The federal government regulates emissions from new and existing power plants. In addition, in Massachusetts, certain facilities are subject to the Regional Greenhouse Gas Initiative, which requires the purchase of allowances for GHG emissions. MassDEP regulations also set annually declining emissions limits for large fossil fuel-powered electric generation facilities.

The state Renewable Portfolio Standard requires retail electricity suppliers to obtain a certain amount of electricity from renewable energy sources. Retail suppliers must also comply with the Clean Energy Standard, which sets a minimum percentage of sales that suppliers must procure from renewable sources and requires they demonstrate they are meeting the requirement.

Communities that do not have municipal light companies may pursue municipal aggregation, which allows for the purchase of electricity supply in bulk and can be used to purchase electricity that has a greater percentage of renewable energy than required by state law. The Cape Light Compact serves the 15 Cape Cod towns, in addition to several Island communities, in this role. As such, they are able to implement energy efficiency programs that utilize funds collected from member communities to reduce energy costs.

## Siting Fossil Fuel Power Plants and Infrastructure

The primary relevant laws for siting fossil fuel power plants or associated infrastructure are the federal Natural Gas Act and the Massachusetts Energy Facilities Siting Act, both of which pose significant limits on local and regional authority. Projects related

to interstate transportation of natural gas that have received a certificate of public convenience and necessity by the Federal Energy Regulatory Commission, pursuant to the Natural Gas Act, generally do not have to comply with state and local laws. Under the Massachusetts Energy Facilities Siting Act, an independent state board (the Energy Facilities Siting Board, or EFSB) reviews proposed large energy facilities to ensure that approved facilities minimize environmental impacts, visual intrusions, and risks to public health and safety. The EFSB has some authority to override or provide exceptions to local laws. Once the EFSB issues a certificate of environmental impact and public interest, communities cannot require any approval, consent, permit, or condition for construction, operation, or maintenance of the facility for which the certificate was issued.

Turning climate policies into broadly embraced action will require sensitivity to decades of business and individual investments in fossil-fuel based technologies. Policies at the state and local levels need to recognize that a gradual phasing out of the old infrastructure in favor of the new will require a dependence on both to supplement the aggressive shifts to cleaner fuels in vehicles and buildings that

are needed to meet our carbon emissions targets. These transitions will also provide opportunities for local, regional, and state actors to coordinate and collaborate on planning for climate action and most effectively work towards achieving the Commonwealth's climate goals.



# Cape Cod's Greenhouse Gas Emissions

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Certain gases that trap heat in the Earth's atmosphere such as carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), and nitrous oxide ( $\text{N}_2\text{O}$ ), are known as greenhouse gases (GHGs) and are widely acknowledged to contribute to climate change. GHGs occur naturally, and they are also emitted from human activities like using fossil fuels, through certain land management practices, or from manufacturing of products we use. In order to reduce or minimize the amount of GHGs the region emits, and to prevent climate change from worsening, it is critical to first understand the region's sources of GHG emissions.





A greenhouse gas emissions inventory is an accounting of the total greenhouse gas emissions for all man-made sources for a specific geography.

This chapter summarizes the methodology developed to inventory the region's GHG emissions, and then presents the results of the inventory. The second part of the chapter presents the findings of the Eastern Research Group's work to characterize the region's future GHG emissions under several different policy and future condition scenarios.

The 2018 Regional Policy Plan includes a planning action to encourage and engage communities to better understand regional GHG emissions through development of an inventory - an estimated baseline of GHG

emissions for the region using available models and data. A GHG emissions inventory is an accounting of the total GHG emissions for all man-made sources for a specific geography.

In 2020, the Commission completed a regional GHG emissions inventory for a baseline year of 2017, calculated using the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. The IPCC Guidelines focus on calculating GHG emissions and removals from anthropogenic (man-made) sources.

**Transportation and home energy use are the primary contributors to the Cape's GHG emissions**



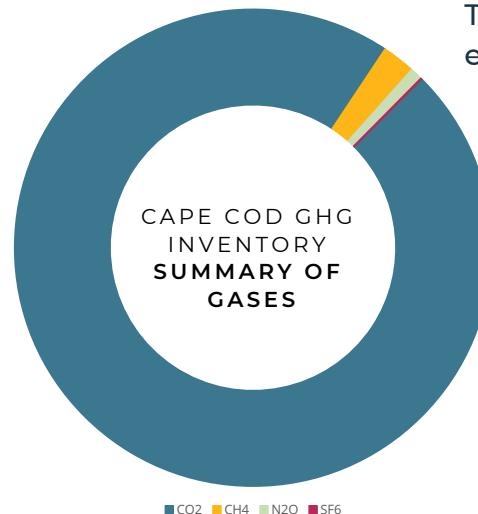
The inventory includes emissions and sequestration from the following sectors:

- Transportation
- Stationary Energy
- Industrial Processes and Product Use
- Agriculture
- Waste
- Land Use and Forestry

Emissions of the following GHGs are included, consistent with the Massachusetts 2017 state inventory:

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Nitrous oxide (N<sub>2</sub>O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF<sub>6</sub>)

Various greenhouse gases have different warming potentials relative to carbon dioxide, which has a warming potential of 1. For example, methane has a warming potential of 25 and for nitrous oxide, it is 298.<sup>1</sup> This allows for calculating GHG emissions in CO<sub>2</sub> equivalent. Emissions were calculated for activities occurring inside Barnstable County and certain activities outside of Barnstable



The vast majority of greenhouse gas emissions on Cape Cod are carbon dioxide

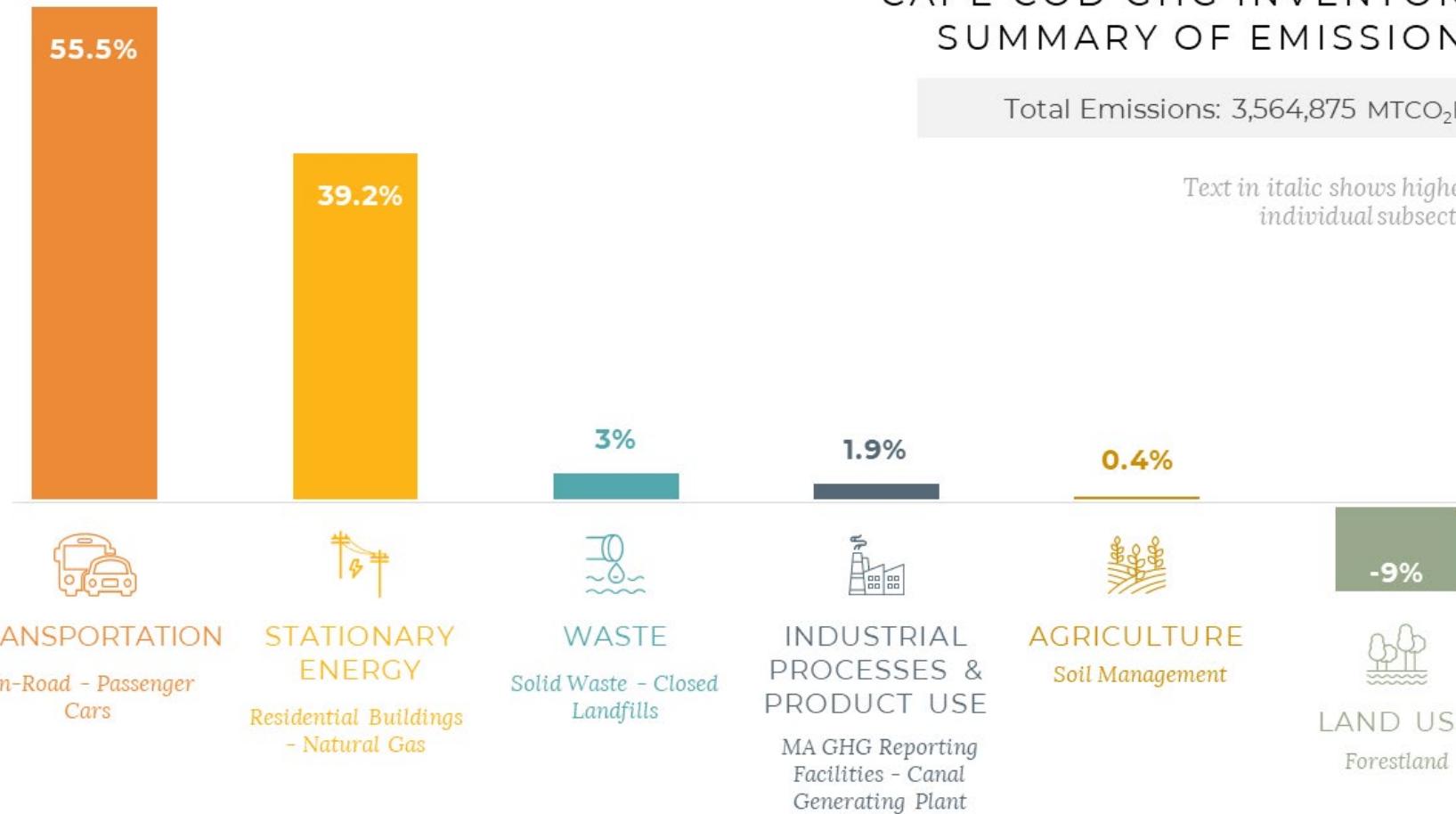
- 96.8% ■ **Carbon dioxide** CO<sub>2</sub>
- 2.2% ■ **Methane** CH<sub>4</sub>
- 0.8% ■ **Nitrous oxide** N<sub>2</sub>O
- 0.1% ■ **Sulfur hexafluoride** SF<sub>6</sub>
- 0.0% ■ **Hydrofluorocarbons** HFCs
- 0.0% ■ **Perfluorocarbons** PFCs

County, namely electricity generation, transportation, and waste. Greenhouse gas removals (sequestration) were calculated in the Land Use and Forestry sector. Other activities, such as the production of food and goods consumed within the region but produced elsewhere, are not included within the inventory.

For more information on the inventory, including the methods used to calculate emissions and removals and data sources, see <https://cccom.link/GHGInventory>. The detailed methodology is also available as [Appendix D](#).

The Cape Cod GHG emissions inventory provides a snapshot of the region's GHG emissions using an accounting method that is comparable and reproducible, allowing changes in emissions to be measured going forward. It also provides clear information about the region's largest contributing sectors for GHG emissions, equipping the Cape and its communities with information on where to focus efforts moving forward to most effectively reduce GHG emissions and thus reduce the region's contributions to climate change.

<sup>1</sup> Intergovernmental Panel on Climate Change, "Climate Change 2007: Synthesis Report." [https://www.ipcc.ch/site/assets/uploads/2018/02/ar4\\_syr\\_full\\_report.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf)



Together, transportation and stationary energy account for nearly 95% of the region's greenhouse gas emissions.



## OUTCOMES

Cape Cod's 2017 GHG emissions equal 3,564,875 MTCO<sub>2</sub>E, approximately 4-5% of Massachusetts state emissions.

Transportation is the highest contributing sector of emissions, accounting for 55.5% of total Cape inventory emissions. The second highest contributing sector is stationary energy use, which is responsible for 39% of total inventory emissions. The remaining 5% of emissions come from the waste (3%), industrial processes (1.9%), and agriculture (0.4%) sectors.

Also calculated are the effects of land use and forestry on the region (represented by forestland, grassland, and cropland), which has the potential to sequester over 340,060 MTCO<sub>2</sub>E per year, equal to 9% of total inventory emissions. The largest potential for sequestration comes from forestland. This percentage of sequestration is consistent with the sequestration from forestland calculated for the state.

## CARBON DIOXIDE EQUIVALENT (CO<sub>2</sub>E)

As defined by the Environmental Protection Agency, carbon dioxide equivalent or CO<sub>2</sub>E is “the number of metric tons of CO<sub>2</sub> emissions with the same global warming potential as one metric ton of another greenhouse gas.” Using the CO<sub>2</sub>E of greenhouse gases other than carbon dioxide allows for a total calculation of the greenhouse gas emissions for an area.



### SEQUSTRATION

*Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide to reduce greenhouse gas emissions.*



## TRANSPORTATION



**55.5%**

of total Cape Cod  
greenhouse gas  
emissions

 COMPARED WITH  
**45.7% OF STATE EMISSIONS**



### ON-ROAD

vehicles account for  
43% of the region's  
emissions and nearly  
80% of transportation  
emissions

**Transportation accounts for  
55.5% of GHG emissions for  
the region.**

Transportation emissions are generated by on-road vehicles, off-road vehicles and equipment, and are the result of personal transportation choices, the evolution of public transportation, and off-road contributions. The movement of people and goods to and throughout the region are captured in this analysis, as well as a variety of other activities captured

under the off-road subsector, such as construction equipment.

On-road vehicles, including passenger cars, light-duty trucks, motorcycles, and heavy-duty vehicles account for 78% of the transportation sector's emissions.

The total emissions generated by on-road vehicles is a function of the fuel efficiency of the vehicles, the number of trips taken, and the length of the trips. The efficiency of vehicles on roads in the region was



**The total emissions generated by on-road vehicles is a function of the fuel efficiency of the vehicles, the number of trips taken, and the length of the trips.**

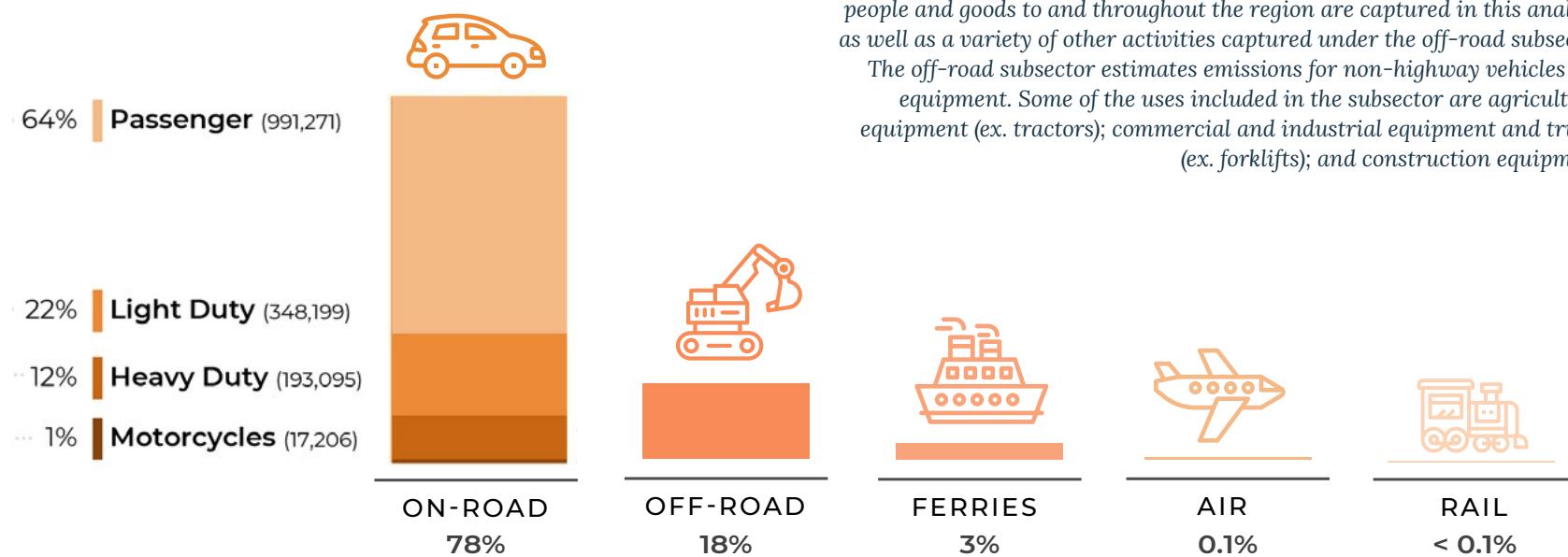


estimated by looking at the mix of vehicles registered on Cape Cod.

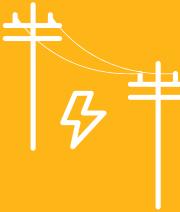
The total distance of all vehicle trips in a given time period can be combined into a measure known as vehicle miles traveled (VMT). For the Cape Cod region, the average daily VMT is estimated to be over 8 million miles. This number is high for a region of this size due to a number of

factors, including miles traveled by second homeowners and visitors to the region, the relatively small proportion of trips in modes other than a personal vehicle, and the geography and development patterns of the region. If the region had the same per capita VMT rate as the rest of the state, the overall regional VMT would be 30 to 40% less.

Public transportation accounts for only 2.5% of the emissions within the transportation sector, and just over 1.3% of total regional GHG emissions. On a per person basis, travel by public transportation results in far fewer GHG emissions.



Source: Cape Cod GHG Inventory



## STATIONARY ENERGY



# 39.2%

of total Cape Cod  
greenhouse gas  
emissions



COMPARED WITH  
47% OF STATE EMISSIONS



### KEY FINDING

Residential energy  
use is nearly twice  
that of commercial  
and industrial use

### Stationary energy accounts for over 39% of GHG emissions for the region.

Stationary energy emissions are generated by the burning of fuel to heat and power homes and commercial, industrial, and other non-residential buildings. The region's development mix, heating fuel mix, and electricity generation fuel mix are the key determinants for the region's emissions in this sector.

Cape Cod is highly residential, with only 2-3% of the reported commercial and industrial building square footage in the state. This residential development

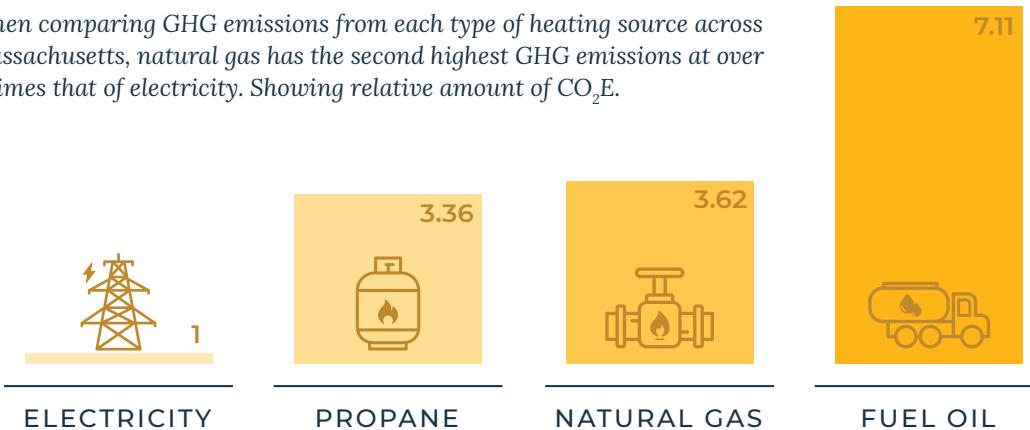
### CAPE COD'S GREENHOUSE GAS EMISSIONS

is predominantly single-family homes, resulting in the residential subsector being the highest single contributor of stationary energy emissions.

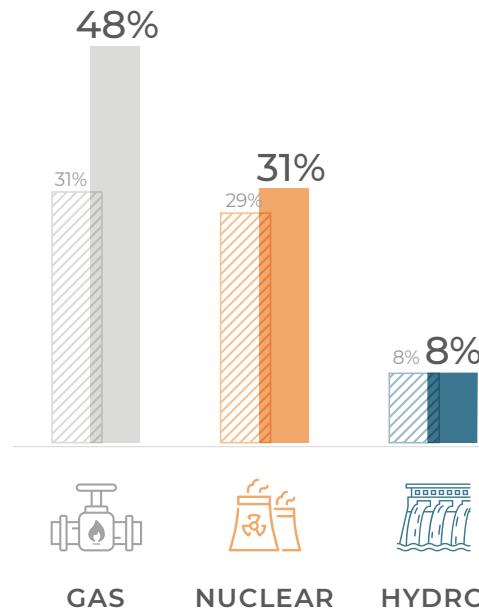
A variety of fuel sources are used in homes across the Cape for home heating and the operation of appliances. The largest residential emissions are attributed to natural gas use. While the number of homes using fuel oil for home heating has decreased, the number of homes using natural gas as a heating source has increased. Today, 59% of residences use natural gas as a heating source. Combined with fuel oil, propane, and electricity, these fuels are used in over 97% of Cape Cod

### EMISSIONS BY FUEL TYPE

When comparing GHG emissions from each type of heating source across Massachusetts, natural gas has the second highest GHG emissions at over 3 times that of electricity. Showing relative amount of CO<sub>2</sub>E.

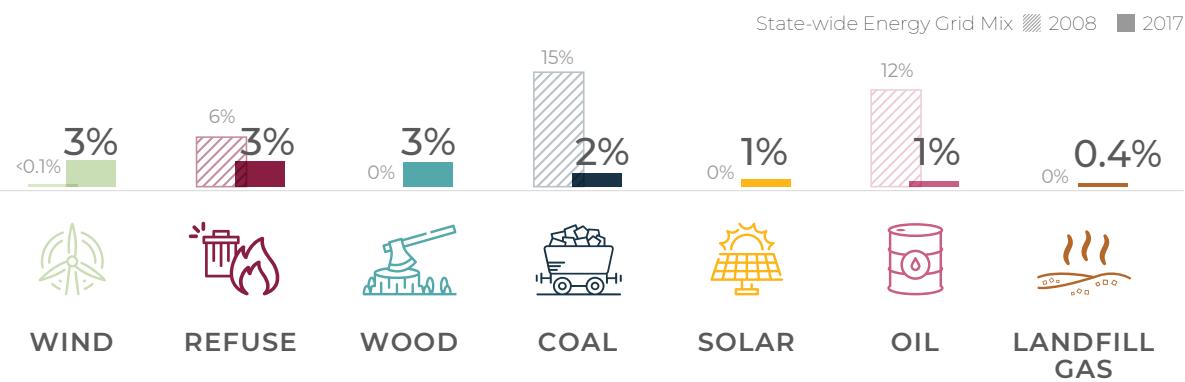


Source: MA Dept. of Energy Resources



### ISO NEW ENGLAND GRID ENERGY GENERATION FUEL MIX

The energy generation fuel mix has changed significantly over the last decade. In the graphic below the cross-hatched bars represent the energy generation fuel mix in 2008 and the solid bars represent the mix in 2017.



Source: ISO-NE

homes for heating. The average home in Massachusetts that uses natural gas for heating, emits over three times as much CO<sub>2</sub> equivalent as a home heated with electricity; a home heated with fuel oil emits over 7 times as much.

The electricity generation fuel mix for our region is defined by all of the contributions

to the ISO New England Grid, which includes a mixture of renewable and non-renewable sources. The electricity generation fuel mix has changed significantly over the past couple of decades. From 2000 to 2017, renewable energy sources into the electricity grid have increased at least 50%. With the transition away from oil and the

increase in renewable energy sources, the electric grid has become cleaner. The continued development of renewable energy generation in the region is expected to continue greening the grid.





## WASTE



**3%**

of total Cape Cod  
greenhouse gas  
emissions

 COMPARED WITH  
**2.6% OF STATE EMISSIONS**



### SOLID WASTE

Processing and  
disposal accounts  
for over 99% of  
greenhouse gas  
emissions from the  
waste sector

### The waste sector accounts for 3% of GHG emissions for the region.

This sector includes emissions from solid waste processing and disposal, and municipal wastewater treatment.

Emissions from solid waste disposal come from closed landfills on Cape Cod, the Bourne Integrated Solid Waste

Management Facility (Bourne Landfill), and processing of solid waste from Cape Cod at the Southeastern Massachusetts (Covanta SEMASS) Resource Recovery Facility in Wareham. Emissions associated with the transportation of solid waste are accounted for in the transportation sector. The largest emissions from this sector are from closed landfills. These emissions are expected to decrease over time as organic matter within those landfills continues to break down,



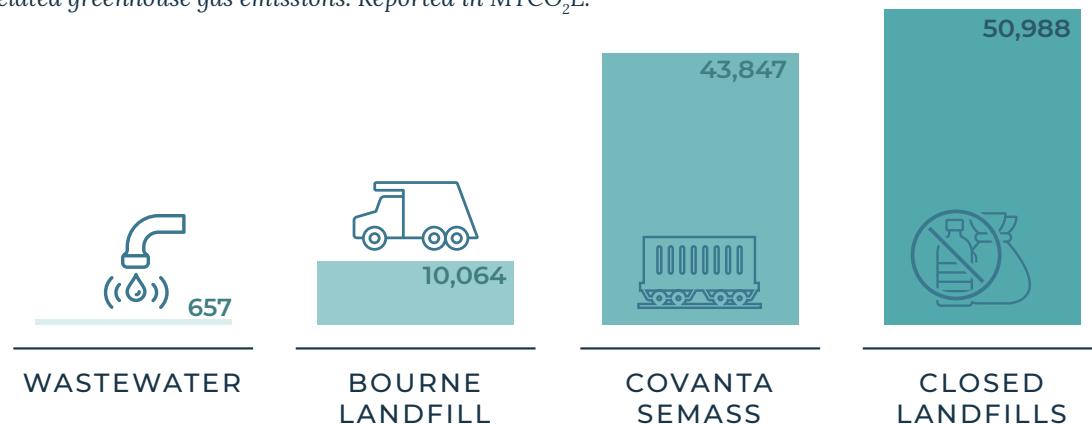


decreasing the available organic matter contributing to GHG emissions.

Municipal wastewater treatment is a very low emissions source in the region. Emissions related to wastewater treatment at municipal facilities are equivalent to the emissions from 142 passenger vehicles driven for one year, or the home energy use for one year for 76 homes.

#### EMISSIONS BY SUBSECTOR

Waste accounts for very little of the region's greenhouse gas emissions but within the waste sector, closed landfills account for nearly half of waste-related greenhouse gas emissions. Reported in MTCO<sub>2</sub>E.



While wastewater treatment systems are not large sources of GHG emissions, they are particularly low in the region given that the vast majority of development utilizes onsite septic systems for wastewater treatment.



## INDUSTRIAL PROCESSES AND PRODUCT USE



**1.9%**

of total Cape Cod greenhouse gas emissions



COMPARED WITH  
5.1% OF STATE EMISSIONS



### KEY FINDING

Only 4 facilities on Cape Cod are required to report to the Massachusetts GHG Reporting Program

### The Industrial Processes and Product Use sector accounts for 1.9% of GHG emissions for the region.

This sector includes facilities that report GHG emissions to the state GHG Reporting Program, and emissions of sulfur hexafluoride ( $SF_6$ ) associated with electricity system transmission and distribution. While this category covers a variety of facility types, there are few of these facilities on Cape Cod, and there is overall very little industrial processing/production in the region.

The types of facilities that report to the Massachusetts GHG Reporting Program are classified as Institutions, Manufacturing, Natural Gas and Petroleum Infrastructure, Power Generation, Solid and Liquid Waste Management, and several others. Emissions are generally reported from the use of industrial products or processes using industrial products and do not typically include the emissions associated with heating or powering these facilities.

Historically, there have been approximately 300 facilities in the state that report to the Massachusetts GHG Reporting Program. Of

#### GHG REPORTING PROGRAM FACILITY TYPES ACROSS THE STATE

*Emissions reported by state reporting facilities are generally from the use of industrial products or processes using industrial products. The reported emissions do not typically include emissions associated with heating or powering these facilities.*



INSTITUTIONS



MANUFACTURING



NATURAL GAS &amp; PETROLEUM



POWER GENERATION



WASTE MANAGEMENT



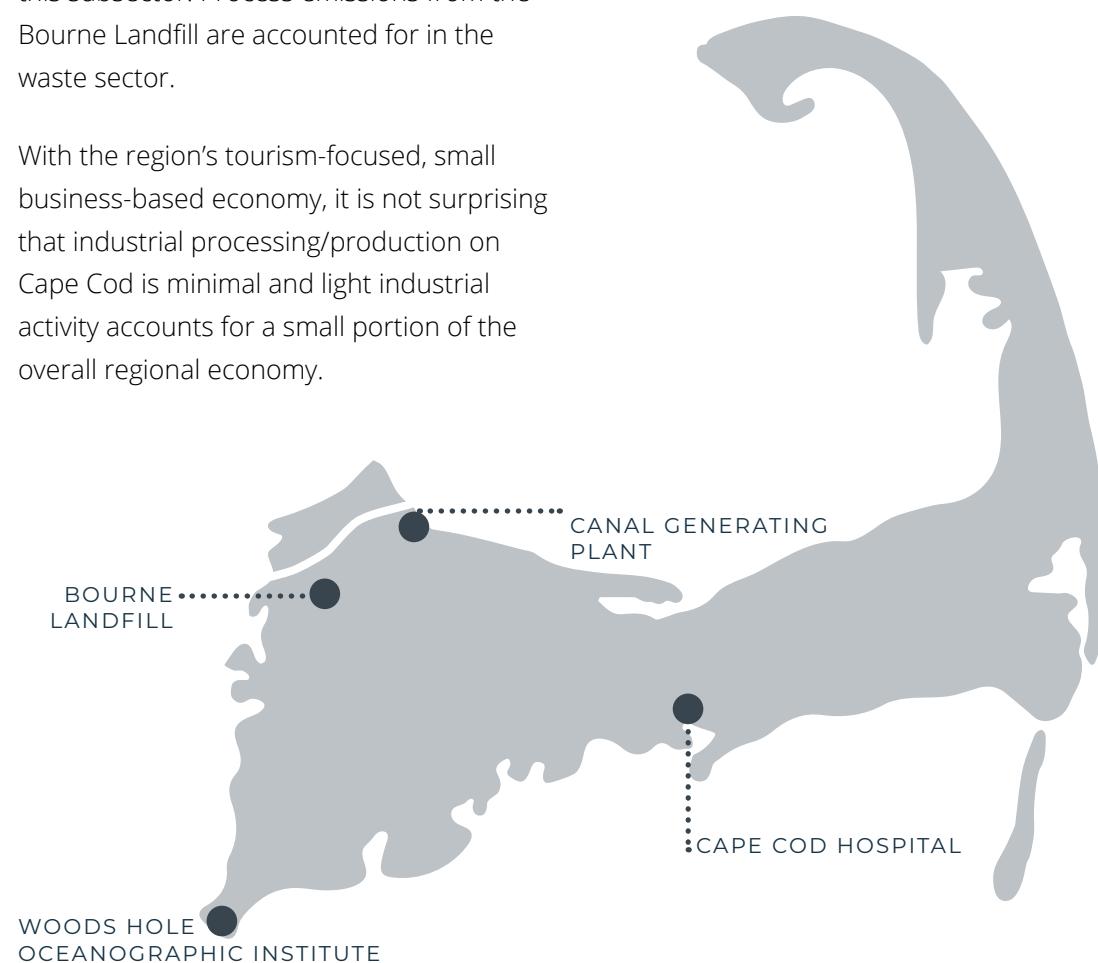
OTHER



those 300 facilities there are only 4 located on Cape Cod—Cape Cod Hospital, Woods Hole Oceanographic Institute, the Canal Generating Plant, and the Bourne Landfill. The process emissions associated with three of these four facilities are included in this subsector. Process emissions from the Bourne Landfill are accounted for in the waste sector.

With the region's tourism-focused, small business-based economy, it is not surprising that industrial processing/production on Cape Cod is minimal and light industrial activity accounts for a small portion of the overall regional economy.

Emissions of sulfur hexafluoride ( $SF_6$ ) associated with electricity system transmission are also minimal for the region, accounting for a tiny fraction of the total industrial processes and product use emissions.





## AGRICULTURE AND SOIL MANAGEMENT



# 0.4%

of total Cape Cod greenhouse gas emissions

 COMPARED WITH  
0.3% OF STATE EMISSIONS



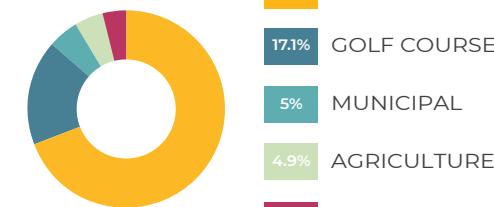
**FERTILIZER USE**  
related to landscaping and agriculture is the largest emissions contributor to this sector

The Agriculture and Soil Management sector accounts for 0.4% of GHG emissions for the region.

This sector accounts for emissions generated from fertilizer use across all land uses in the region and the emissions associated with other agriculture activities.

The largest contribution to this sector comes from fertilizer application associated with agriculture as well as residential and commercial landscaping activities. The amount of emissions from fertilizer use is based on the acreage of different land uses across the region and the fertilizer application rates for those land uses.

## CAPE COD'S GREENHOUSE GAS EMISSIONS



Source: CCC Pesticide and Fertilizer Use Inventory 2014

## FERTILIZER USE BY LAND USE CATEGORY

To estimate and report on emissions from synthetic urea fertilizer use, data from the 2014 Cape Cod Pesticide and Fertilizer Use Inventory was used for the estimated areas fertilized and fertilizer application rates for residential, commercial, municipal, golf course, and agricultural uses.



## VALUABLE FARM LAND

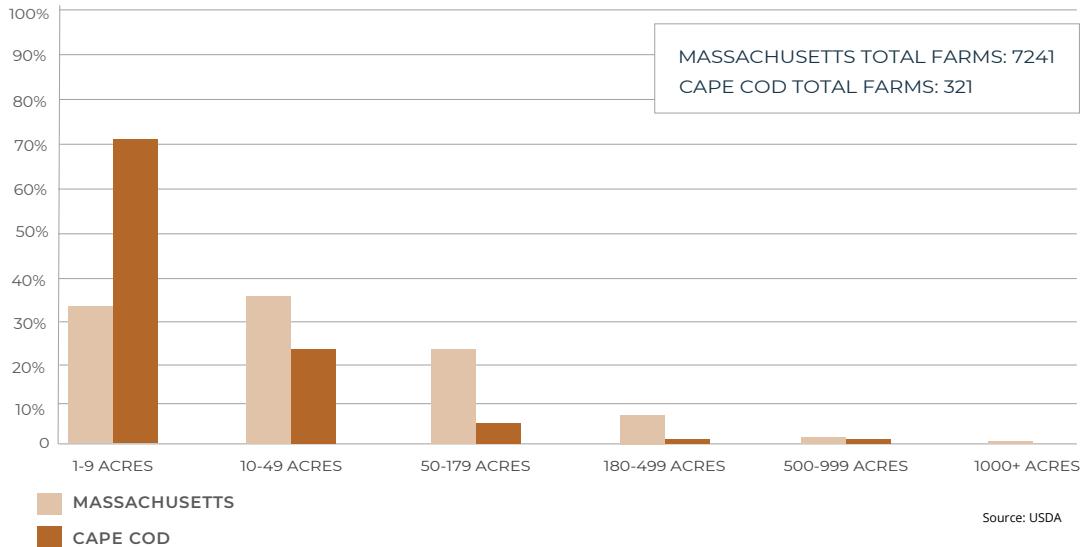
Barnstable County ranks third in the state for the highest average estimated market value per acre of farmland and associated buildings. Barnstable County is \$30,555 per acre, higher than the state average of \$10,894 per acre.



There are approximately 300 farms on Cape Cod covering about 4,250 acres. Most farms are relatively small, averaging about 14 acres. Cranberry bogs, wood lots, and tree farms tend to be some of the largest. Emissions from farms tend to be fairly small and some farm types, such as cranberry bogs, actually have the potential for some carbon sequestration.

Local food production is important in mitigating climate change because it can reduce regional emissions related to the regional imports of farm products.

## F FARMS BY SIZE IN MASS VS. THE CAPE



## F FARMS BY SIZE IN MASS VS. THE CAPE

Most farms on Cape Cod are relatively small. Due to the small number of livestock on Cape Cod, most emissions from the livestock subsector are attributed to manure management.

**Agriculture sector emissions equal  
15,153 MTCO<sub>2</sub>E, 0.4% of total  
inventory emissions. Livestock and  
soil management emissions equal  
2,769 MTCO<sub>2</sub>E and 12,384 MTCO<sub>2</sub>E,  
respectively.**



## LAND USE AND FORESTRY



**-9%**

of total Cape Cod greenhouse gas emissions or emissions sequestered



COMPARED WITH  
**-9% OF STATE EMISSIONS**



### KEY FINDING

Carbon sequestration from forestland absorbs the equivalent of 20% of on-road vehicle transportation emissions from the region

### The land use sector can sequester 9% of the Cape's total 2017 carbon emissions.

Natural land, including vegetated areas and soils, can sequester or emit carbon based on land management practices like vegetation removal or soil disturbance. Land management for conservation interests, as detailed in the State Wildlife Action Plan and others, have important purposes and can have neutral or beneficial effects on carbon sequestration.

This sector includes emissions and sequestration from forestland, cropland, and grassland. Net carbon sequestration, or storage, was calculated in the land use sector. The natural process of plants and soils absorbing CO<sub>2</sub> leads to carbon sequestration.

For the Cape, forestland has the most potential for carbon sequestration, able to absorb 20% of on-road vehicle transportation

### LAND MANAGEMENT PRACTICES MATTER

*Natural land, including vegetated areas and soils, can sequester or emit carbon based on land management practices like vegetation removal or soil disturbance.*

emissions. Soils and wetland ecosystems also have the potential to sequester large amounts of carbon, though due to data and analysis limitations, the potential for carbon sequestration from these systems was not included in this inventory.

However, coarse assessments of soil carbon sequestration based on the forthcoming Massachusetts Healthy Soils Action Plan<sup>2</sup>, Mass Audubon<sup>3</sup> and Waquoit Bay National Estuarine Research Reserve<sup>4</sup>, estimate that the Cape's approximately 44,000 hectares of

<sup>2</sup> Analysis Summary, Goals, + Strategies for Soil Health Briefing for the Executive Office of Energy and Environmental Affairs July 13, 2020: [https://www.regenerativedesigngroup.com/wp-content/uploads/2020/07/HSAP\\_Public-Meetings-Presentation\\_July-2020.pdf](https://www.regenerativedesigngroup.com/wp-content/uploads/2020/07/HSAP_Public-Meetings-Presentation_July-2020.pdf)

<sup>3</sup> The Value of Nature: <https://www.massaudubon.org/our-conservation-work/advocacy/shaping-the-future-of-your-community/current-projects/the-value-of-nature>

<sup>4</sup> Model – Waquoit Bay National Estuarine Research Reserve: <http://waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/expanding-blue-carbon-phase-2/model/>



forest could sequester over five million tons; the Cape's 2,080 hectares of grassland could sequester an additional 275,000 tons of carbon; and the Cape's numerous wetlands may sequester millions more tons of soil organic carbon.

To better understand the potential of salt marshes and freshwater wetlands to sequester carbon, it is critical to develop a methodology for these calculations that can be incorporated into future updates of the GHG emissions inventory.

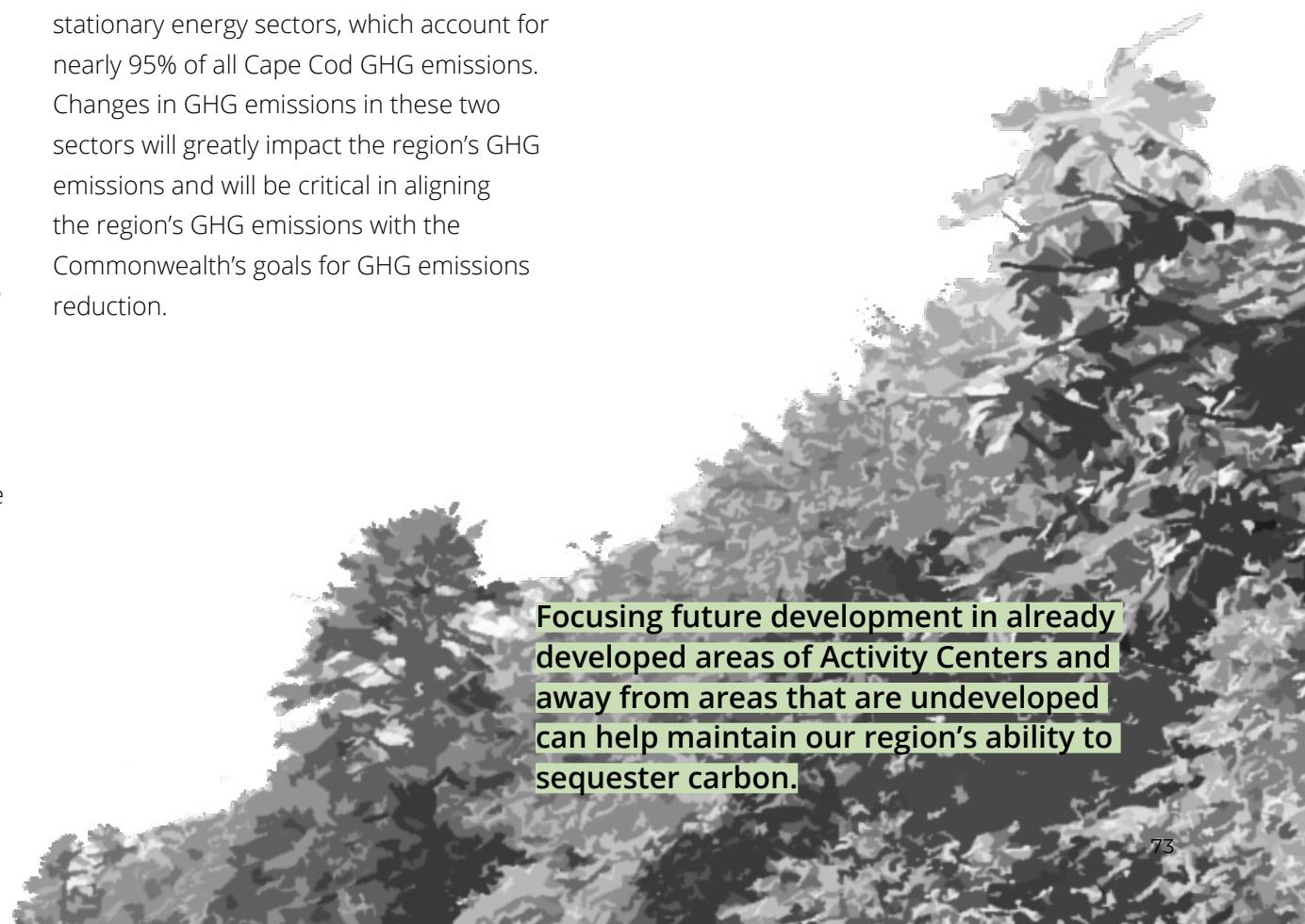
Over 80% of the region's land area is already protected or developed, with over 90,000 acres of protected open space. Between 2001 and 2011, however, the Cape lost more than 2,300 acres of forest cover, with 70% of the loss replaced by development (buildings, driveways, parking lots, etc.). Focusing future development in already developed areas of Activity Centers and away from areas that are undeveloped can help maintain our region's ability to sequester carbon.

Continuing to protect and increase the region's ability to sequester carbon will be important moving forward. It will also be important to promote sustainable agricultural practices and to look for ways to reduce emissions from the waste and industrial processes and products sectors. This baseline inventory, however, points to the need to drastically reduce the region's emissions in the transportation and stationary energy sectors, which account for nearly 95% of all Cape Cod GHG emissions. Changes in GHG emissions in these two sectors will greatly impact the region's GHG emissions and will be critical in aligning the region's GHG emissions with the Commonwealth's goals for GHG emissions reduction.

## Recommendation

Determine a methodology for calculating the potential of the region's salt marshes and freshwater wetlands to sequester carbon

**Focusing future development in already developed areas of Activity Centers and away from areas that are undeveloped can help maintain our region's ability to sequester carbon.**



# Future Emissions Scenarios

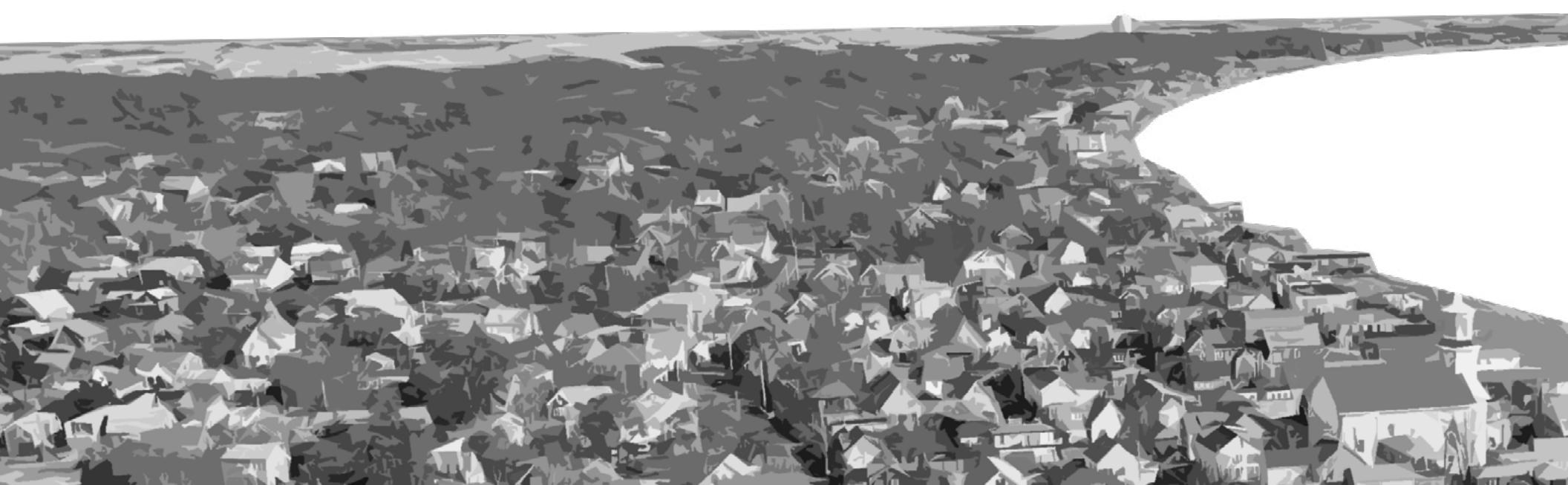
The Cape Cod Commission contracted Eastern Research Group, Inc. (ERG), and Synapse Energy Economics, Inc. (Synapse), to, in part, develop scenarios to help better understand how the region could contribute to GHG emissions reductions in support of the Commonwealth's GHG emissions reductions goals. Synapse modeled emissions from the transportation, building, and electricity sectors from 2021 through 2050 for five scenarios, including one sustained policy scenario that assumes current policy goals (at the time of the analysis) are met, thus representing a

snapshot in time given the current policy and regulatory context, and four decarbonization scenarios.

The sustained policy scenario fails to reduce GHG emissions to 50% below 1990 levels by 2030 and to 85% below 1990 levels by 2050 in Barnstable County, emissions reductions goals that were selected to be consistent with the overall goals in Massachusetts. Emissions are projected to decline through those time periods; however, total regional emissions in 2050 are projected to be 1.5 million metric tons, which is a little less than

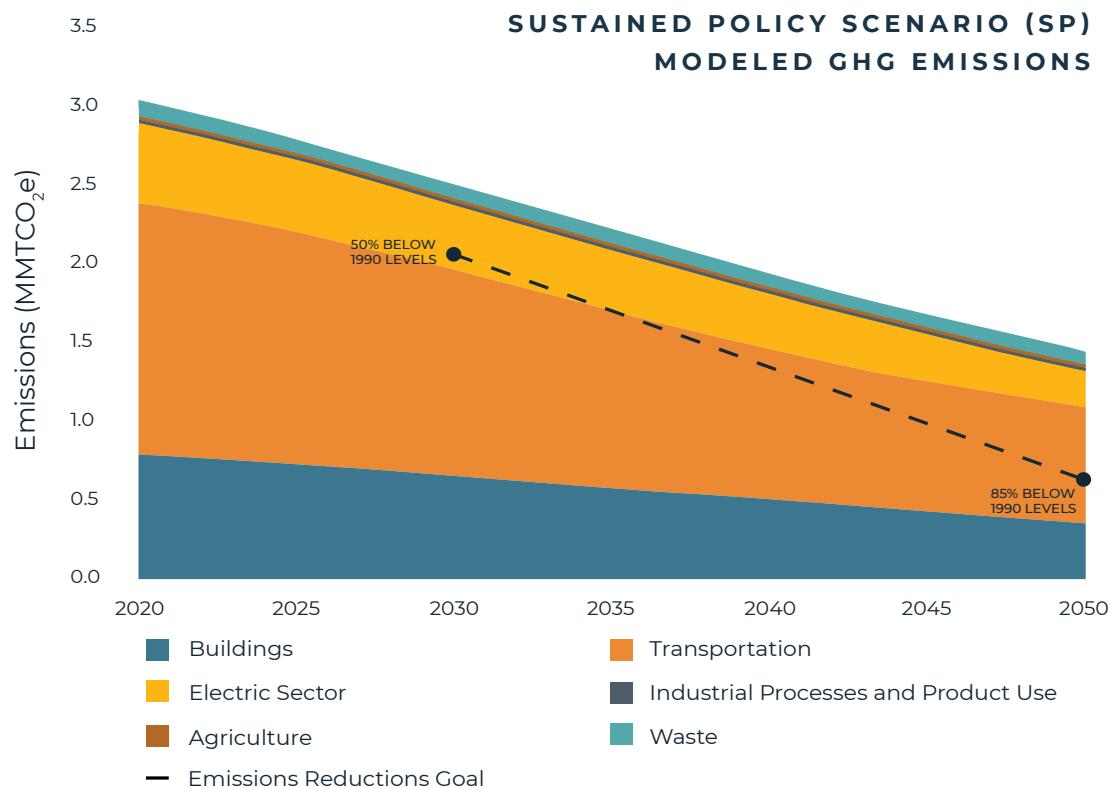
1 million metric tons above the 2050 target. The transportation sector continues to be the largest source of emissions through 2050, representing 48% of economy-wide GHG emissions.

The future emissions scenarios provide context for the extent of actions necessary within each modeled sector to contribute to achievement of the Commonwealth's goals. While they were used to support identification of the priority strategies presented later in the plan, no one scenario was selected to guide the plan in its entirety.



Synapse and the Cape Cod Commission developed the following four decarbonization scenarios:

- **Aggressive electrification scenario (SER1)**—The state-level emissions reduction baseline scenario determines the level of beneficial electrification necessary given baseline energy efficiency gains to meet Massachusetts's GHG emissions reduction goals.
- **Aggressive efficiency scenario (SER2)**—The state-level emissions reduction aggressive efficiency scenario determines the level of beneficial electrification necessary assuming aggressive efficiency efforts to meet Massachusetts's GHG emissions reduction goals. These efforts include targeted programs and policies on Cape Cod to aggressively reduce VMT and improve the energy performance of homes and businesses through weatherization.
- **Increased year-round population scenario (SER3)**—The state-level emissions reduction year-round residency sensitivity scenario determines the level of beneficial electrification necessary assuming 50% of seasonal residents convert to year-round residents relative to historic patterns,

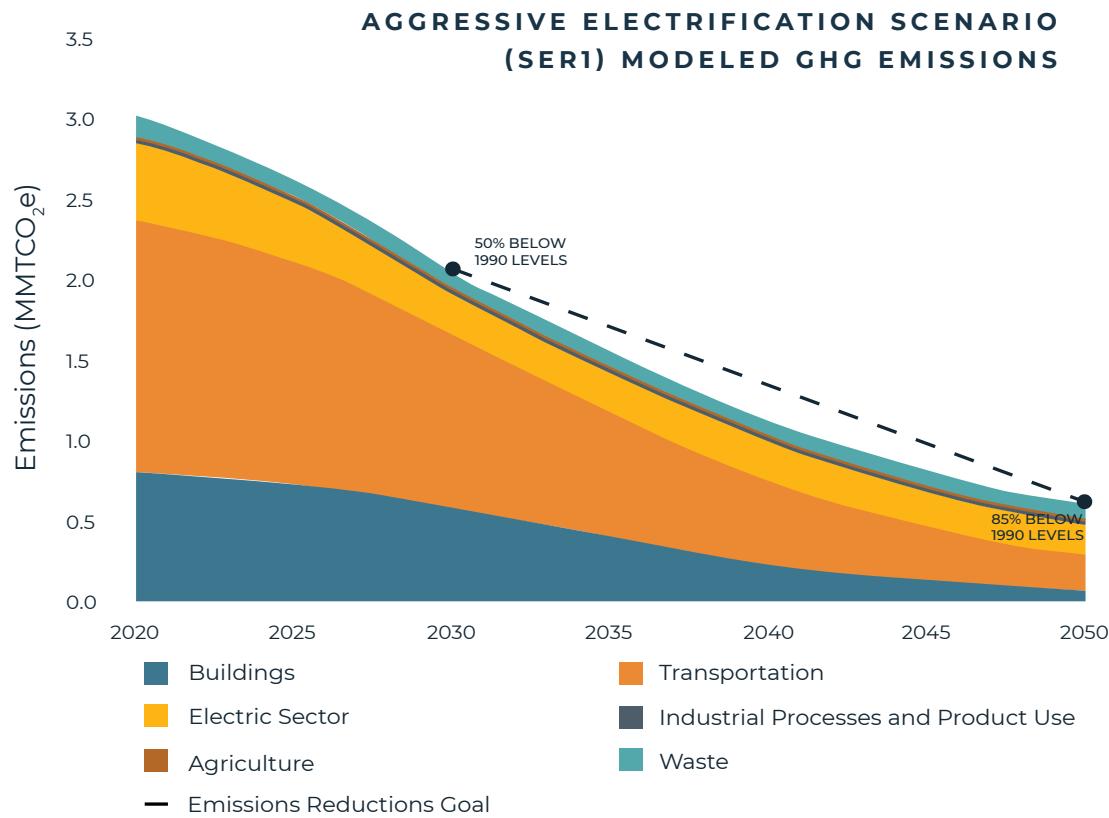


Modeled economy-wide GHG emissions for the sustained policy (SP) scenario in Barnstable County relative to Commonwealth Emissions Reduction Goals.

while meeting Massachusetts's GHG emissions reduction goals.

- **Carbon neutral scenario (CEN)**—The carbon emissions neutrality reduction scenario determines the level of beneficial electrification necessary given baseline energy efficiency gains to meet the goal

of carbon neutrality by 2050. While all three "SER" scenarios are strictly based on emissions reductions from 1990 emissions levels, this scenario is a slightly more aggressive decarbonization scenario (approximately a 90% reduction from 1990 levels) where all remaining emissions are offset by sequestration.



Modeled economy-wide GHG emissions for the aggressive electrification (SER1) scenario in Barnstable County relative to Commonwealth Emissions Reduction Goals.

The CEN scenario assumes sequestration increases from 9% in 2017 to around 12% of 2017 emissions levels by 2050.

For the aggressive electrification scenario (SER1), emissions drop to 2.05 million metric tons of carbon dioxide equivalent (MMT CO<sub>2</sub>E) per year in 2030 and 0.61 MMT CO<sub>2</sub>E in

2050, meeting the goals of a 50% reduction from 1990 levels by 2030 and 85% reduction from 1990 levels by 2050. The other three decarbonization scenarios all meet these goals as well (details for which can be found in [Appendix B](#)).

The differences between the four decarbonization scenarios are small when compared with the much larger difference between the decarbonization pathways and the sustained policies case. Rapid transformations are required across all sectors to be on pace to meet decarbonization targets. While the sustained policies case shows a future that is much different than today, the decarbonization cases show that substantially more change is necessary to meet GHG emissions reduction goals.

For each of the scenarios, Synapse modeled several key metrics, which will help the region understand the necessary magnitude of change—and progress toward it—to play its part in achieving the Commonwealth's GHG emissions reduction targets.



## EMISSIONS SCENARIOS

### Sustained Policy Scenario (SP)

The baseline modeling in each sector used a sustained policy approach, which assumes that the current policy goals are met, thus representing a snapshot in time given the current policy context.

### Carbon Neutral Scenario (CEN)

The carbon emissions neutrality reduction scenario determines the level of beneficial electrification necessary to meet the goal of carbon neutrality—where all remaining emissions are offset by sequestration—in 2050 given baseline energy efficiency gains.

### Aggressive Electrification Scenario (SER1)

The state-level emissions reduction baseline scenario determines the level of beneficial electrification necessary given baseline energy efficiency gains to meet Massachusetts's GHG emissions reduction goals.

### Aggressive Efficiency Scenario (SER2)

The state-level emissions reduction aggressive efficiency scenario determines the level of beneficial electrification necessary to meet GHG emissions reduction goals for Massachusetts, assuming aggressive efficiency efforts. This includes targeted programs and policies on Cape Cod to aggressively reduce vehicle miles traveled and improve the energy performance of homes and businesses through weatherization.

### Increased Year-round Population Scenario (SER3)

The state-level emissions reduction year-round residency sensitivity scenario determines the level of beneficial electrification necessary to meet GHG emissions reduction goals for Massachusetts, assuming 50 percent of seasonal residents convert to year-round residents relative to historic patterns.

Complete details for the emissions scenarios can be found in the Economic Impacts Technical Report at: [capecodcommission.org/ClimateActionPlan-AppendixB](http://capecodcommission.org/ClimateActionPlan-AppendixB)

To analyze scenarios that could meet goals of reducing GHG emissions to 50 percent below 1990 levels by 2030 and to 85 percent below 1990 levels by 2050, Synapse analyzed four decarbonization

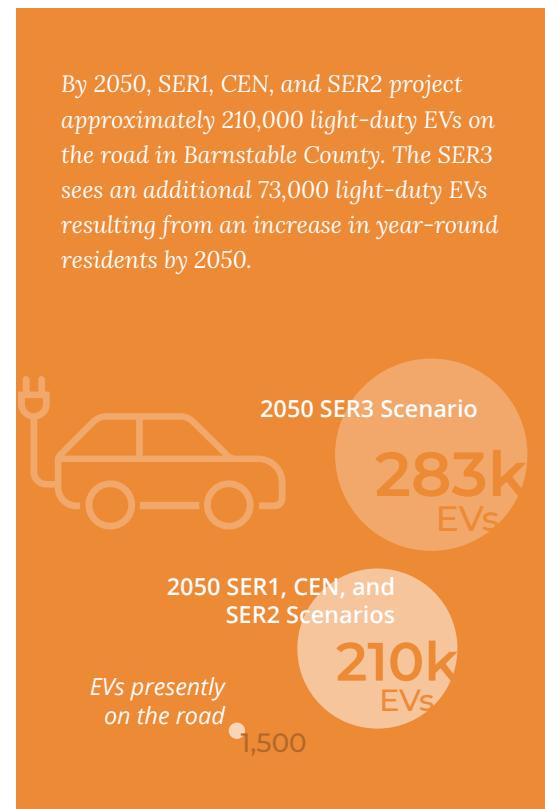
scenarios, as well as a sustained policy scenario to provide context with regards to the magnitude of changes which may need to occur to achieve these goals.

## TRANSPORTATION SECTOR

All decarbonization scenarios require significant growth in the share of new vehicle sales that are light-duty EVs. Even the aggressive efficiency scenario (SER2), with reduced VMT relative to the other decarbonization cases, requires 63% of new vehicle sales to be EVs by 2030. The increased year-round population scenario (SER3) requires 85% by 2030. The aggressive electrification scenario (SER1) and the carbon neutral scenario (CEN) each require 93% of new sales to be EVs by 2030. By 2050, all decarbonization scenarios require 100% of new vehicle sales to be EVs.

Additionally, it is important to note that electrification of the transportation sector will only significantly reduce GHG emissions if the fuel mix for the power grid is greener, as electrification of transportation will increase Cape Cod's electricity consumption. On the low end, electricity consumption for EV charging in 2050 equals 0.8 TWh in the SER2 scenario. On the high end, the SER3 scenario sees electricity for EV charging equal to 1.2

TWh in 2050. The SER3 scenario has more year-round residents and thus more EVs charging from the grid.





## BUILDINGS SECTOR

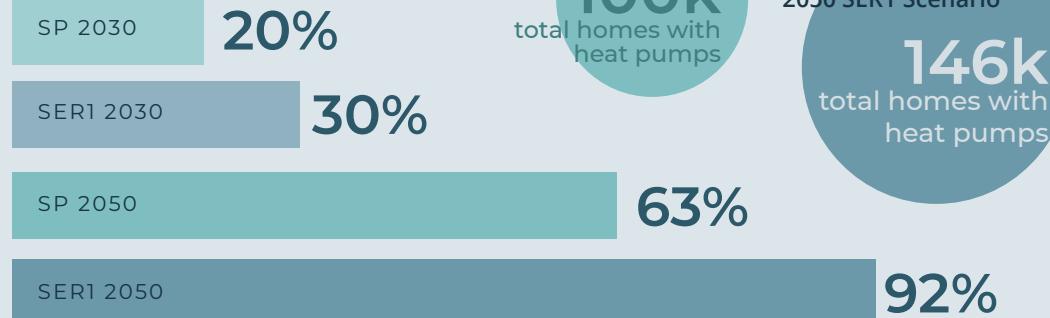
The sustained policy scenario for the buildings sector results in a reduction of emissions to about 0.67 MMT CO<sub>2</sub>E by 2030 and about 0.37 MMT CO<sub>2</sub>E by 2050 from approximately 0.8 MMT CO<sub>2</sub>E in 2020.

Similar to the transportation sector, all four decarbonization scenarios require substantial changes from the status quo, including significant growth in the use of heat pump systems, for both retrofits and whole home systems. By 2030, the sustained policy scenario calls for over 20,000 heat pump systems in year-round residences (both through retrofits and whole home heat pump systems) and over 63,000 by 2050. The aggressive electrification scenario (SER1), by comparison, calls for nearly 34,000 combined heat pump retrofits and whole home heat pump systems by 2030 and nearly 92,000 by 2050.

As with the transportation sector, as more buildings are heated with electricity, electricity use will likely increase. The aggressive electrification (SER1), carbon neutral (CEN), and aggressive efficiency (SER2)

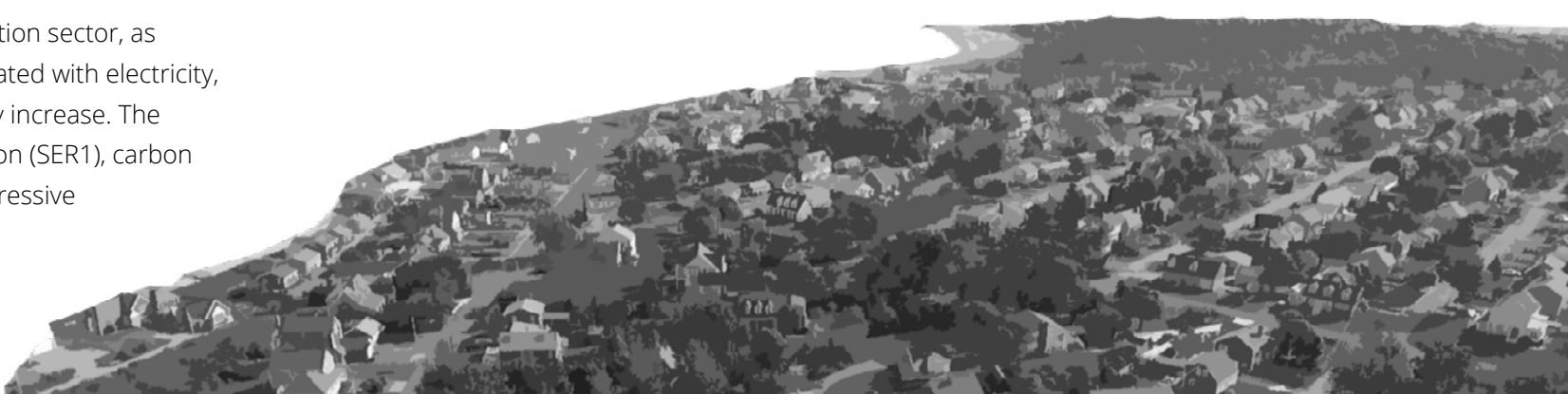
*Even in the SP scenario, there is a significant shift to heat pump systems by 2050, though the SER1 scenario estimates a need for about 30,000 more than the SP scenario for year-round households. These numbers become even larger when considering seasonal residences.*

PERCENT OF ALL HOUSEHOLDS  
WITH HEAT PUMPS UNDER  
EACH SCENARIO



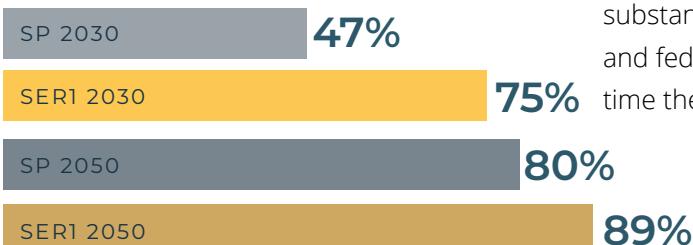
scenarios all project similar electricity use for space heating, with about 0.7 to 0.8 TWh in 2030 and approximately 1.5 to 1.7 TWh in 2050. The increased year-round population (SER3) scenario sees electricity use for space heating reach 0.9 TWh in 2030 and 2.2

TWh in 2050. Due to the increased electricity use in both the transportation and building sectors, cleaner electricity sources will be critical to achieving GHG emissions reductions.



## ELECTRICITY SECTOR

The significant electrification of the transportation and building sectors will result in increased electric load for the region. However, due to anticipated shifts to lower or no emissions electricity sources, the actual emissions from the electric sector for the region are modeled to decrease from 2020 to 2050 in all five scenarios.



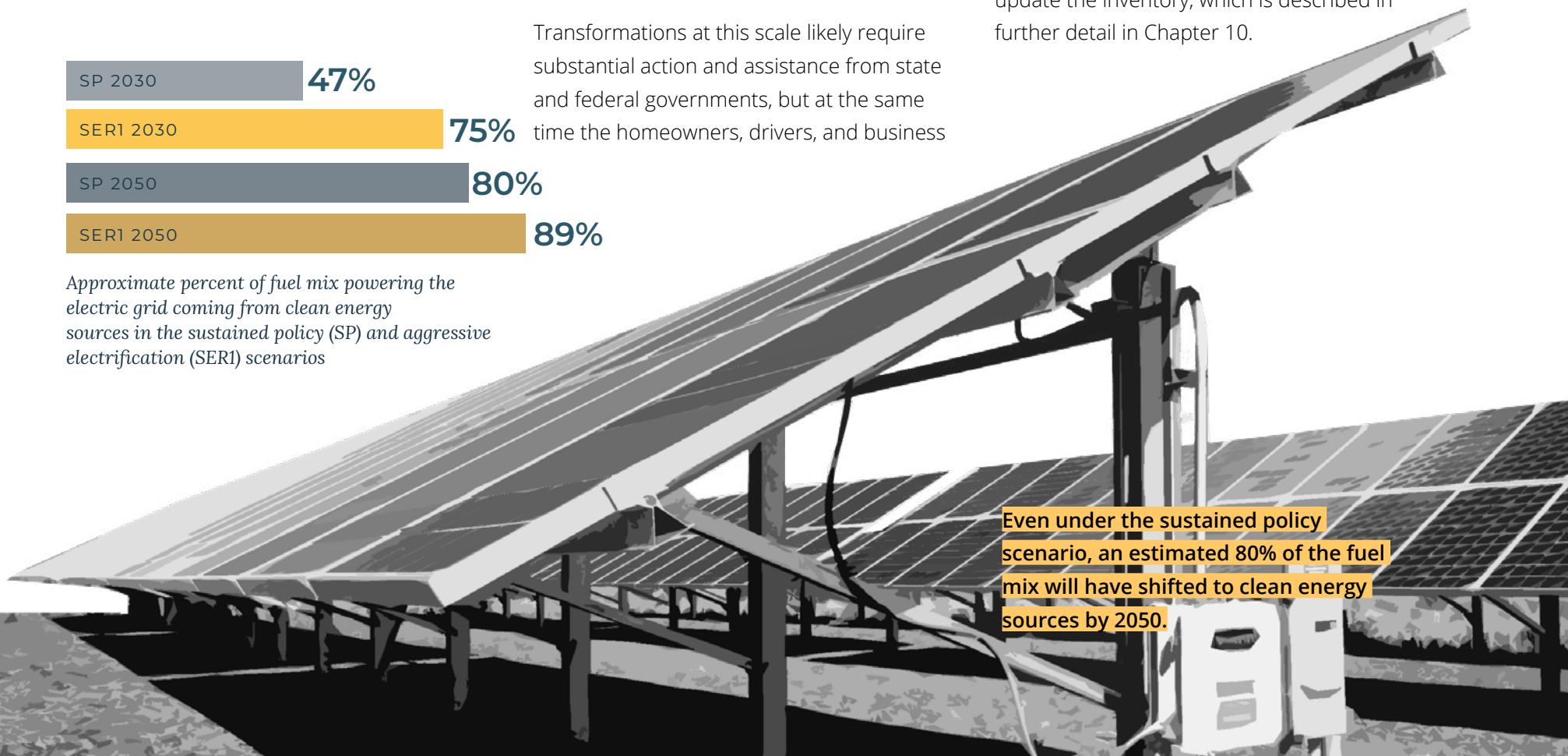
Approximate percent of fuel mix powering the electric grid coming from clean energy sources in the sustained policy (SP) and aggressive electrification (SER1) scenarios

The sustained policy scenario estimates that by 2030, approximately 47% of the fuel mix powering the electric grid will come from clean energy sources; this increases to 80% by 2050. For the aggressive electrification scenario (SER1), the fuel mix consists of 75% clean sources by 2030 and over 89% by 2050.

Transformations at this scale likely require substantial action and assistance from state and federal governments, but at the same time the homeowners, drivers, and business

owners on Cape Cod are the fundamental actors who can decide to choose electric options for their next heating system or vehicle.

To determine if individual, local, and regional actions are impacting the GHG emissions from the region, it will be necessary to update the inventory, which is described in further detail in Chapter 10.



# 5

## Planning for Climate Change on Cape Cod

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The Cape Cod community has been working to address the impacts of climate change for many years. The Cape Cod Commission has led efforts to develop targeted regional plans meant to advance progress around specific issues of interest or concern, including elements that address climate resiliency and mitigation. Other entities have also made significant contributions to address climate-responsible energy use and generation, and mitigate the region's contribution to greenhouse gases. Towns have developed plans to adapt to climate impacts and have worked together at the subregional level to identify paths to greater coastal and climate resiliency. This chapter summarizes climate-related planning that has occurred at the local and regional level.



This chapter summarizes climate-related planning in the region; however, a more comprehensive accounting of the events, plans, and key actors that have shaped the Cape's response to the threat of climate change can be found on the [Climate Change Action Timeline](#).

Most recently, the Barnstable County Assembly of Delegates and Barnstable County Board of Regional Commissioners voted unanimously to adopt a Climate Crisis Declaration that recognizes the human-induced threats posed by climate change and directs county departments to reduce GHG emissions from county operations as soon as technically and economically feasible.



## REGIONAL PLANS AND INITIATIVES

### REGIONAL POLICY PLAN

The Cape Cod Commission is responsible for balancing the protection of the region's resources with appropriate development and economic progress. As the regional planning agency for Cape Cod, the Commission is also responsible for preparing and overseeing the implementation of a regional land use policy plan. The [2018 Cape Cod Regional Policy Plan](#) (RPP) provides a framework for guiding appropriate growth and development to centers of activity, while protecting those unique Cape Cod assets that cannot be replaced. While the 2018 RPP takes a new approach to framing the growth policy, the core principles and resulting goals are consistent with the goals and objectives that have defined the RPP since the Commission's establishment in 1990. Smart growth or sustainable planning principles, including directing growth toward activity centers, promoting walking, biking, and reducing the use of personal vehicles, protecting open space, and encouraging cluster development, are long-standing core RPP policies geared

### A GROWTH POLICY FOR BARNSTABLE COUNTY

Growth should be focused in centers of activity and areas supported by adequate infrastructure and guided away from areas that must be protected for ecological, historical or other reasons. Development should be responsive to context allowing for the restoration, preservation and protection of the Cape's unique resources while promoting economic and community resilience.

toward redirecting the growth patterns of the mid-20th century toward a more efficient use of land and resources. This approach to guiding growth and development is inherently protective of the climate, as it aims to create vibrant community centers of activity where reliance on vehicles is reduced and alternate modes of transportation are prioritized, and where the infrastructure needed to support human activities has a smaller (both physical and carbon) footprint.

The 2018 RPP identified key regional challenges facing the natural, built, and community systems of Cape Cod. Among them, climate change poses significant threats to the region. The RPP recognizes that reducing GHG emissions sooner rather

than later will provide more time to plan for and respond to the effects of climate change on Cape Cod, and that while the problems posed by climate change appear unstoppable, there are actions the Cape Cod community can take to reduce emissions and participate in the effort to slow the rate of change. Cape Cod's response to these threats must consider the region's vulnerabilities, priorities, and opportunities.

The RPP also includes several actions the Commission commits to undertake. Planning actions for climate change response, readiness, and mitigation were established to encourage and engage communities to better understand regional GHG emissions and identify opportunities for mitigation.

These actions include:

- Develop an estimated baseline of GHG emissions for the region;
- Encourage communities to seek Green Communities designation and participate in the Community Rating System;
- Conduct a GIS screening analysis of potential electric vehicle charging station locations; and,
- Conduct a GIS analysis to identify appropriate potential sites for development of utility scale solar photovoltaic arrays or energy storage facilities.

More information on these projects can be found [here](#).

Since adoption of the RPP in January 2019, the Commission has prioritized these climate-related actions to support development of the Climate Action Plan. The GHG emissions inventory is presented in Chapter 4. Based on 2017 data, the Cape Cod inventory provides a baseline by which to measure progress. The two screening analyses – one for [potential electric vehicle charging station locations](#) and one for [more appropriate sites for development of utility scale solar photovoltaic arrays](#) – provide guidance on siting infrastructure targeted at reducing emissions from the highest emitting sectors on Cape Cod (transportation and energy).

The Commission carried forward amendments to the 2018 RPP to incorporate a new Climate Mitigation goal and objectives. The Assembly of Delegates adopted the changes in February 2021. The Cape Cod Commission simultaneously adopted new technical guidance to support the new Climate Mitigation goal, and amended the Energy technical bulletin to reflect additional considerations for net-zero and net-zero-ready buildings.

# REGIONAL POLICY PLAN

## CLIMATE MITIGATION GOAL & OBJECTIVES

**GOAL:** To support, advance and contribute as a region to the Commonwealth's interim and long-term greenhouse gas reduction goals and initiatives, including a state-wide net zero carbon target by 2050.

### OBJECTIVES:

- Promote low or no carbon transportation alternatives and technologies
- Promote low or no carbon technologies for building energy use, including appliances, lighting, and heating, ventilation and cooling (HVAC) systems
- Promote carbon sequestration and other emissions removal practices and technologies as appropriate to context
- Promote low or no carbon energy generation technologies as appropriate to context

## COASTAL RESILIENCY GOAL & OBJECTIVES

**GOAL:** To prevent or minimize human suffering and loss of life and property or environmental damage resulting from storms, flooding, erosion, and relative sea level rise, including but not limited to that associated with climate change.

### OBJECTIVES:

- Minimize development in the floodplain
- Plan for sea level rise, erosion, and floods
- Reduce vulnerability of built environment to coastal hazards



## REGIONAL TRANSPORTATION PLAN

The Regional Transportation Plan, a long-range comprehensive plan, is the primary means by which federal and state funds are allocated for Cape Cod's transportation needs. The [Cape Cod 2020 Regional Transportation Plan](#) presents a regional vision and sets funding priorities to guide transportation investments that support the

long-term vitality of the region. Consistent with federal legislation, this plan is built on a performance-based planning approach with a vision statement, goals, objectives, performance measures and targets, strategies, and policies.

One of the goals of this plan is to maintain, protect, and enhance the natural environment while strengthening the

economy. It identifies climate change challenges and environmental protection opportunities for Cape Cod, and aims to prepare the region for the impacts of climate change through a focus on adaptation, sustainability, mitigation and energy sources, and ensure that transportation projects provide environmental benefits, including GHG emissions reductions.

**For the first time, the 2020 Regional Transportation Plan recommends dedicated funding for climate change mitigation and adaptation**



This approach to climate change is based on Federal Highway Administration policies, defined by a vision for improved coastal resiliency, and includes:

- Adaptation – Preparing for the impacts of global climate change on the nation's transportation infrastructure and systems;
- Sustainability – Ensuring that balanced choices are made among environmental, economic, and social values that will benefit current and future road users;
- Mitigation – Identifying strategies that reduce GHG emissions from transportation sources; and,
- Energy – Promoting the use of alternative and renewable fuels, and vehicle technologies to reduce oil dependence, vehicle pollution and energy use.

Livability, climate change resiliency, and scenario planning are important planning concepts that are incorporated directly into the Regional Transportation Plan. For the first time, the 2020 plan recommends dedicated funding for climate change mitigation and adaptation.

## COMPREHENSIVE REGIONAL TRANSIT PLAN

As recommended for all regional transit authorities by the Commonwealth's 2019 Task Force on Regional Transit Authority Performance and Funding, the Cape Cod Regional Transit Authority (CCRTA) participated in the development of a [Comprehensive Regional Transit Plan](#). This plan will guide the CCRTA as it seeks to provide service that meets the current and future mobility needs of the region.

The plan includes recommendations for service enhancements that could increase the geographic reach, frequency, and convenience of transit service on Cape Cod. The plan also directly addresses environmental stewardship with a commitment to help as many riders as possible reduce their carbon footprint and to consider lower emission technologies across its fleet and facilities.



## COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY

The [Comprehensive Economic Development Strategy](#) (CEDS) is an economic development plan consistent with the growth policy and goals of the Regional Policy Plan and includes a comprehensive summary of the region's economy. With this plan, Cape Cod retains its designation as an [Economic Development District](#) and is eligible for US Economic Development Administration funding to build infrastructure, support planning and technical assistance, and establish revolving loan funds. The CEDS is developed

with a broadly representative stakeholder group, identifying regional strengths and weaknesses as well as opportunities and challenges. It outlines a five-year action plan and a framework for evaluating progress on plan implementation.

The action plan lays out specific regional priority projects and initiatives, including a Climate Change Innovation Initiative, which looks to: "Continue efforts to mitigate climate change and address its potential impacts, including planning to move the region away from fossil fuels, encourage renewable energy, electrify transportation, ensure protection of the region's natural resources

and natural carbon sinks, and identify and promote public and private opportunities for climate change mitigation and adaptation on a local and/or regional scale."

Regional partners identified climate change mitigation and adaptation planning, supporting a resilient utilities coalition, establishing a regional economic resiliency information clearinghouse, and coordinating an Obstacles to Opportunities challenge as potential projects and actions to support climate change innovation.

**The 2019 CEDS action plan lays out specific regional priority projects and initiatives, including a Climate Change Innovation Initiative.**



## MASSACHUSETTS JOINT STATEWIDE ELECTRIC AND GAS THREE-YEAR ENERGY EFFICIENCY PLAN

The twenty-one towns of Cape Cod and Martha's Vineyard formed the Cape Light Compact JPE to locally administer energy efficiency programs. The Cape Light Compact, as a sponsor of the Mass Save® initiatives, is working on the Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan for 2022-24 in collaboration with the electric and natural gas utilities across the Commonwealth. Per statute, the Plan is developed in coordination with the Massachusetts Energy Efficiency Advisory Council and approved by the Department of Public Utilities. The Plan enables the Cape Light Compact to provide energy efficiency and demand response programs to residents and businesses on the Cape and Vineyard. For more information, please visit [ma-eeac.org/plans-updates](http://ma-eeac.org/plans-updates).

## PATHWAYS TO NET ZERO

The Cape Cod Climate Change Collaborative issued the Pathways to Net Zero call to action in 2019, following the second annual Net Zero Climate conference on Cape Cod. The Pathways to Net Zero is a compilation of actions that individuals, governments, and businesses can take to reduce GHG emissions, and move the region toward net zero carbon. Many of these actions were incorporated into the actions and steps that formed the stakeholder discussions for this Climate Action Plan.

## CAPE COD OCEAN MANAGEMENT PLAN

The 2011 Cape Cod Ocean Management Plan (CCOMP) provides guidance on the use and protection of Cape Cod's ocean resources, coordinating regional interests and goals with the Commonwealth's Ocean Management Plan. Revisions to the Massachusetts Ocean Sanctuaries Act in 2008 allowed for certain limited new activities, including sand and gravel mining, cable and pipeline installation, and installation of community wind turbines

in state waters. The CCOMP establishes policy and provides technical support for review of the development activities allowed in the state's ocean waters. The CCOMP resulted from a months-long region-wide planning process that engaged local officials and technical experts to ensure that local interests in resource protection, including viewsheds, are incorporated into the planning of ocean development.

As a CCOMP action item, the Cape Cod Commission carried forward changes to the Regional Policy Plan to incorporate performance standards for regulatory review of ocean-based development. The Assembly of Delegates adopted the recommended amendments in 2012, creating a new marine resources section of the RPP to address sand and gravel mining and cable and pipeline installations. A future action item calls for incorporating regulatory standards for offshore renewable energy development within state ocean waters.

## RESILIENT CAPE COD PROJECT

In 2016 the Commission received a National Oceanic and Atmospheric Administration (NOAA) grant to explore the Cape's vision and values for the future of the Cape Cod shoreline. The [Resilient Cape Cod Project](#) was a three-year effort to investigate the environmental and socio-economic effects of local and regional coastal resiliency strategies. Resilient Cape Cod brought stakeholders from across the region together to discuss the coastal climate threats that the Cape faces, and to identify possible strategies to address the effects of erosion, storm surge, and sea level rise. The grant allowed the Commission to analyze the ecosystem services that coastal resources provide to the region and to compile a database of strategies that may help property owners adapt to the changing coastline and coastal threats. These analyses and products were used to inform the development of a map-based decision-support tool, the Cape Cod Coastal Planner.

The [Cape Cod Coastal Planner](#) was built by the Commission and its partners to help

residents and decision makers understand the relative environmental and socio-economic effects of implementing adaptation strategies to address sea level rise, storm surge, and erosion. The tool integrates research on potential adaptation strategies for Cape Cod communities and how ecosystem services are impacted by hazards and strategy selection.

The Cape Cod Coastal Planner helps to communicate the impacts of coastal threats and adaptation strategies, including costs and benefits, and the need for action in a GIS-based tool that allows for user interaction. The Coastal Planner educates users on the climate change hazards impacting Cape Cod's coastline, the adaptation strategies available to address them, and implications for local infrastructure and delivery of ecosystem services. It relies heavily on up-to-date and complex data sets to inform outputs, such as aerial photography and planimetrics, in addition to hazard projections that rely on LiDAR data. To continue to provide the best available information through the Coastal Planner and other decision-support tools, it is critical

that these types of data sets are updated regularly.

The tool includes a database of information on 41 strategies to increase resiliency on Cape Cod, including nature-based solutions, structural solutions, and policy approaches, which were researched and classified based on their ability to protect against, accommodate, or retreat from the impacts of erosion, storm surge, and sea level rise. Fact sheets are also available on individual strategies. The value of Cape Cod's ecosystems, the influence of adaptation strategies on these ecosystems, and the impact of ecosystem services on property values in the region were considered and incorporated into the tool.

### Recommendation

Maintain regionally consistent aerial photography, planimetrics, and LiDAR data in a regional, accessible database



## RESILIENT CAPE COD PROJECT ADAPTATION STRATEGIES MATRIX

The Adaptation Strategies Matrix presents actions that can be taken to protect an area from coastal hazards like sea level rise, storm surge, and erosion. The matrix organizes information on the spectrum of resiliency strategies available, including where they may be used, and advantages and disadvantages of each action. The strategies range from taking "no action" to "green" or policy-based options, to "gray" engineering structure options. The information is presented in multiple formats, including educational fact sheets and integration with the Coastal Planner for scenario planning.



DO  
NOTHING

G

BEACH  
NOURISHMENT

OFFSHORE  
REEFS

COASTAL  
ARMORING

### STRATEGIES

The database includes 41 strategies, categorized based on their ability to protect against, accommodate, or retreat from the impacts of erosion, storm surge, and sea level rise.



STRATEGIES



PROTECT



ACCOMMODATE



RETREAT

## MODEL BYLAW DEVELOPMENT

Recognizing a need identified through many communities' Municipal Vulnerability Preparedness planning, Commission staff sought and received funding through the Massachusetts Executive Office of Energy and Environmental Affairs Planning Assistance Grant Program to develop a model bylaw to better address coastal development in hazard areas. Working with four partner towns and a team led by the Urban Harbors Institute, the Commission developed model regulations to help communities regulate development and redevelopment in flood plains and areas of high coastal erosion. A model regulation should be available by summer 2021.

Simultaneously, the Cape Cod Cooperative Extension/WHOI Sea Grant has been working to develop a model zoning bylaw that addresses development in the floodplain. If adopted, the bylaw will maintain a town's standing in the Community Rating System (CRS), a federal program to help communities reduce flood insurance rates through the National Flood Insurance Program. Barnstable County's CRS coordinator is currently working with Cape communities to adopt this new bylaw.

Further work is needed to develop model bylaws in support of local implementation of the Climate Action Plan. Development of a model bylaw for siting large and small scale solar projects will provide guidance for communities as they seek to

## Recommendations

Develop a model bylaw for siting large and small scale solar projects that considers opportunities to encourage co-location on built or disturbed sites, and discourages greenfield development

Develop a model bylaw for energy efficiency to encourage or require energy assessments, among other best practices

enhance renewable energy opportunities in appropriate areas. A model bylaw that includes options for increasing energy efficiency in buildings will provide an additional resource for communities as they seek to address GHG emissions from the energy sector.



## DESIGN GUIDELINES

Commission staff is working to create design guidelines for development located in the floodplain. The design guidelines will help property owners and permitting bodies better understand how they can support the evolution and development of resilient structures within the floodplain as property owners look to protect their developments through fortification, elevation, or relocation of their buildings and structures in a way that complements the iconic Cape character.

### Recommendation

Develop design guidelines for solar projects to encourage solar projects to develop in a way that complements an area's historic and community character, while also addressing concerns over energy use and its impact on the region's GHG emissions

Additional guidance should be developed relative to development of solar projects. Renewable energy projects are sometimes at odds with concerns over historic and other culturally significant resources. Design guidelines regarding development of solar projects in a way that complements an area's historic and community character can provide guidance on the development process, as well as the review process.

## STORM TIDE PATHWAYS

Storm tide pathways are low-lying locations determined by GIS analysis and fieldwork to be the path of least resistance for the flow of elevated water levels during coastal storm events into developed and vulnerable areas. The Center for Coastal Studies has been working to identify these pathways for several years, and is the only entity conducting this analysis. In partnership with the Commission and the Cape Cod Cooperative Extension, they have identified pathways in the coastal

### Recommendation

Complete the stormtide pathways analysis for the remaining segments of Nantucket Sound and the Buzzards Bay shoreline

villages along the entire Cape Cod Bay shoreline, and are now working to map the storm tide pathways along sections of Nantucket Sound, including those located in the towns of Barnstable, Yarmouth, Dennis, Harwich and Chatham. Storm tide pathways are mapped from the highest high tide of the year to four feet above the storm of record. These analyses are critical to future planning and funding should be secured to analyze the remaining segments of Nantucket Sound and the Buzzards Bay shoreline.

## LOCAL PLANNING

### MULTI-HAZARD MITIGATION PLANNING

The Federal Emergency Management Agency (FEMA) promotes and supports the development of local hazard mitigation plans to help communities consider and prepare for natural hazards that they may face.

Once certified by FEMA, a local Multi-Hazard Mitigation (MHM) Plan makes a community eligible for federal funding to implement risk-reduction and preparation actions identified in the plan. The Commission has assisted nearly all Cape Cod communities with developing or updating their local MHM Plans. Since 2014, Commission staff has worked with 11 towns to complete new or updated plans, and will continue to provide this assistance as towns look to update and maintain their plans.

### MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

In 2017, the Massachusetts Executive Office of Energy and Environmental Affairs created the Municipal Vulnerability Preparedness

(MVP) program to provide support for cities and towns to plan for climate resiliency and to implement priority projects identified during the planning process. With funding from the state, towns work through a public process with certified MVP providers to complete vulnerability assessments and develop action-oriented resiliency plans. Communities that complete this climate resiliency planning process are then designated an MVP community and are eligible for state MVP Action Grant funding to implement priority projects identified during the planning process.

All towns on the Cape are designated MVP communities and some have on-going or completed projects that received Action Grant funding. The governor has signaled a commitment to supporting the MVP program; Cape communities should work to keep their MVP plans current in order to remain eligible for MVP Action Grant funds, or for Coastal Resiliency Grant funding administered by Massachusetts Coastal Zone Management (CZM). The Commission is prepared to assist communities as they update their plans or seek funding for climate resiliency projects.

### Recommendation

Communities should continue to pursue MVP Action Grants, and the County, Cape Cod Commission, and others should support communities in this effort

### OUTER CAPE INTERMUNICIPAL SHORELINE FRAMEWORK

The towns of Eastham, Wellfleet, Truro, and Provincetown have recently formalized their longstanding informal coordination around coastal resiliency issues into a project to better manage coastal resources shared by and connecting their communities. Phase 1 of the Outer Cape Intermunicipal Shoreline Framework, funded through a grant from Massachusetts Coastal Zone Management focused on collecting data on coastal resources and infrastructure and compiling the information into a map-based tool that helps illustrate the interconnectedness of the Outer Cape shoreline and informs management decisions. Phase 2, underway in 2020-2021, will help to identify a framework



to improve coastal resource management along the shoreline, and ensure better coordination across town boundaries.

## ENERGY AND CLIMATE ACTION COMMITTEES

Many of the Cape communities have established Energy Committees who work to advance energy efficiency programs, renewable energy projects, and other activities that support the reduction of fossil fuel use. Most of these committees have been advocates for the Green Communities Program, establishing zoning for solar projects and adopting the stretch building code. A few committees have helped to install EV charging stations in their towns, and others are interested in doing so. Nine towns have completed solar installations on town landfills or other municipal properties, and other towns have projects in progress or are interested in developing municipal solar. Most are interested in pursuing battery storage projects. Communities are working with Cape and Vineyard Electric Cooperative on these renewable energy projects.

More recently, a few towns have established Climate Action Committees, either in combination with the energy committee or as a separate group. These groups are developing their agendas and workplans, but are focusing on climate awareness and education, working on local climate policies, and developing local GHG inventories, among other activities. They may collaborate with the grass roots Climate Action Networks (advocacy groups), which have been established in most of the Cape communities.

## COASTAL RESILIENCE COMMITTEES

Some Cape communities have established coastal committees to assist with planning, community engagement, and priority setting around coastal management issues. These committees have assisted with MVP planning, with climate change vulnerability assessments, supported targeted planning efforts to address specific use or access concerns, sought grant funding for coastal resiliency projects, and have authored

strategic resiliency plans for their towns. For example, the Falmouth Board of Selectmen, recognizing that Falmouth's coastline was vulnerable to multiple climate threats, established the Coastal Resilience Action Committee and charged them with identifying actions the town might take to improve resiliency. In 2014, the Town of Brewster established the Coastal Committee, later pausing that group to convene the Brewster Coastal Advisory Group to work on building consensus among a large and diverse group of stakeholders on a coastal adaptation strategy for the town. Provincetown established a coastal resiliency advisory committee in 2020 to help consider strategies for managing coastal hazards. Cape communities are taking different approaches to managing coastal development, but all are wrestling with how to balance development pressures with resource protection and climate hazards.

The above plans and initiatives are a partial accounting of the efforts that governments and organizations have taken in recent years to address the causes and effects of climate change on Cape Cod. As the Cape community works to implement this Climate Action Plan, effort and focus is needed to identify the organizational and

individual actors that are working to make a difference, and to foster connections and partnerships among those groups to enhance and launch implementation actions. Additionally, engaging organizations that may not traditionally include climate action in their mission, but who are open to folding relevant actions into their work, will provide

an opportunity to leverage those groups' existing networks to better understand and reflect a diversity of opinions and ideas, as well as expand the impact of climate plan implementation into the broader community.

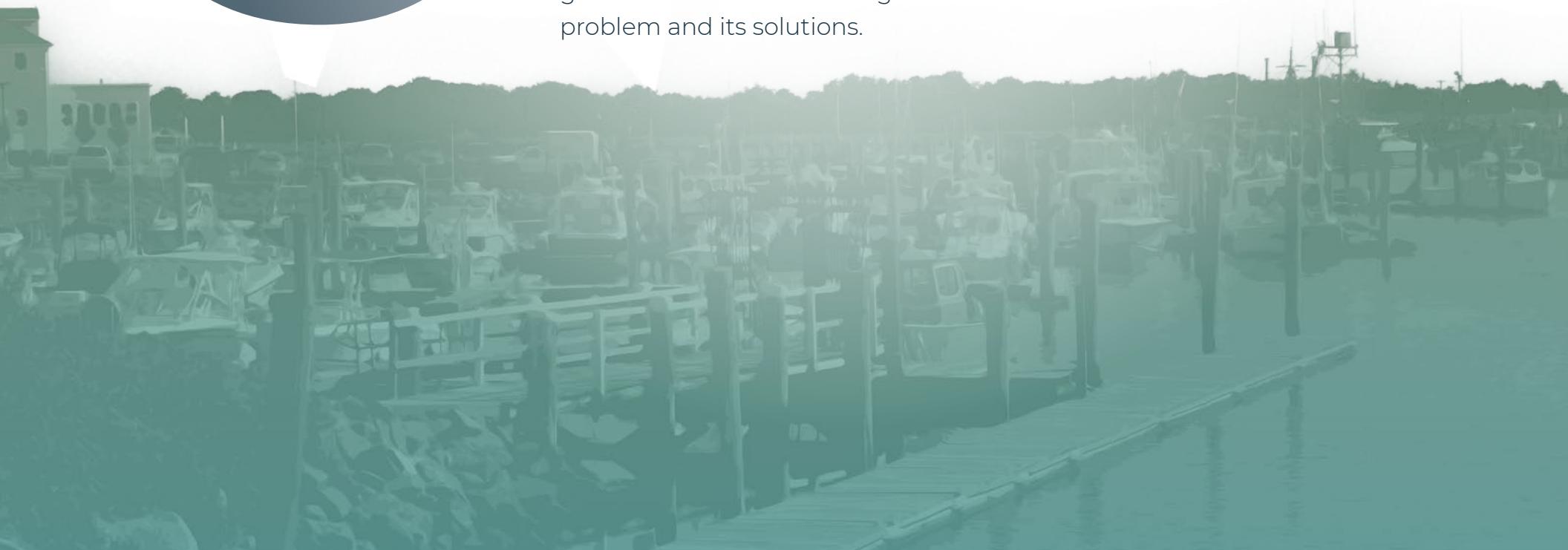


# 6

## Community Engagement

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How we mitigate greenhouse gas (GHG) emissions and adapt to the impacts of climate change requires broad participation from stakeholders and residents. The actions we take as communities and as a region will greatly impact Cape Cod residents and must be considered in relation to other regional challenges and priorities. In order to develop an effective climate action plan, it is necessary to include broad stakeholder engagement in the planning and implementation process, as well as gain a better understanding of residents' views and attitudes toward the problem and its solutions.





Cape Cod residents are concerned about climate change; 79% of respondents to a Cape-wide survey on climate change identified that they believe climate change will impact the well-being of themselves and their family.

Cape Cod residents recognize the region's vulnerabilities, and the potential for further impacts in the future. A [survey of Cape Cod residents](#) (Appendix E) conducted by the University of Massachusetts (UMass) Donahue Institute and the Center for Public Opinion at UMass Lowell found that most residents believe that, left unaddressed,

climate change will lead to moderate or serious problems for Cape Cod in the coming years, particularly 30-80 years out into the future. The region's younger population feels the most strongly about the potential severity and ramifications of climate change in the coming years.

Residents identified a number of barriers to taking action and addressing climate change in the region, including difficulty in changing behavioral habits and lack of government support, which were identified as the most significant barriers, as well as the cost of action and lack of education and public information on the issue. Lack of coordination between government and other actors, such as the business community, was cited as another barrier – one that older residents cited more frequently than younger residents.

Climate change is a challenge of such significance for the region that it warrants a dedicated process to develop a region-wide, stakeholder-driven strategy for mitigating its causes and increasing resilience to the impacts faced today, and those projected for the future. In recognition of the region-wide effort necessary to tackle this challenge, the Cape Cod Commission launched the Cape Cod Climate Initiative in the Fall of 2019.

The Climate Initiative—a collaborative process to develop a strategic framework to address the region's contributions to and threats from climate change—was informed by a series of recommendations from the 2018 Regional Policy Plan, including development of a baseline GHG emissions inventory for the region, and structured in response to broad community input.



## CAPE COD CITIZEN SURVEY

### SURVEY SECTIONS

The survey was organized into four main sections.

#### Demographics and Background

#### Climate Change Awareness

#### Climate Action

#### Climate Action Strategy

**719**  
**TOTAL SURVEYS  
COMPLETED**

The UMass Donahue Institute distributed 17,000 postcards to randomly selected households in a “push to web” survey format. The 719 completed responses resulted from 596 households completing the web survey, and 123 respondents collected through a convenience sample panel purchased through Qualtrics. The data were weighted to be representative of Barnstable County by gender, age, and education, with a margin of error of five percent.

The Cape Cod Commission worked with the UMass Donahue Institute and the Center for Public Opinion at UMass Lowell to develop and administer a Climate Action Plan Survey of Barnstable County residents ([Appendix E](#)). This survey

was designed to understand Cape Cod residents’ views on climate change, its impact on the region, and potential policy interventions. A total of 719 surveys were completed between November 27, 2020 and January 11, 2021.

### AGE OF RESPONDENTS



## CLIMATE CHANGE AWARENESS



**70%**

think climate change is somewhat or very important as a public policy issue



**75%**

say climate change will cause serious problems for the Cape within the next 80 years



**80%**

indicate a strong understanding of the causes of climate change and its impacts



Most residents believe unaddressed climate change will lead to moderate or serious problems for Cape Cod in coming years, particularly 30 to 80 years out into the future.



Younger respondents (18-34) tended to see climate change as a more important public policy issue than older residents.



**79%**

believed that the changing climate would impact their family's well-being, but were less concerned about climate change's impact on their livelihoods



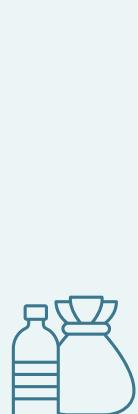


## CLIMATE ACTION



77%

somewhat or strongly agree that human behavior plays an important part in climate change.



73%



60%



15%

### TOP ACTIONS TAKEN TO MITIGATE CLIMATE CHANGE

Respondents indicated that reducing waste and reducing electricity/natural gas consumption were the top two actions already being taken (73% and 60%); 15% currently drive an EV or hybrid vehicle.

### TOP 5 BARRIERS TO ADDRESSING CLIMATE CHANGE

Difficulty in changing behavior

69%

Lack of governmental support

57%

Cost of taking action

56%

Lack of public information and education

55%

Lack of business or industry support

52%

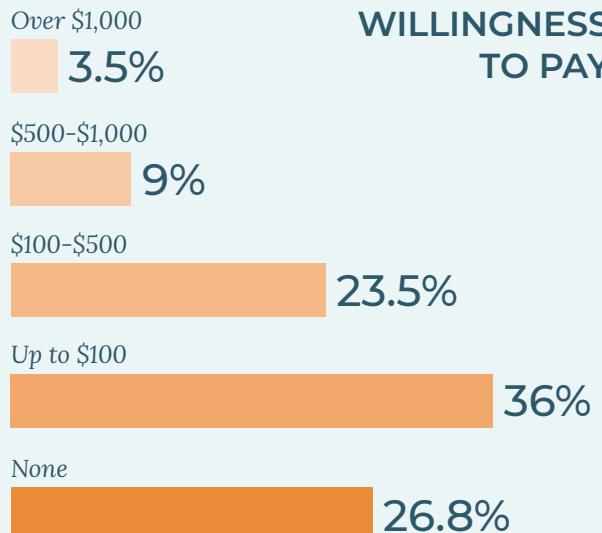
## CLIMATE ACTION STRATEGY



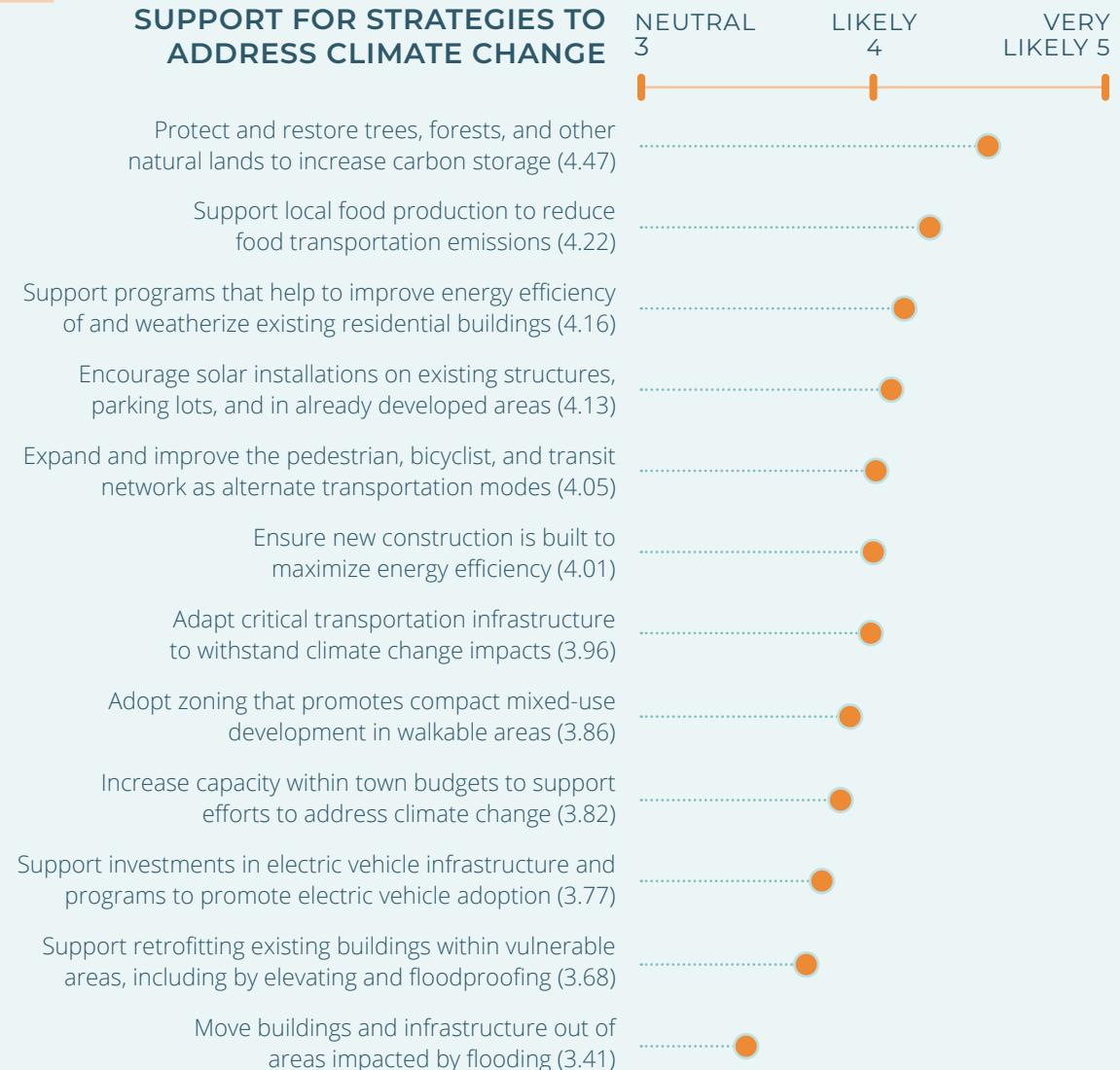
agree or strongly agree with the statement  
“I am willing to change my behavior to mitigate the impacts of climate change.”



are willing to pay between \$1 to \$500 annually, to help invest in climate mitigation programs



### SUPPORT FOR STRATEGIES TO ADDRESS CLIMATE CHANGE



Respondents supported natural resources protection and restoration along with clean energy strategies more than more disruptive strategies such as moving and retrofitting existing buildings and infrastructure from areas vulnerable to flooding.



FALL 2019

WINTER 2020

FALL 2020

WINTER 2021

# Launching the Climate Initiative



## COMMUNITY MEETINGS

In the Fall of 2019, participants in a series of facilitated subregional community meetings provided input on planning priorities, concerns, and barriers to moving climate adaptation and mitigation actions forward on Cape Cod. The community meetings were also an opportunity to share current, past, and anticipated climate-related initiatives on Cape Cod, in order to clarify the context of the Climate Initiative and better understand opportunities for local and regional action to

### Locations



200+

alleviate barriers or lend support to efforts already underway.

### BARRIERS AND CHALLENGES

Through the community meetings, stakeholders offered thoughts on the biggest barriers and challenges to making real progress on climate mitigation and adaptation on Cape Cod. They shared ideas for overcoming challenges and discussed ways in which a collaborative process might help to alleviate barriers at the local and regional scale.

Several common themes emerged, including:

- inadequate information and education, coupled with the fact that many methods for reducing GHG emissions require personal changes to behavior;
- lack of municipal capacity and resources to dedicate to climate-related issues;
- quantity of private and public infrastructure at risk;
- heavy reliance on personal vehicles, with limited public transportation options;
- costs associated with adaptation and mitigation actions and the need to better understand their fiscal and economic impacts; and
- the need for more unified and coordinated efforts to advocate for action.



200+ Community Participants offered feedback to establish a strategic framework and collaborative approach that helped shape this plan

Participants suggested that providing data and information that reflects the magnitude of the challenge in a format easily understood by the general public, and developing communications strategies for the variety of stakeholders that need to better understand climate change issues and potential solutions is key to addressing barriers associated with implementation of climate actions.

## OPPORTUNITIES

Stakeholders were asked to consider how a regional effort could leverage and coordinate with activities already underway. They were also asked to offer thoughts on the greatest opportunities for local and regional impact.

Opportunities for education and engagement were identified in each of the subregional meetings. Participants noted that youth interest in climate change presented an opportunity to engage students in climate-related planning and implementation of actions. They identified the range of data and information available on climate change and its impacts, and opportunities

## CLIMATE COMMUNICATIONS FRAMEWORK

Stakeholders throughout the Climate Initiative and Climate Action Plan development process identified the need for better information and uniform communications on climate change and actions to mitigate its causes and adapt to its impacts. To fill this gap, Commission staff produced a Climate Communications Framework with input from stakeholders. The framework will help communicators and educators raise broad awareness of community and individual responsibilities related to Cape Cod's changing climate, integrating equity into implementation and increasing engagement on climate issues.



at the state level to fund collection of additional information. They also noted that when sharing information on various mitigation and adaptation actions, there is an opportunity to identify co-benefits that may be unrelated to climate change, but important to an individual's financial outlook or personal values.

Several other themes emerged, including opportunities to:

- engage experts from local institutions studying climate change and potential solutions;
- apply tools and technologies available to predict flooding and inundation pathways to protect existing infrastructure and minimize development in flood-prone areas;
- support adoption of the stretch code in those communities that are not yet a designated Green Community;



- promote green jobs and become a leader in new technologies related to resilient coastal construction and renewable energy;
- work with partner organizations to expand public transit and increase access to electric vehicles, especially as it relates to transportation for tourism; and
- protect and enhance natural resources capable of absorbing carbon.

Many participants identified development of a regional, collaborative process as a critical step toward convening those individuals and organizations necessary to make progress in the identified areas of opportunity.

## PROCESS AND OUTCOMES

Finally, stakeholders were asked to look forward, and to share where they would like to see the Cape on climate-related issues in the next several years. They were asked to share what the region would have accomplished together, and how the Climate Initiative should engage the range of actors and stakeholders to maximize meaningful impacts to achieve those forward-looking visions.

Across the subregions, participants identified that they would like to see Cape Cod as a recognized leader on climate action, with

Cape Cod communities working together to reduce GHG emissions and adapt to climate hazards. They noted that the region would have a clear understanding of the economic impacts of climate change, including the impact of no action, and the economic considerations necessary for sound decision-making. Participants indicated that a variety of communications strategies should be in place to increase transparency and broaden education. The region should be speaking with one voice on the topic of climate change, clearly articulating needs and a shared vision for becoming a more climate resilient region.



To achieve the broad visions identified by participants, they indicated that a regional, collaborative process must include elements, such as:

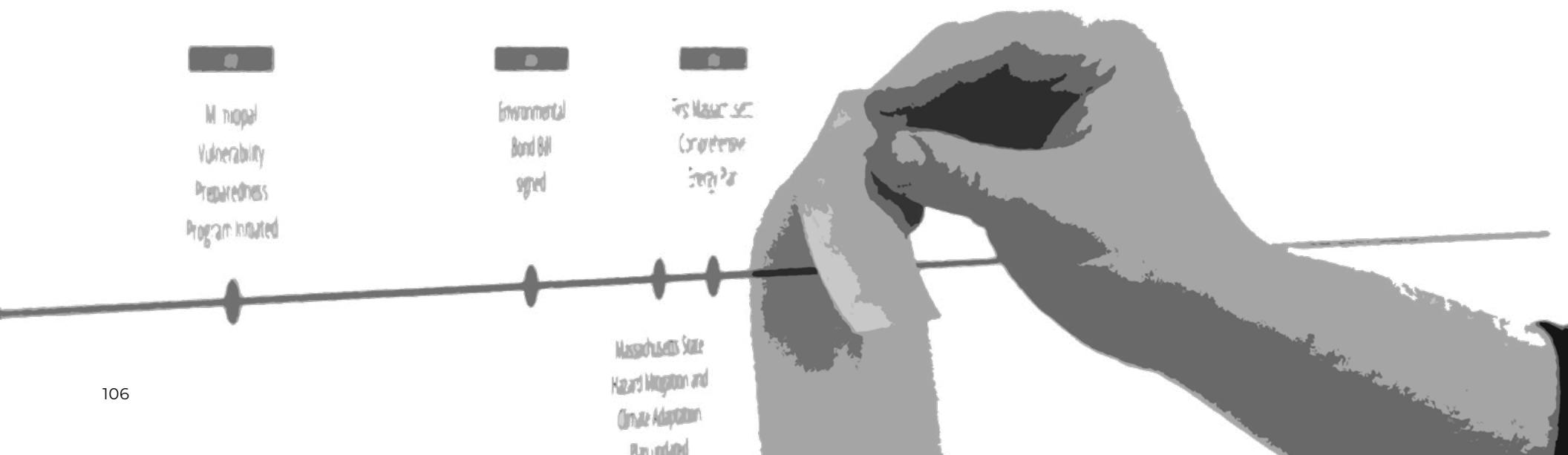
- active engagement of all 15 Cape Cod towns and a wide range of stakeholders, including those that provide services related to transportation, energy, and housing;
- opportunities for youth engagement;
- lessons learned and best practices from climate action planning efforts in other areas;

- lessons learned and strategies for collaboration from other regional planning processes on Cape Cod;
- collection of data on the costs and benefits of climate mitigation and adaptation actions, and other information to support decision-making; and
- development of communications strategies, including traditional methods, social media, podcasts, and others, to increase broad education and awareness.

The subregional community meetings also resulted in a timeline of local and regional actions that allow for a better understanding of the evolution of Cape Cod's response

to climate change. Placed in the context of state and federal actions, this timeline helps to support identification and development of future actions, and opportunities for communities to learn from one another.

The input received in the subregional community meetings was used to develop and refine questions for focus group discussions held early in 2020, and to help inform the structure of the collaborative process to develop the Climate Action Plan.





## TIMELINE OF CLIMATE ACTIONS

The [Climate Change Action Timeline](#) is a compilation of organizations, reports, and events that have helped shape and advance the recognition and understanding of the causes and effects of climate change, and action taken to mitigate and adapt to its impacts. The timeline is intended to document local and regional efforts on this issue, and to be a tool for access to resources and information. The timeline is a living document, compiled with the input of over 200 regional stakeholders through the Climate Initiative Community Meetings.



# Launching the Climate Initiative



## FOCUS GROUPS

Following the subregional community meetings, five focus groups were convened to have more in depth discussions on some of the issues raised. The five focus groups included town energy committees, environmental groups, municipal staff, the Cape Cod Chamber of Commerce, and young professionals and educators. Several themes came out of these meetings, including:

**Communications:** The importance of communication and outreach about the realities of climate change on Cape Cod. Participants emphasized that efforts are needed to reach the broader Cape Cod community, including youth and summer residents and visitors, and to make climate change threats tangible with customized messaging.

5

### Focus Groups

Following the community meetings, five focus groups were convened to have more in depth discussions on some of the issues raised.

**Education:** The need for, and importance of, education and science literacy around climate change, taking advantage of local scientific expertise to craft messages supported by data and information.

**Regional Action:** The need to tackle the climate change challenge regionally. Participants noted that, through the leadership of the Cape Cod Commission, and by towns working together, tools and resources can be developed to support decision-making. They also noted that the collection and compilation of data at the regional scale is critical, with the ability to break data down to smaller scales (town-specific presentation of data, for example), as appropriate and available. Participants also discussed the ability of the Cape Cod Commission to convene stakeholders and improve collaboration and consistency as

YOUNG PROFESSIONALS AND EDUCATORS

MUNICIPAL STAFF

ENVIRONMENTAL GROUPS

TOWN ENERGY COMMITTEES

SUSTAINABLE ECONOMIC DEVELOPMENT PILLAR

communities work together to address shared problems.

**Funding:** The need to identify and pursue funding opportunities. Participants emphasized that municipalities and others are motivated by funding, but capacity is needed to pursue appropriate funding sources.

**Prioritization:** The importance of prioritizing action. Participants discussed that the Climate Initiative is an opportunity to prioritize climate action in a way that individual towns may have trouble doing, given the priorities that often take precedence at the local level.

In addition to these broad themes, detailed ideas contributed to the development of the strategies and actions reflected in Chapter 7.

# Stakeholder- Driven Planning



## STAKEHOLDER GROUPS

The stakeholder process held during Fall 2019 and Winter 2020 illustrated the deep concern and interest in finding solutions to the Cape's climate challenges, and also highlighted the breadth of the problem. The feedback and input from these initial stakeholder meetings informed development of a detailed climate action planning process, launched in the Summer of 2020. While initiated during another global challenge – the COVID-19 pandemic – the stakeholder process was adapted to take advantage of new tools and resources for collaboration in a virtual environment.

Working with the Consensus Building Institute (CBI), the Commission developed an approach to the process that strived to engage a broad cross section of interests

from the Cape community. Representatives of public and private interests, advocates for climate change action and advocates for housing, economic growth, and other regional priorities, local elected and appointed officials, town staff, youth, and others were engaged throughout the planning process. A months-

long discussion about the challenges and opportunities in addressing climate change, as well as the actions and actors that may contribute to both mitigation and adaptation, helped to refine an action plan that reflects the unique lenses through which stakeholders provided feedback and input.

### COVID-19 IMPACTS

Due to the COVID-19 pandemic, public outreach and engagement for the Climate Action Planning process took place virtually in the fall of 2020 and winter of 2021. While this shift to an online platform was not without its drawbacks, it was a proving ground for effective virtual community engagement. Virtual community engagement and remote work reduces the need for individuals to travel by car and can play a role in reducing regional greenhouse gas emissions today and into the future. However, lack of access to technology and/or connectivity is an aspect of virtual participation that must continue to be addressed.

31

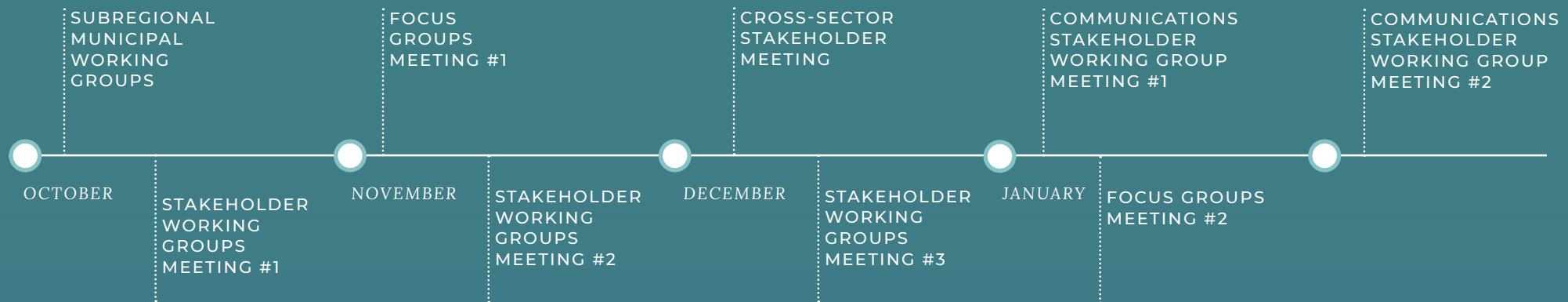
Stakeholder & Focus Group Meetings held between October 2020 and February 2021

266

Participants engaged throughout the process

# Stakeholder Meeting Timeline

FALL 2020 - WINTER 2021



In response to the COVID-19 pandemic, stakeholder meetings were conducted virtually. The meeting format was enhanced with the use of online collaboration tools, detailed presentations, and virtual breakout rooms that provided opportunity for participant conversation and feedback.



FALL 2019

WINTER 2020

FALL 2020

WINTER 2021

OCTOBER 2020



## SUBREGIONAL MUNICIPAL WORKING GROUPS

Recognizing that municipalities have been at the forefront of managing local climate-related impacts, and that many are taking action to reduce GHG emissions from energy use and other sectors, particularly as they seek Green Communities designation, the Commission held subregional meetings with municipal staff, elected officials, and appointed committee members in October 2020. While the meetings provided an opportunity to introduce the Climate Action Plan process to critical municipal partners, the majority of the meetings focused on better understanding current municipal priorities, barriers and needs, and opportunities for regional, subregional, and local action.

15 Meetings with key town staff and local committee members

### Reported Barriers to Addressing Priority Actions

FUNDING AND FUNDING SOURCES

STAFFING CAPACITY

PUBLIC EDUCATION/AWARENESS

TOWN/PRIVATE PROPERTY RELATIONSHIP

REGULATORY/BYLAW OBSTACLES

Communities reviewed common priorities identified in their respective Municipal Vulnerability Preparedness (MVP) planning processes, as well as opportunities for additional actions that could be supported by the Climate Action Plan and its process.

As evidenced through the MVP process, and resulting priorities, and through further discussion at subregional municipal meetings, there are several common themes related to priority actions.

- Cape Cod communities are concerned with addressing low lying roadways and other infrastructure critical to supporting residents and visitors;

- obtaining Green Communities designation and implementing associated requirements, such as adoption of the stretch building code

### FOCUSING ON LOCAL NEEDS

Municipal meetings focused on better understanding current municipal priorities, barriers and needs, and opportunities for regional, subregional, and local action.



- assessing, prioritizing, and addressing vulnerabilities in stormwater infrastructure
- reviewing and updating local bylaws and regulations to incorporate best practices for reducing GHG emissions and adapting to climate hazards
- increasing electrification and energy efficiency in public buildings and amongst other public assets, such as vehicle fleets

Common barriers were identified by participants from across the region, including:

- **Funding and funding sources.** Lack of funding was identified as the most significant barrier. Moreover, support was requested to continue exploring and identifying additional funding sources. (i.e., status quo funding sources and new/other programs).
- **Staffing capacity.** There is an overall lack of bandwidth and capacity to adequately staff exploring and implementing the necessary projects, interventions, actions, and/or funding sources required to implement priority actions.
- **Public education/awareness.** The need to increase and bolster public

education and outreach across the spectrum of climate resilience and adaptation/mitigation solutions was noted as a necessity. Closing the existing gap in understanding around proposed and/or ongoing climate-related activities was noted as crucial.

- **Town/private property relationship.** Towns noted a limited ability to intervene on private property to fully execute programs such as beach nourishment.
- **Regulatory/bylaw obstacles.** The need to better understand the existing state regulatory environment, and guidance on how to maneuver within it was noted as





a necessity. Additionally, there was the suggestion to explore standardization of coastal regulations regionally.

When prompted to talk more about actions they would like to pursue, with additional support from neighboring towns, government entities, and others, town representatives noted the need for support to develop and implement public outreach and engagement strategies to educate residents on town priorities. They identified data and information on coastal risk and sea level rise to be shared with residents in a clear and concise manner, and that information on the costs and benefits of different actions will both assist with outreach, as well as decision-making. They identified technical assistance to review and update bylaws and regulations, and identify and coordinate implementation of approaches for managing development in coastal resource areas that can be applied across the region. In addition, town

representatives identified that additional support and partnerships are needed to create more multi-modal transportation options, address critical transportation vulnerabilities, and promote and implement both renewable energy and electric vehicle charging infrastructure.

Participants agreed that the Climate Action Plan can help to provide support for town communities and leverage efforts already underway. Key opportunities of the Climate Action Plan and its associated planning process that emerged were:

**■ Regional coordination.** Participants identified the need for assistance with information sharing, coordinating across regional activities, particularly with respect to identifying and communicating regional priorities, and a centralized way to identify funding sources.

**■ Communications and outreach products.** Participants noted a need

for pre-developed and standardized communication materials that identify regional priorities and provide information on long-term versus short term actions, as well as capacity building for wide-spread engagement.

**■ Metrics and tools.** Participants expressed the need for measurable goals against which they could monitor progress, and the development of supporting tools (e.g., solar planning tool).

**■ Regulations and bylaw review.** Participants asked for strategic support with implementation of adaptation and mitigation actions in the regulatory environment, as well as model bylaws.

**■ Grant-writing capacity.** Participants requested technical capacity for grant-writing and application submissions, as well as the management of funds once they are dispersed.

FALL 2019

WINTER 2020

FALL 2020

OCTOBER - DECEMBER 2020

WINTER 2021



## SECTOR WORKING GROUPS

In order to focus discussions on the detailed goals, strategies, actions, and steps needed to address climate change within critical sectors, stakeholders were organized into four working groups, each focused on a different sector of human influence on the environment. Discussions were focused on the broad thematic areas of Housing and Development, Transportation, Energy, and Natural Resources and Working Lands. Early meetings were designed to expand collective thinking on the broad areas of need, and resulted in the identification of broad concepts and aspirations, as well as specific steps to address the dual interests of climate mitigation and resiliency. Out of these discussions emerged the need to include a fifth thematic area



### Housing and Development



### Energy



### Transportation



### Natural Resources and Working Lands

captured under the term Community, more broadly focused on the need for education, awareness, data availability, and partnerships. Equity considerations were incorporated throughout discussions in each of the working groups, but are also directly identified within the Community goals. The Community themes were broadly incorporated into each of the sector-specific working group discussions.

Coupled with the literature review of climate action plans, development of the baseline GHG emissions, and other analyses, the results of early discussions with stakeholders informed development of goals for regional climate action, organized under these five sector areas: housing and development,

energy, transportation, natural resources and working lands, and community.

Over the course of three meetings, each working group explored the causes and need to address climate change; discussed criteria for evaluating actions and strategies; and identified strategies, actions, and steps to move the region toward climate action. The planning process was iterative, incorporating details from parallel research and analyses into materials and presentations provided to stakeholders to inform their discussion. Meetings were structured to allow stakeholders the opportunity to debate, critique, elaborate on, and refine a list of strategies, actions, and steps identified to support the goals within their sector.



As the groups discussed the details of each thematic area, areas of overlap emerged, enriching the overall discussion and resulting in further stakeholder discussions, in a cross-sector meeting, to share and discuss perspectives on topics that transcended more than one working group. Participants in this cross-sector meeting included members from each of the four working groups, in addition to stakeholders from other interest groups. The following discussion summarizes feedback received throughout the sector working group process. Documentation of all of the [stakeholder meetings](#) can be found on the Commission's website.

## EVALUATION CRITERIA

During the early stakeholder meetings each working group considered criteria to help prioritize the identified strategies and actions. The groups brainstormed possible criteria, focusing on important values and principles to guide decisions about which mitigation and adaptation actions to take with limited resources available. Four criteria emerged as common themes from the four working groups. Though all four criteria are considered important, all four working

groups suggested prioritizing impact and feasibility when evaluating strategies and actions, and guiding development of the Climate Action Plan.

**Equity:** Working group members emphasized that marginalized populations are disproportionately affected by climate change issues and solutions. They stressed the need to explicitly engage and address Cape Cod's most vulnerable populations by facilitating equitable access to participate in all parts of the decision-making. Working group members also stressed the importance of defining who Cape Cod's "vulnerable" populations include, and then working to specifically focus on how to integrate, solicit, and incorporate this set of voices. It was also noted that engaging the Cape's vulnerable populations could require going to meet folks where they are, rather than inviting their participation to an ongoing process.

**Impact:** Participants noted the magnitude of action that is needed for change to occur and that using a lens of high impact to prioritize actions would be key. This high-impact lens was described as not only critical to making concrete gains, but also as a way

to illustrate progress to those who may be skeptical, overwhelmed, or otherwise unconvinced about the value of the proposed actions. Working group members noted that demonstrating "baby steps" that indicate momentum (even at the individual level) would ultimately catalyze and increase collective action. Priority of an action should also be tied to its alignment with other (non-climate-specific) regional priorities.

**Feasibility:** Participants suggested that actions should be evaluated by their ease of implementation, and should be based in science and fact. Participants noted that we are currently in a climate emergency, so there are immediate needs to be addressed, but actions should lead to viable long-term solutions. Participants suggested that the duration of implementation for actions should be considered.

**Cost:** Participants observed that the value of emissions reductions should be calculated for actions. Participants also noted that economic feasibility could be the ultimate deciding factor for whether an action comes to fruition.



# Energy Working Group

## SECTOR WORKING GROUPS

### GOAL

Increase the production and use of clean energy

The Energy working group stakeholders noted the importance of understanding the limits and opportunities on the region's ability to take action, and the importance of understanding cost – both the cost of implementing new policies or infrastructure as well as the cost of doing nothing.

The energy group focused much of their attention on strategies for increasing

renewable energy, electric vehicle infrastructure, and energy conservation. Discussion, additions, and edits to the strategies centered around questions regarding the full life cycle of renewables and how to manage them effectively and efficiently, particularly regarding co-benefits and any possible negative impacts (e.g. health and safety). Participants also

expressed the need to ensure affordability and that sustainable and fair pricing is developed for both the commercial and residential users. Working group members noted the importance and necessity of providing access to existing infrastructure like charging stations. They also highlighted the importance of education about expectations for Cape Cod residents and visitors.



# Natural Resources and Working Lands Working Group

## SECTOR WORKING GROUPS

### GOALS

- Support and promote protection, conservation, and restoration of natural ecosystems
- Protect the ability of working lands and waters to provide essential social and economic services while protecting the environment
- Increase carbon sequestration in the natural environment

The Natural Resources and Working Lands stakeholders noted that equity is a key consideration – one not to lose sight of during development and implementation of the Climate Action Plan. Additionally, stakeholders noted the importance of finding ways to calculate and incorporate the “social costs of carbon,” or acknowledging that current activities that rely on fossil fuels have adverse effects on human and environmental health and well-being. Stakeholders also noted the importance of coordinating with existing planning activities and not to lose sight of both opportunities and efficiencies to be gained in working with partners in and outside of the region.

The working group considered and confirmed many strategies and actions addressing the conservation and restoration of natural ecosystems, including actions that sustain the natural environment’s ability to provide the functions and services that we depend upon. The discussion centered around maintaining and increasing the protection of open spaces and natural vegetation, especially trees. The group affirmed that as the climate changes, action is needed to ensure that the Cape’s natural communities and ecosystems have room to evolve and migrate, and to ensure that there continues to be a diversity of habitats across the region. Uplands, wetlands,

and water resources were all identified as priorities for protection and support. The group affirmed the importance of keeping natural lands and soils intact, and focusing attention on the preservation and restoration of salt marshes in order to maximize the carbon sequestration potentials of the Cape’s natural resources. Finally, the group affirmed the importance of supporting the Cape’s resource-based industries, especially as these industries face changes in the environment that force shifts in the types of agricultural and aquacultural products cultivated, and fish harvested and marketed.





# Housing and Development Working Group

## SECTOR WORKING GROUPS

### GOALS

- Reduce GHG emissions from the built environment
- Reduce GHG emissions from waste management systems
- Improve and advance the resilience of the built environment

The Housing and Development stakeholders noted the importance of the cost of implementation and that cost considerations should be factored into the planning process. Stakeholders were interested in understanding the willingness of Cape Cod residents to pay to address climate mitigation and adaptation actions, and requested that the cost effectiveness of certain strategies be incorporated into the economic analysis of implementing strategies on Cape Cod. Members of this group also observed that implementation of certain climate strategies could open doors for more “green” jobs that would benefit the Cape’s economy as well as reduce GHG emissions.

The working group focused on the need to incorporate electric heating and cooling systems into homes and businesses, and actions to achieve this enormous task. Many different strategies and actions are needed to transition the region’s existing and new structures toward net-zero energy. Changes in building codes, bylaws and regulations, incentives and subsidies for retrofits and energy efficiency programs will all be needed to bring down the region’s fossil fuel use. The group also affirmed the importance of land use and development policies that focus growth in activity centers and improve the efficient provision of infrastructure. The group affirmed the importance of recycling, reducing the generation of waste, and better addressing

the emissions associated with waste management. The group also discussed in detail the continuing need for a variety of strategies and proactive actions to address vulnerable public and private structures, including roads within coastal hazard areas, as well as the need for changes in policies to ensure that new infrastructure is built to be resilient to the changing climate.



# Transportation Working Group

## SECTOR WORKING GROUPS

### GOALS

Reduce emissions from the transportation sector

Improve the resilience of the transportation system to the impacts of climate change

Transportation stakeholders were concerned with getting people out of cars and increasing public transit, rail service, and other modes of transportation. The group noted the economic benefits of land use policies and transportation infrastructure that promotes walking, biking, and the use of public transit. At the same time, members noted the challenges around the current and proposed canal bridges and the ease with which visitors to Cape Cod can or will be able to travel by personal vehicle. The electrification of the transportation system was also

highlighted as important to the region. Participants noted the need for a resilient electric transmission and storage systems to support electrification. The group identified four key types of actors within this sector: car manufacturers and sellers, public transit officials, the business community, and town officials.

Discussion of actions focused on the need to reduce vehicle miles, enhance low and no-carbon transportation options, and electrify the transportation system. The group

noted the importance of making streets more friendly for pedestrians and bicyclists throughout the region. Regarding public transit the group expressed the importance of understanding the transportation demand of the traveling public, the need to continue improving coordination between transit modes, and the idea of expanding programs for free or reduced fares for seniors and potentially other vulnerable populations.





## Community

Throughout the working group discussions common themes emerged around the need for improved communication, outreach, and inclusivity. These ideas apply universally across the sectors and are related to how the region communicates and supports its communities. The discussion helped define five goals that are key to integrating climate change thinking and action into the region's cultural, social, economic, and community fabric.

### GOALS

- Improve broad public knowledge and understanding of climate change impacts and programs
- Accelerate adoption of emissions reduction strategies and actions across regional and local governments
- Increase data collection and access
- Ensure the health, safety, and equitability of mitigation and adaptation solutions
- Establish strategic partnerships to advance shared goals

### ADDRESSING EQUITY

As noted throughout these summaries of the stakeholder meetings, addressing equity as climate actions are identified and implemented is a top concern. Equity was named as a criterion for prioritizing climate action planning efforts, with participants noting that connectivity and communications will factor heavily into the equity discussion on the Cape. Municipal staff and others emphasized the need for the Commission to clarify what "equity" means in this context (e.g., economic equity, environmental justice, equitable dispensation of mitigating resources, equitable distribution of climate impacts, etc.). Participants also noted that the Commission, and municipalities with support of the Commission, will need to conduct intentional outreach to bring voices of vulnerable and/or previously unheard communities into the climate action planning process.

Participants suggested that the Commission first identify the most vulnerable segments of the community and complete an economic analysis to better understand the relationship between vulnerability and capacity to bear the burden of climate



impacts. For example, it was suggested that Environmental Justice areas on the Cape are often in low lying areas. Further complicating the issue, the Cape has large areal income disparities, with low-income communities mixed in and around wealthy, seasonal communities; participants questioned how to target communities with the greatest need without appearing to cater to the seasonal, higher income population. Vulnerable populations are often disproportionately impacted by the effects of climate change, and typically have less access to the resources needed for recovery. These groups can include, but are not limited to, communities of color, indigenous populations, low-income neighborhoods, youth, older adults, people with impairments,

people facing homelessness, and people with limited English proficiency.<sup>1</sup>

Commission staff recognize the need to better address equity considerations in this plan, and that addressing equity requires a dedicated effort. Equity may be defined many different ways, and will vary by location and the characteristics of the community; age, income, race, ethnicity, language barriers, traditional industries, tribal interests, mobility challenges, and education level may all be factors, as well as location of homes or businesses in climate hazard areas. A first step is to better understand who the most vulnerable populations on the Cape are and where they are located, and then find strategies

## Recommendation

Engage an equity working group to develop solutions and adapt strategies to address issues of climate justice and equity

to engage them, including going directly to where they are located. Then, the Commission should convene an Equity Working Group with representatives from the defined groups together with other members of the Cape community to share their diverse perspectives on how to most equitably implement the strategies and actions in this plan.

1 City of Boston. "Climate Action Plan." 2019. Link: [https://www.boston.gov/sites/default/files/embed/file/2019-10/city\\_of\\_boston\\_2019\\_climate\\_action\\_plan\\_update\\_4.pdf](https://www.boston.gov/sites/default/files/embed/file/2019-10/city_of_boston_2019_climate_action_plan_update_4.pdf)



## CROSS SECTOR WORKING GROUP

While the stakeholder meetings generated a wealth of ideas and input on specific topics, they also highlighted that the design of the stakeholder process itself led to various siloed discussions. The Commission recognized the need to enhance collaboration and convened a Cross Sector Working Group part way through the stakeholder process to generate debate and ideas from participants with diverse perspectives. The Cross Sector Working Group was comprised of members of each of the working groups, plus members of the Participating Organizations (see following section). Outcomes of the meeting included a better understanding by all parties of potential tensions around certain strategies. The discussion helped to refine the language of certain strategies and define new actions that take a more nuanced approach to the areas of concern. Three questions were explored:

### **How can the real estate transaction process be leveraged to encourage implementation of energy efficiency measures in existing building stock?**

Concern around applying grades to homes helped reframe the interest in encouraging efficiency improvements amongst homeowners toward creating incentives for retrofits and expanding existing systems for marketing homes by their amenities.

**How can the region strive toward net zero development and redevelopment of public buildings and affordable housing while being sensitive to cost and potential financial impacts to residents?** Deep concerns around making new structures increasingly unaffordable to build challenged group members to confront some of the wider issues with building public structures and affordable housing, including financing and town meeting approval, municipalities leading by example, and the need for additional subsidies to support climate-friendly construction on Cape Cod.

**How can the region encourage development of renewable energy while preventing the development of vegetated, forested, and working lands?** Regulatory barriers and competing interests, such as historic districts and aesthetic differences, were seen as some of the barriers to building solar projects in the “right” places;

## Recommendation

Convene stakeholder groups to further progress on overlapping priorities and opportunities.

members identified design guidance as a possible solution.

These types of cross sector conversations should continue to inform climate action on Cape Cod. There are opportunities to align efforts to grow the Cape Cod economy with climate action. Efforts should be made to work with partners to advance actions that are found in both the Climate Action Plan and the Comprehensive Economic Development Strategy. Additionally, and more specifically, stakeholders should be convened to continue conversations on the intersections and impacts of energy efficient and net zero building on the region’s housing challenges. Emphasis should be placed on opportunities to further both priorities, and incentives that will support successful implementation.



## PARTICIPATING ORGANIZATION FOCUS GROUPS

In the Fall of 2020 the Commission issued a call for participating organizations who wished to engage more directly in the climate planning process. Participating organizations were asked to host two focus groups of their staff and membership - the first during the stakeholder process and the second following the conclusion of the stakeholder meetings. These facilitated focus groups were designed to elicit the particular perspectives of each of the organizations with regard to the goals and strategies being discussed in the working groups and to discuss their organizational priorities and capacities appropriate for supporting implementation of the Climate Action Plan.

8 Participating Organizations

2 Rounds of Meetings

ASSOCIATION TO PRESERVE CAPE COD  
BARNSTABLE CLEAN WATER COALITION  
CAPE COD AND ISLANDS ASSOCIATION OF REALTORS  
CAPE COD CHAMBER OF COMMERCE  
CAPE COD CLIMATE CHANGE COLLABORATIVE  
COMMUNITY DEVELOPMENT PARTNERSHIP  
HOUSING ASSISTANCE CORPORATION  
COMPACT OF CAPE COD CONSERVATION TRUSTS

The focus groups held by these organizations helped to define the strategies and actions shared and discussed with stakeholders. The meetings also helped to highlight opportunities where participating organizations could become partners in implementing strategies, make connections through their larger networks, or where their specific expertise shed insight into how implementation of certain strategies could impact different populations on Cape Cod. As with other stakeholder groups, the participating organizations raised concerns about equity and fairness in implementation, as well as the need for broad communication and education, thinking creatively about how

to engage the broader public, and illustrating business opportunities.

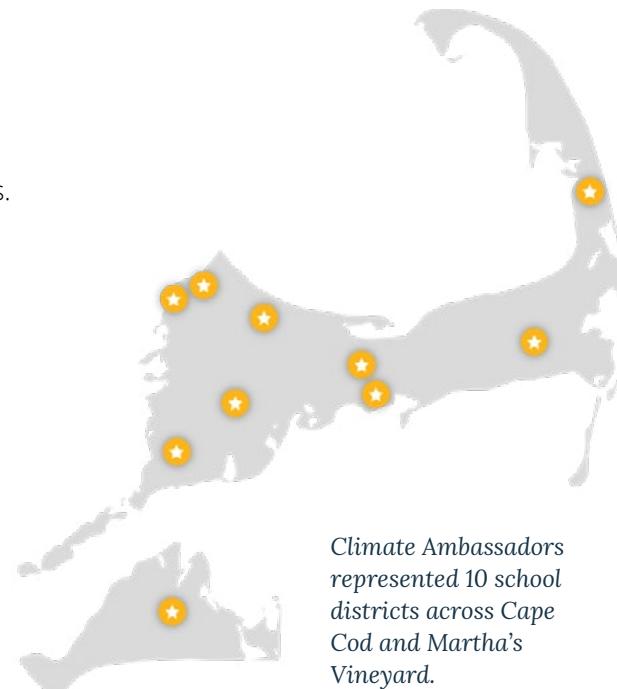
During the second set of meetings the focus groups were paired in order to improve the dialogue and understanding across groups. These conversations helped further refine some of the strategies and actions where apparent conflicts had arisen. There were also opportunities for the focus groups to identify steps on which they could lead or partner with other organizations.

## CLIMATE AMBASSADOR PROGRAM

Youth stakeholders raised their voices early during the Climate Initiative, indicating that they felt strongly about climate change and wanted to be part of the process; and that to date they felt it was difficult to make their voices heard. The Commission took steps to try to make the planning process more accessible to youth. Hearing that young people often look to their peers as trusted sources of information, the Commission developed the [Climate Ambassador Program](#) as a means to educate and engage youth and build a network for information-sharing. Following a call for students, a group of 18 high school students from districts across Cape Cod and Martha's Vineyard were selected to participate in the eight-week program.

Throughout the Program, students learned about global and local climate causes and impacts, climate policy and advocacy, climate change communications, equity considerations, and workforce opportunities. Each participant worked on a student-led project, either on their own or in a small group, and had an opportunity to present their work.

The initial call for participants generated far more interest than could meaningfully be accommodated and the 18 students that have participated in the program have expressed positive feedback. With the demand for and success of the program to date, the Commission anticipates continuing the Climate Ambassador Program in the future, working with additional groups of students.



Climate Ambassadors represented 10 school districts across Cape Cod and Martha's Vineyard.



## COMMUNICATIONS STAKEHOLDER WORKING GROUP

Across all stakeholder groups and meetings, the need for consistent and robust communication emerged as key to climate action. To better develop a strategy for communicating about climate change and spurring climate action, the Commission convened a communications stakeholder working group comprised of members with experience in education and communication. Over the course of two meetings, stakeholders identified the challenges in communicating about climate change, as well as the opportunities that are present, and tested out a framework for developing climate communications strategies. The resulting [climate communications framework](#) supports implementation of the climate

2  
Rounds of  
Meetings



CHALLENGES AND  
OPPORTUNITIES  
COMMUNICATIONS  
FRAMEWORK

action plan and enables municipal and regional government staff, educators, NGOs, and others who wish to build on the regional Climate Action Plan to communicate effectively with their target audiences about climate change, mitigation, and adaptation on Cape Cod. It will help communicators and educators raise broad awareness of community and individual responsibilities related to Cape Cod's changing climate, integrating equity into implementation and increasing engagement on climate issues. The framework outlines the six components for developing a climate communications plan, and provides resources and case studies.

## SHAPING THE CLIMATE COMMUNICATIONS FRAMEWORK

*The Climate Communications Framework works in tandem with the research and strategies put forth by the Climate Action Plan to offer a path to developing a coordinated and effective strategy for delivering key messages and engaging with local communities about climate change. It describes both theoretical and practical guidance focused on how to develop a climate communications plan.*



# Building Momentum

The planning process engaged hundreds of stakeholders, who came to meetings energized for action, and with ideas and expertise to inform the Climate Action Plan. Participants identified and refined hundreds of strategies, actions, and steps to mitigate GHG emissions, improve resiliency, and contribute to the State's climate-related goals. The range and breadth of potential actions identified through this stakeholder process makes clear that action is needed in all sectors, at all levels of government, by businesses and individuals, as collective policy decisions and as personal life choices and investments.

It is critical to maintain engagement during the implementation phase of the Climate Action Plan. Developing new resources to educate and engage a wide range of stakeholders on climate action will assist in garnering broad community support for implementation of this plan. Methods and platforms for an online engagement tool should be evaluated and an approach should be identified that will allow more people to participate remotely, outside of formal stakeholder processes and in-person meetings. The tool should incorporate data and information, and also provide ample opportunity to gather feedback and input from participants.

## Recommendation



Methods and platforms for an online engagement tool should be evaluated and an approach should be identified that will allow more people to participate remotely and outside of a formal stakeholder process and meetings. The tool should incorporate data and information, and also provide ample opportunity to gather feedback and input from participants.



# Strategies for Climate Action



Through the Climate Action Plan process, Climate Action Plan goals, strategies, actions, and steps to address the dual interests of climate change mitigation and adaptation were developed. Cape Cod Commission staff compiled methods and tools to take action through a literature review of climate action plans from around the country; from the Pathways to Net Zero developed by the Cape Cod Climate Change Collaborative; from additional research; and through an iterative process of additions, editing, and refinement received through the stakeholder process.



Stakeholders helped to refine and add to the database, and incorporate additional considerations, such as equity and co-benefits. The complete database of actions identified through the stakeholder process is included as [Appendix F](#); an updated and evolving, living list of actions may be viewed online through the Cape Cod Climate Actions tool, available here: [capecodcommission.org/climate](http://capecodcommission.org/climate).

This chapter identifies the strategies that will best address the plan's purpose to reduce emissions and improve resiliency. The strategies that rise to the top are those that directly target the highest emitting sectors of human activity on the Cape, address the key criteria that the stakeholder process identified as priorities, are within the region's legal and policy spheres of influence, and are generally more cost effective:

- As discussed in Chapter 4 of this plan, the greenhouse gas (GHG) inventory identifies transportation and building heating and cooling as the region's highest emitting sectors.
- Chapter 6 discusses the key criteria identified by stakeholders for evaluating priority climate actions, including Feasibility, Impact, Affordability, and Equity.
- The legal and policy framework addressing climate emissions within Massachusetts is explored in Chapter 3.

The findings of the economic and fiscal analysis are included in Chapter 2, Chapter 4, and later in this chapter, demonstrating that investments in retrofitting buildings with air source heat pumps and transitioning to EVs are among the strategies which will have near-term returns for both individuals and the region.



#### CLIMATE ACTIONS DATABASE

*Strategies, actions, and steps that contribute to achievement of the housing and development, transportation, energy, natural resources and working lands, and community goals are included in a comprehensive database at: [capecodcommission.org/climate](http://capecodcommission.org/climate)*

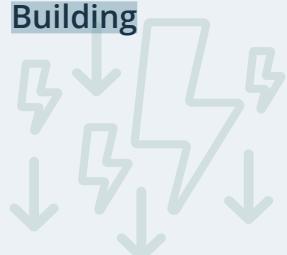


## PRIORITY STRATEGIES

The following 11 mitigation and adaptation strategies emerged to broadly characterize the areas where the region should focus its climate action efforts (in some cases the strategies represent a consolidation of the strategies discussed with the stakeholder groups). A list of the priority strategies is provided

below, in no particular order, followed by a brief description of each strategy that itemizes some of the actions needed to move forward. The complete database of strategies and associated actions and steps can be found at: [capecodcommission.org/climate](http://capecodcommission.org/climate).

Reduce energy consumption and strive towards Net Zero Energy



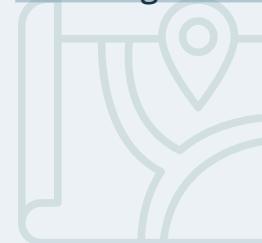
Promote efficient land use policies and development patterns that protect the nature and character of the region



Address vulnerabilities in public infrastructure and in the road network, including adapting critical transportation infrastructure for climate change impacts



Identify approaches to managing development in coastal resource areas region-wide



Address vulnerable buildings and structures threatened by flooding and erosion through retrofits and relocation





## PRIORITY STRATEGIES

11 Strategies to focus the region's climate action efforts



Adaptation and mitigation strategies



Generate and increase the use of safe, reliable, and clean energy



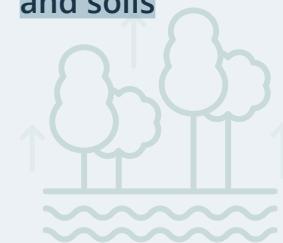
Reduce vehicle miles traveled and support low and no carbon transportation options



Accelerate the electrification of the transportation system



Reduce emissions by increasing protected open space, including enhancing carbon storage and sequestration in forests, wetlands, and soils

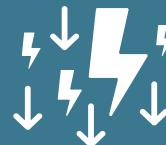


Increase education and communications about climate change mitigation and adaptation options



Support increases in municipal capacity and provide technical assistance





## REDUCE ENERGY CONSUMPTION AND STRIVE TOWARDS NET ZERO ENERGY BUILDING

The built environment is one of the most significant sources of GHG emissions on Cape Cod, largely due to heating with fuel oil, natural gas, and propane. Air conditioning needs are another large energy demand. Exacerbating the demand to heat and cool is an older and inefficiently insulated building stock. The region can take advantage of opportunities to improve energy conservation, heating and cooling efficiency, and transition to non-fossil fuel sources of energy to reduce emissions and, in many instances, save money. Several actions can support these strategies, with different actions appropriate for the non-residential and residential building stock.

### Non-Residential:

- **Ensure new commercial, industrial, and publicly funded construction is built to minimize greenhouse gas emissions and maximize energy**

**efficiency** – The steps to address this action include ensuring that all Cape communities have adopted the stretch building code and that towns are supporting best building practices in town codes and regulations to ensure energy efficiency measures and assessments become the norm. Towns can also establish new procurement rules to specify low energy demand buildings and solar readiness in municipal structures.

- **Retrofit existing commercial, industrial, municipal, and other public buildings** – Energy assessments

are an important first step to implementing energy efficiency and conservation. The Cape Light Compact provides no-cost energy assessments to residents and businesses. Smart temperature controls, weatherization, insulation, retro-commissioning of HVAC systems, and other system upgrades will also reduce energy consumption.

- **Expand solar incentive programs such as Solarize Our Town to all Cape communities** – Towns and others

can take steps to promote the Energize Cape & Islands effort, which will help to subsidize and promote the installation of solar on public and private buildings, as well as develop solar PV systems on town buildings, over parking lots, and on appropriately sited town owned land.

### Residential:

- **Retrofit existing residential buildings/ houses** – With over 163,000 existing

housing units Cape-wide (2019 American Community Survey), homeowners will need to be supported and encouraged to retrofit their homes. Steps to achieve this action include taking advantage of incentives and rebates through Mass Save® to weatherize and improve the energy efficiency of buildings. Homeowners will also need to replace aging oil, propane, and gas energy systems with electric ground and air

source heat pumps (while the exact costs depend on the specific home, an analysis by ERG shows that generally cost savings can be realized by replacing existing systems well before they fail). The rate of home energy conversions to electric also needs to increase in order to achieve the state's goals to reduce emissions. With much of the Cape's older buildings having historic value or contributing to the region's character, steps to address the unique considerations of weatherizing and electrifying historic homes, as well as engaging historic district commissions about ways to incorporate renewable energy installations are needed to address concerns.

■ **Encourage and support transition to lower emissions by homeowners –**

Municipalities and others can promote home energy assessments, and establish systems for tracking home energy assessments and energy retrofits to aid homebuyers in making smart home choices and further incentivize weatherization and electrification. Similarly, the real estate community can incorporate additional home energy and efficiency data into real estate listing services.

■ **Ensure new residential construction is built to minimize greenhouse gas emissions and maximize energy efficiency –**

While existing homes require weatherization and HVAC upgrades, many steps are needed to support

improvements in new construction.

There are many certification programs that can be used to reduce greenhouse gas emissions and maximize efficiency. Builders, contractors, architects ,and building code enforcement officials may all benefit from training to understand and apply programs such as those that take advantage of solar gain and shade, and opportunities to implement efficient electric heat pumps. Changes to the stretch code that accompany Green Communities designation will also help ensure that new construction is built to maximize efficiency while providing flexibility in how buildings meet efficiency requirements. Towns may also consider limiting single family home building size which would address both energy use as well as community character interests.



## PROMOTE EFFICIENT DEVELOPMENT PATTERNS THROUGH LAND USE POLICIES THAT PROTECT THE NATURE AND CHARACTER OF THE REGION

The development patterns of the latter half of the twentieth century have resulted in spread out development that requires more clearing of land for infrastructure and the development itself and a reliance on cars to get from one place to another. The transportation sector is the largest single GHG emitting sector for the region, in large part because of the pervasive suburban development patterns. Focusing growth into areas with a mix of uses and compact forms will allow greater walkability, reducing the region's reliance on cars and thus reducing GHG emissions. This strategy also helps to protect the sensitive natural resources of our region, which can help to further reduce GHG emissions through carbon sequestration.

- **Encourage a mix of land uses where possible** – Towns can work to change zoning in core areas in their communities to allow for a mix of land uses in a single area. Allowing for a mix of uses

in specific areas can increase the use of alternative modes of transportation, reducing the need to travel by car. The Commission can provide technical assistance to towns for specific zoning changes and amendments.

- **Promote infill and adaptive reuse** – Developing or redeveloping in already developed areas minimizes the clearing of vegetation, protecting those natural resources. Utilizing existing infrastructure and buildings can save energy and reduce emissions related to the production of new materials, infrastructure, and buildings. The Commission can help

promote infill and adaptive reuse through technical assistance to towns, including changes to zoning that promote infill and reuse in appropriate areas.

- **Focus growth in Activity Centers** –

Towns and the Commission can work together to focus growth in Activity Centers—areas with existing development that have the potential for greater redevelopment. Focusing growth in these specific areas will concentrate growth, promote more compact forms of development and hence more efficient land use, and will protect the natural and sensitive resources of our region.





## ADDRESS VULNERABILITIES IN PUBLIC INFRASTRUCTURE AND IN THE ROAD NETWORK, INCLUDING ADAPTING CRITICAL TRANSPORTATION INFRASTRUCTURE FOR CLIMATE CHANGE IMPACTS

Decades of development, especially over the last century, have resulted in the development or expansion of roadways and other infrastructure in areas that are increasingly vulnerable to flooding and erosion. Roadways, culverts, bridges, and utilities, many of which were built at a time when the Cape's population and demands on infrastructure were less, are now facing flood threats or were inadequately designed to accommodate the realities of sea level rise or higher intensity storms.

### ■ **Explore remedies to state regulatory barriers that delay or prevent solutions to resiliency problems –**

Towns and others are finding difficulties and delays in permitting solutions to address some of the vulnerabilities they face along the shoreline. A step needed to advance projects that protect infrastructure and other public assets is streamlining the permitting process

for certain types of projects, but without compromising the integrity of the Commonwealth's environmental laws. Assessing and examining the regulatory barriers to certain public infrastructure projects is an important first step.

■ **Assess and correct vulnerabilities in utility infrastructure –** Electricity delivery, wastewater conveyance, and other utilities are threatened by flooding, wildfire, and storms. Steps should be taken to install underground utilities for all new construction and as streets are opened for other construction needs. Assessments are needed at the municipal level to determine the nature and the level of risk that utilities face.

■ **Conduct vulnerability assessments of municipal facilities and carry out recommendations –** Community shelters, public safety buildings, and other critical facilities may be located in harm's way, and assessments are needed

to prioritize action. Understanding what facilities are threatened in what time frame also requires projections of sea level rise and landward extent under different climate scenarios. Towns should continue to keep their hazard mitigation plans current, and take steps to address the recommended actions within those plans.

■ **Improve stormwater management through culvert retrofits and other stormwater best management practices –** Moving water off roadways is a critical component to keeping roadways safe; steps to address this action include updating stormwater management design protocols to address higher rain volumes, and coordinating with MassDOT on state roadway projects and to resolve areas of overlapping authority.

■ **Assess low-lying and key roads and elevate, relocate, or abandon as appropriate –** Many roadway segments

across the region already experience flooding during extreme high tides and storm events. Town staff are likely familiar with these problem areas, but assessment and prioritization of the roadway segments most at risk over the near term, as well as assessment of the roadway criticality for transportation, is needed across the Cape. Following these assessments, community discussions about the best approach for each road segment are needed, including elevation, relocation, culvert replacements, bridges, or in some cases, abandonment.

In addition, an examination of the vulnerability of regional roadways to storm threats, including from overhead transmission lines, is needed. Often low-lying roadways, especially those associated with undersized culverts, can be opportunities for implementing nature-based solutions that can restore wetland habitats.

#### ■ **Evaluate and address evacuation route vulnerabilities and disconnected areas**

– When regional roadways and local roads flood, emergency access and egress to the flooded areas can become difficult. Assessment of evacuation and emergency response routes are needed to ensure safety during flooding events and other climate-related disasters.





## IDENTIFY APPROACHES TO MANAGING DEVELOPMENT IN COASTAL RESOURCE AREAS REGION-WIDE

Part of what defines Cape Cod is the region's beaches and coastline. Because of their draw, and people's desire to live near the water, there is a significant amount of development along our coast. Rising sea levels, intensifying storms, and coastal erosion put development in our coastal resource areas at risk of substantial damage. The proliferation of development in these sensitive ecological areas also threatens ecosystems that are not only critical for our environment but our economy as well. Identifying approaches to managing development in coastal resource areas can help mitigate damages to the buildings and infrastructure and protect the area's natural resources and systems.

- **Draft and adopt floodplain bylaws to address development and redevelopment in vulnerable areas** – Towns, the Commission and Cape Cod Cooperative Extension, and other research organizations can work

together to develop model bylaws to limit development in vulnerable areas, identify best practices for redeveloping in vulnerable areas, and identify appropriate strategies for conservation commissions and other town boards to take to remediate erosion and/or flooding that may impact vulnerable properties. While many of the implementing factors will be site-specific, compiling best practices or preferred strategies will help conservation commissions to take appropriate action. Additionally, identifying best practices will help foster more consistent action from towns across the region in response to protecting vulnerable properties from erosion and/or flooding. Included in the model bylaws may be methods for reducing new development in vulnerable areas as well as ways to protect public access to the coast.

- **Develop regional sediment management plans** – Coastal sediment transport is part of a natural system that does not know town boundaries.

Consequently, when management is needed, decisions should consider the natural forces that erode and rearrange sand along the shore. Understanding the sources and sinks of sediment that move seasonally along the Cape Cod shoreline should improve the ability of coastal resource managers to target resource management activities. Developing regional sediment management plans will help assess potential impacts to shorelines and vulnerable properties. Regional sediment management planning will enable more efficient use of resources and the design of coastal management approaches, such as nature-based solutions.

- **Protect properties using green or nature-based solutions** – As both private and public coastal property owners look to protect their land and buildings, the use of green infrastructure or nature-based solutions should be encouraged. Nature-based solutions can have co-benefits such as providing

needed habitat, supporting critical ecosystems, and potentially sequestering carbon. Towns and the County can work to provide more education on green or nature-based solutions to ensure more property owners are aware of them and understand the benefits of implementing such projects.

■ **Explore buy-out possibilities and “undevelop” with willing owners –**

Towns and the State can work together to investigate the feasibility of buy-out programs in certain areas or communities. A buy-out program is one in which the government will buy vulnerable properties, allowing those owners to purchase property somewhere else and

reducing the amount of development at risk in a community or area. Once the property is owned by the local or state government, it can be “undeveloped,” meaning buildings and infrastructure are removed and the property is allowed to return to its natural state.





## ADDRESS VULNERABLE BUILDINGS AND STRUCTURES THREATENED BY FLOODING AND EROSION THROUGH RETROFITS AND RELOCATION

This strategy considers the need to reduce the vulnerability of homes, businesses, and infrastructure to the threats posed by climate hazards (specifically flooding and coastal erosion). Thousands of homes and structures are threatened by accelerating erosion along the region's coastlines; many thousands more are threatened by flooding. The Cape community needs to carefully examine the nature of the threats and identify those structures and homes most vulnerable to flooding and erosion. Prominent or expensive properties located along the shoreline often receive attention or headlines during permitting for shoreline structures, or when undermined by coastal storms. Many other, and more modest structures, are at risk of significant damage from flooding, and need to be folded into the region's priority strategies to address threatened property. For historic or iconic neighborhoods, it will be important to carefully determine whether relocation, elevation, or accommodation is the correct approach.

**Move buildings and infrastructure out of the floodplain** – This action will need many different approaches to achieve the goal of improving the resilience of the built environment. Steps identified include assessing where the most vulnerable locations are and the buildings and structures under the greatest threat, and developing a plan for relocating certain structures. Not all buildings or structures are suitable for relocation, but where there are iconic (historic) structures or even neighborhoods that should be preserved because of their value to the community, towns should identify and set aside potential areas for them. Other properties, where owners are willing, may be more appropriate for buy-out programs. Limited resources are available for buy-outs of coastal properties, so communities should identify criteria for prioritizing strategic use of public funds to buy-out private homes or businesses.

**Floodproof or retrofit buildings to withstand flooding** – Many buildings in the floodplain may be protected from the worst effects of potential flood damage through floodproofing measures. Steps include building retrofits that help a structure withstand flood forces by allowing flood waters to pass through non-habitable portions of the building. Other measures may include installation of break-away walls or moving utilities and HVAC systems to upper levels of a building.

**Elevate buildings** – Some buildings in the floodplain may be suitable for elevation, which may provide an effective means for protecting a home or business. Due to the expense, this may not be a universally available measure; additionally, elevation of structures will change the character of a neighborhood, potentially blocking views. Important steps for communities to help manage the desire to elevate structures include the adoption of bylaws and regulations that help guide the form and design of elevated buildings.



## GENERATE AND INCREASE THE USE OF SAFE, RELIABLE, AND CLEAN ENERGY

The Cape will need to generate its own renewable sources of energy to support the transition from fossil fuels to clean energy. While the Cape, and Massachusetts generally, will directly benefit from the wind energy generation facilities being planned and permitted in the ocean water off-shore of Martha's Vineyard and Nantucket, the operation of these facilities is still years away and will not meet all of the Commonwealth's renewable energy needs. The Climate Action Plan acknowledges that the Cape will have to contribute to renewable energy generation and storage, and that various strategies are needed to realize a future powered by electricity.

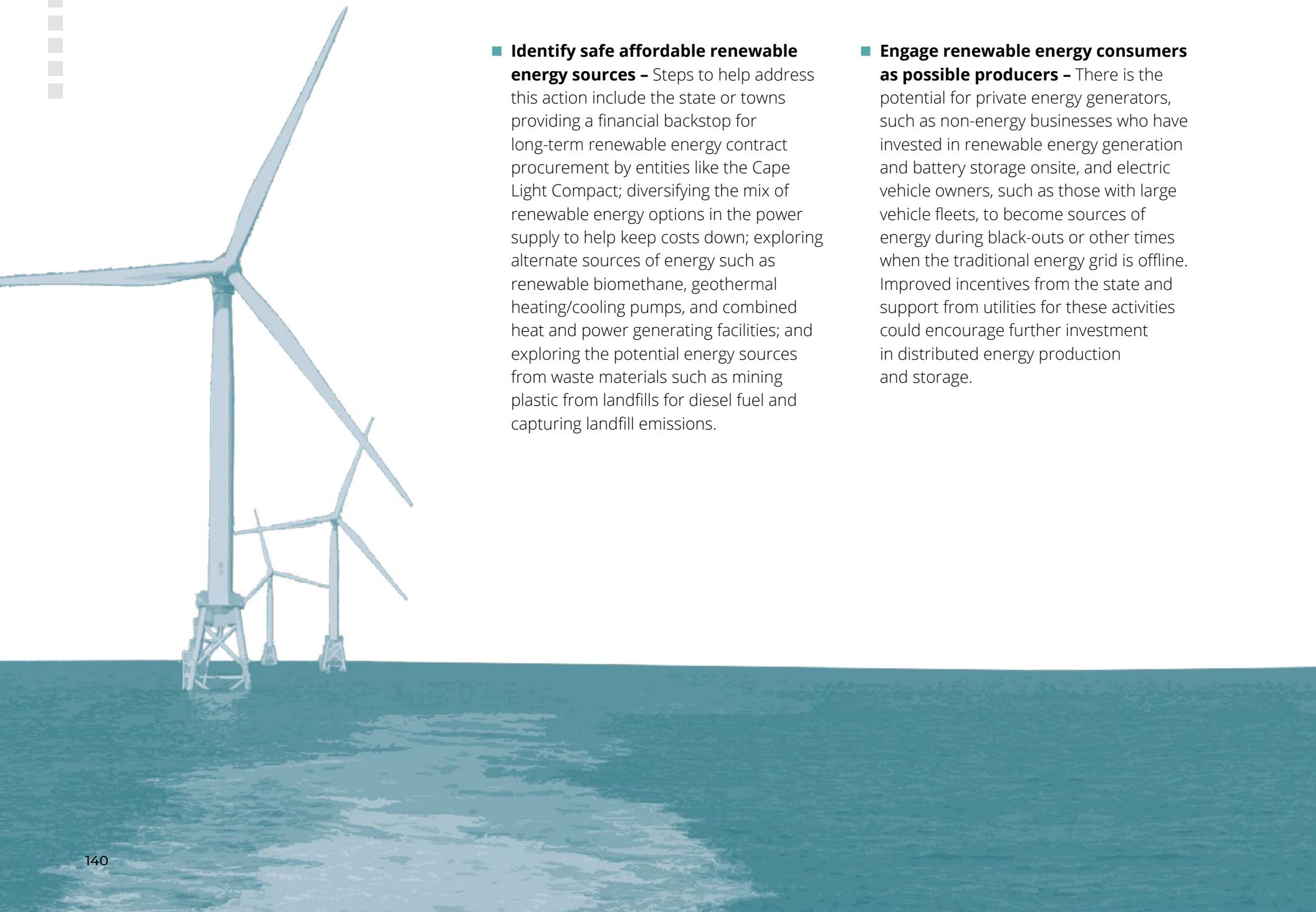
- **Facilitate investment in renewable energy generation and storage** – Steps under this action include encouraging businesses and municipalities to finance and install renewable energy systems and storage on private and

public facilities. There is an opportunity for businesses to incorporate onsite renewable energy generation as part of their branding and marketing; similarly, government entities can lead by example through onsite generation of renewable energy. Additionally, renewable energy investments will require workers to install and maintain these systems; a step will include providing workers with the skills necessary for the new and expanding jobs associated with new technologies.

- **Use clean energy sources in municipal operations** – Municipalities can lead the way on many fronts, using public funds, to electrify municipal operations. Municipalities can acquire electric vehicles for many municipal needs, like inspection and emergency vehicles. Towns can invest in renewable energy generation on municipal buildings and in carports over parking lots, and in appropriate land-based installations that do not result in extensive new clearing. And since towns

may not be able to generate all of their own energy needs, especially in the short term, an important element in the mix is for towns to specify clean energy in their electricity source purchasing.

- **Encourage renewable energy installations that limit new clearing and loss of sequestered carbon** – New energy generation on Cape Cod is needed to address current and future electricity needs. Siting new energy facilities should be done thoughtfully to avoid adverse impacts that work against other regional interests. Steps to support appropriate siting of renewable energy facilities include: development and adoption of model solar siting bylaws; engaging historic commissions to ensure historic interests are incorporated into new regulations; developing design guidelines for solar canopies so that these facilities can better blend into the local character; and create incentives to appropriately site renewable energy facilities.



■ **Identify safe affordable renewable energy sources** – Steps to help address this action include the state or towns providing a financial backstop for long-term renewable energy contract procurement by entities like the Cape Light Compact; diversifying the mix of renewable energy options in the power supply to help keep costs down; exploring alternate sources of energy such as renewable biomethane, geothermal heating/cooling pumps, and combined heat and power generating facilities; and exploring the potential energy sources from waste materials such as mining plastic from landfills for diesel fuel and capturing landfill emissions.

■ **Engage renewable energy consumers as possible producers** – There is the potential for private energy generators, such as non-energy businesses who have invested in renewable energy generation and battery storage onsite, and electric vehicle owners, such as those with large vehicle fleets, to become sources of energy during black-outs or other times when the traditional energy grid is offline. Improved incentives from the state and support from utilities for these activities could encourage further investment in distributed energy production and storage.



## REDUCE VEHICLE MILES TRAVELED AND SUPPORT LOW AND NO CARBON TRANSPORTATION OPTIONS

The regional GHG emissions inventory identified that the transportation sector accounts for over 55% of emissions for the region. In order to reduce GHG emissions in this sector, shifts need to be made in how much individuals travel and the mode of travel, as well as ensuring that freight movement occurs in the most efficient ways possible.

- **Utilize virtual options to reduce vehicle trips** – Remote work as well as virtual meetings, appointments, and other services can reduce the overall travel demand. Improved broadband internet

across the region is important for both the effectiveness and equitability of this strategy.

- **Enhance public transit and shared transportation options** – Public transit is an important component of an efficient and equitable transportation system. Trips taken by public transit and shared transportation options have a lower carbon footprint than single-occupancy vehicle trips. Expansion of transit options, including commuter rail, and frequency along key routes would make travel by public transit easier and more desirable.

- **Enhance bicycle and pedestrian options**

**options** – Better connectivity of the region's bicycle and pedestrian networks would allow for more zero carbon transportation trips while providing a host of other community benefits. When combined with enhanced transit options, residents and visitors would have access to a transportation network more consistent with the long-term vision of the region as articulated in the Regional Policy Plan and Regional Transportation Plan.





## ACCELERATE THE ELECTRIFICATION OF THE TRANSPORTATION SYSTEM

Electric vehicles (EVs) emit significantly less GHG emissions per mile traveled than gas or diesel vehicles, but currently make up only a small portion of the vehicles in the region. Aggressive electrification of the transportation system is required to achieve significant GHG emission reductions in the transportation sector, while still facilitating the necessary movement of goods and people.

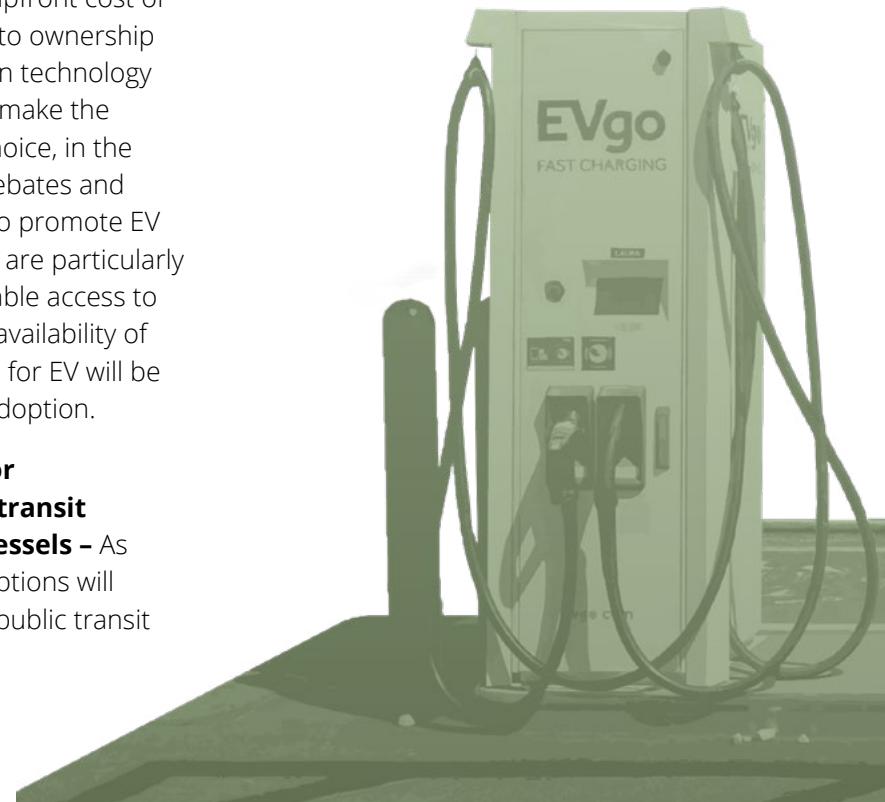
- **Encourage investments in EV charging infrastructure** – To accelerate the adoption of EVs, additional investment in charging infrastructure is required. Residential and commercial developments and redevelopments should be designed and built with EVs in mind. While the majority of EV charging takes place at home there is also a clear need for public charging stations, particularly for a region where a significant proportion of motorists on the roadway are visitors. This

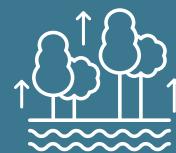
will require action from both the public and private sectors.

- **Support programs that incentivize EV adoption** – With lower operating and maintenance costs, the lifetime cost of owning an EV is being shown to be less than a gas-powered vehicle. Unfortunately, the higher upfront cost of EVs still presents a barrier to ownership for many. While advances in technology are expected to ultimately make the EV the most economical choice, in the near- and medium-term, rebates and other incentives can help to promote EV adoption. These incentives are particularly important to ensure equitable access to EVs. Additionally, the local availability of dealers and repair facilities for EV will be important for large-scale adoption.

- **Explore opportunities for electrification of public transit and fleet vehicles and vessels** – As technology advances, EV options will become more feasible for public transit

vehicles, municipal vehicles, school buses, police vehicles, delivery vehicles, and various marine vessels. Feasibility studies could help inform decision-makers of the current opportunities, barriers, costs, and grant options for electrification.





## REDUCE EMISSIONS BY INCREASING PROTECTED OPEN SPACE AND NATURAL HABITATS, INCLUDING THROUGH ENHANCING CARBON STORAGE AND SEQUESTRATION IN FORESTS, WETLANDS, AND SOILS

As detailed throughout these strategies, Cape Cod communities will most effectively reduce emissions by working as a region to reduce the use of fossil fuels for heating, cooling, and transportation needs. The regional GHG emissions inventory also illustrated, however, that the Cape's natural lands play a significant role in helping to sequester carbon, and prevent the additional contribution of 9% of the region's emissions. A key strategy, then, which coincides with other regional goals to protect open space for water supply and habitat protection, is the protection of existing unprotected lands and natural habitats, as well as the protection of natural ecological processes which provide so many co-benefits.

- **Maintain and increase parks and open spaces** – Steps to achieve this important action include supporting and funding the continued acquisition and permanent protection of woodlands,

wetlands, and key parcels that will help maintain landscape connectivity, buffer sensitive lands, and allow for coastal resource migration landward as sea level rises. Work needs to be done to prioritize the land to be protected and identify where additional protected land is needed. Steps may be needed in some towns to better signal the importance of land protection in key areas through changes in subdivision regulations, land clearing regulations, or possibly adoption of transfer of development rights bylaws. Towns should also indicate the importance of maintaining the tree canopy in urban, village, or residential settings, and creating parks where opportunities arise. Ongoing work by land trusts, advocates, and towns to educate the public and promote the benefits of open space and maintaining the tree canopy is also needed.

- **Urban reforestation – Plant trees or increase urban tree canopy** – Auto-oriented development, mostly along

regional roadways, has resulted in seas of pavement and spread out buildings. These areas are less pleasant visually, challenging to navigate by bicycle or on foot, and can be shade-starved and hot in summer months. Efforts to plant trees in these areas can help sequester carbon, reduce heat-island effects with the accompanying need for cooling, and can improve the streetscape for the safety of pedestrians and bicyclists. Towns can consider requiring trees as part of landscaping and stormwater management requirements. And as streets are opened for utility work, towns and the state can work to underground overhead wires, improving the reliability of electricity delivery and allowing for planting of street trees.

- **Improve soil management techniques in both agriculture and landscaping**
  - Many steps are needed to help address the huge opportunity to maximize carbon sequestration in soils. Some steps are targeted at agriculture, including using

cover crops, avoiding topsoil erosion, and using compost in lieu of fertilizers. Other steps apply to all property owners who maintain landscaping, yards, and home gardens. Steps include avoiding and reducing fertilizer; when needed, apply fertilizers, pesticides, and other soil amendments efficiently; use mulches and compost to provide nutrients and conserve moisture; use native species to restore natural soil processes and biology; and avoid or reduce clearing and grading of soils for development. Work needs to be done to educate homeowners, landscapers, and businesses on these practices.

**■ Protect trees, small wooded lots, and reforest disturbed areas** – Efforts to protect trees across the spectrum of land management and scales will contribute meaningfully to carbon sequestration. Steps include protecting large diameter trees, including specimen trees; identifying areas with high densities of tree and natural vegetation growth for protection; and revegetating disturbed areas with trees. Stump dumps, gravel pits, buffers to abandoned bogs, as well as lots that have been cleared or are underutilized may be suitable for reforestation. See also “Maintain and increase parks and open spaces,” above.

**■ Support forest management to protect healthy forests and reduce wildfire threat and severity** – Decades of wildfire suppression and centuries of land use changes have contributed to dangerously high fuel loads (extremely dense and flammable vegetation) that could contribute to devastating wildfires. In addition to being a public hazard and health threat, wildfires will contribute to carbon emissions. Steps to create fuel breaks at strategic places in woodlands, performing some forest thinning as advised by forest professionals, and conducting prescribed fires to bring down the fuel load can contribute to managing healthy forests and preserving carbon sequestration.

**■ Protect and restore wetlands (in particular salt marshes) and preserve wetland functions** – We know that the biomass caught up in centuries of peat and wetland soils, as well as the biomass of the living species in marshes and wetlands, is a significant sink for carbon – we just don’t know how much. An important step prior to the effort to update the GHG inventory is identifying a method for estimating the carbon sequestration potential of salt marshes and wetlands. Additionally, a next step is helping the public better understand

the major benefits of healthy wetlands and their role in supporting human life. These systems are also very vulnerable to climate change threats, particularly sea level rise. Work is needed to identify locations where salt marshes are vulnerable, educate conservation commissions about restoration techniques, and support towns in adopting wetland bylaws and regulations that will promote wetland restoration.

**■ Make room for salt marsh migration (landward)** – Salt marshes are vulnerable to drowning by sea level rise – the natural process of the build-up of peat cannot compete with the rate of sea level rise. Salt marshes may migrate landward where the geography of the land allows it and other (manmade) barriers are not in the way. Work is needed to identify the best areas for salt marsh migration, and educate the public about the need to take steps to accommodate migration through land acquisition or regulation. Additionally, some marshes may respond to sea level rise by growing vertically; research is needed to examine the viability of thin-layer deposition to raise the level of the marsh surface and promote the growth of salt marsh grasses.



## INCREASE EDUCATION AND COMMUNICATIONS ABOUT CLIMATE CHANGE MITIGATION AND ADAPTATION OPTIONS

Action at a variety of scales will be necessary to implement the above-detailed strategies and actions and successfully mitigate the causes and adapt to the effects of climate change on Cape Cod. Broad awareness of the effects of climate change, what actions contribute to climate change, and what the appropriate actions are to mitigate and adapt to climate change is critical, so that implementation of those actions are supported. Equally important is the need for Cape Cod communities to have a clear understanding of legal and jurisdictional constraints, as well as opportunities for municipal action. A variety of actions have been identified to improve access to climate change data and information, encourage collective and informed action, increase support for appropriate mitigation and adaptation strategies, and ensure ongoing engagement on this issue into the future.

**■ Identify the legal framework for action –** There are a variety of actors that may lead or support climate action efforts. It is necessary to understand the legal framework within which governments can take action, as well as opportunities for individual, non-profit organizations, and others to contribute. Maintaining a clear understanding of government roles and responsibilities, especially as they evolve with new federal or state policy or changes in administration, is important to ensuring action at appropriate scales.

**■ Customize information to the needs of the community –** Steps should be taken to consider how information is utilized by residents and visitors. Steps to support this action include maintaining the legal and jurisdictional analysis, identifying vulnerable populations, determining the flow of information through both regional and local organizations, and developing methods for reaching a larger proportion and variety of citizens and stakeholders.

**■ Develop educational programming –** Steps toward this action should forward educational opportunities for all ages and audiences, and incorporate a variety of media and means to do so. Steps include widely distributing Climate Action Plan material in a variety of easily accessible formats, and engaging students and faculty at the high school and college levels to develop and incorporate climate change into the curriculum.

**■ Target information and guidance –** Information and education should be targeted to the audience. Actions to reduce GHG emissions and adapt to climate hazards may be taken by individuals, government, non-profit organizations, businesses, and others, but the information required to inform each of their decisions may differ. Steps toward providing information and guidance should differ accordingly. Steps toward forwarding actions individuals can take include defining individual actions, developing and distributing

tools for assessing emissions associated with individual choices, developing methods for distribution of information, and engaging those who can help to influence individual decision-making. Steps to provide information and guidance to municipalities include developing communication materials that identify short- and long-term priorities and means for increasing capacity for implementation, strategies for a variety of

media to reach different audiences, and tools for measuring and communicating progress toward local and regional climate action goals. Steps toward providing businesses with industry-specific materials include sharing information on the use of technology to manage heating and cooling in hotels, and providing guidance on restaurant kitchen upgrades to improve efficiency and reduce costs.

**■ Acknowledge tradeoffs associated with different climate actions -**

Incorporate information from the economic and fiscal impact analysis to illustrate tradeoffs associated with climate action into education and outreach materials. Information shared should recognize that not all actions are without cost or compromise, but benefits to health, sustainability, and equity may also result.





## SUPPORT INCREASES IN MUNICIPAL CAPACITY AND PROVIDE TECHNICAL ASSISTANCE

Municipal staff regularly contribute to and lead local initiatives and efforts to address a wide range of challenges and opportunities within a community. Their time and resources are stretched and they must balance a wide range of priorities to meet the needs of residents. Cape Cod municipalities have demonstrated great interest in addressing climate change and its impacts and several local actions have been taken. Additional support and resources would pave the way for municipalities to take additional and appropriate actions.

- **Support municipal staff** – Identifying appropriate staff to support climate action, and providing the time and resources needed to do so, is challenging given competing priorities. On climate-related issues, municipal staff must meet the needs of the populations they serve, as well as plan for minimizing or

eliminating risks to those populations in the future. Steps to support municipal staff include providing information or training to response personnel on the needs of the elderly, identifying appropriate funding sources for climate action initiatives, and providing training and/or grant writing assistance.

- **Provide technical assistance** – Regional organizations have a unique perspective in that they can work to identify common themes or needs across multiple municipalities and target technical assistance. To provide resources and increase municipal capacity, steps can be taken to develop model bylaws, regulations and policies; guidance on retrofitting public buildings, modifying operations, and converting vehicle fleets; guidance for advancing private home and business energy and heating retrofits; grant writing assistance; and engaging organizations that assist home and

business owners with renewable energy investments.

- **Facilitate information sharing** – There are many opportunities for municipalities to learn from one another through improved communication and established channels for information sharing. This might occur across two municipalities, on a subregional basis, or as part of a region-wide effort. Steps to facilitate information sharing include convening town leaders to build coalitions to accomplish specific tasks, or achieve goals; provide materials and resources to municipal committees to enable community engagement; encouraging partnership amongst municipalities pursuing similar actions; and providing region-wide opportunities for sharing best practices and lessons learned.

# Economic Considerations of Action

As discussed in Chapter 2, the cost of doing nothing to address the impacts of rising seas, damaging storms, and Cape Cod's contributions to climate changing emissions is very high. Climate change impacts will reshape our coastline, affect municipal budgets, and disproportionately affect the health and safety of more vulnerable populations. The case for taking strategic action is strong; and yet, taking action also has costs. However, with thought and

preparation, the region can shape the costs into opportunities for economic growth and solid land use planning.

To better understand how climate changes will affect the region economically, and to understand the opportunities to plan for and incorporate needed changes into the region's economic development, the Commission engaged the Eastern Research Group, Inc (ERG) to examine several future GHG

emissions scenarios (see Chapter 4) and analyze impacts and opportunities. Relying on existing data and available research, ERG was able to provide insight into several areas where the Cape is vulnerable to climate change threats. The following section presents the findings of ERG's research and analysis into the costs of taking action to address adaptation and mitigation.





## ADAPTATION STRATEGIES

### ESTIMATING THE COST OF SEA LEVEL RISE AND STORM SURGE IMPACTS

**A mix of adaptation strategies will be needed to deal with building and land losses from sea level rise and storm surge over time; regional solutions will need to be considered.**

Shoreline solutions, such as sea walls and natural infrastructure, could help avoid billions of dollars of losses and in some cases may be cost-effective. However, these types of solutions are expensive and thus it will be most cost-effective to implement these in targeted, densely developed locations where a mile of protection reduces damage to more numerous properties that

A mix of adaptation strategies will be needed to cost-effectively address losses from sea level rise and storm surge and impacts from flooded roads. Siting can help address

the cost-effectiveness of restoration efforts like salt marsh restoration, while integrating regional solutions can help address other impacts to land and infrastructure.



ERG estimates that \$15.3 billion in building damage could occur, another \$14.5 billion in land could be at least partially inundated by sea level rise, nearly \$9 billion in tax revenue could be lost, based on 2020 housing and land prices, and \$600 million in wages could be impacted between 2021 and 2100.



amount to a much higher value.

Coordination will be necessary to ensure that infrastructure in one location does not result in exacerbated flooding in a neighboring area. While shoreline solutions may be cost-effective, this analysis does not reflect losses related to beach, coastal resources, and other ecosystem services that would be lost by widespread shoreline protection solutions. Future studies will need to evaluate

these losses to ensure these valuable resources and recreation opportunities are also protected.

In less densely developed areas, building-level strategies (e.g., flood-proofing and raising buildings) in the near term (to prevent damage from single events) may be more cost-effective. For example, the technical report shows that raising buildings has a benefit of about \$3 to \$5 for every dollar

spent. However, retreat and possible buyouts may be more appropriate for these locations in the long term, when permanent inundation from sea level rise threatens those areas and access to buildings is no longer feasible. ERG found that moving buildings was a much less cost-effective strategy and should potentially be reserved for historic or culturally valuable buildings that cannot be protected with shoreline solutions.



**Shoreline solutions could help avoid billions of dollars of losses; however, they are expensive, and therefore most cost-effective in targeted, densely developed locations.**



### ESTIMATING THE COST OF FLOODED ROAD IMPACTS

**A mix of adaptation strategies will be needed to cost-effectively address the impacts from flooded roads.**

ERG estimates it would cost about \$1.4 billion to rebuild the 212 miles of roads expected to be flooded by 2100, but costs to raise these roads might be eight to 10

times that. In short, the cost of raising all roads will far exceed the benefit of the avoided financial losses. Raising roads will be most cost-effective for segments that serve highly traveled or critical routes, whereas longer-term retreat may make sense in areas that are less dense. Shoreline solutions that can both protect buildings and keep roads dry will provide a dual benefit and make economic sense in denser areas. Further analysis is needed to

determine how, when, and where to apply strategies to raise roads, re-route roads, abandon roads, and protect roads from flooding with shoreline solutions.



ERG estimates flooded roads will lead to the loss of approximately \$290 million in tax revenue between 2021 and 2100 and will isolate just over \$1 billion in property.



## ESTIMATING THE COST OF SALT MARSH RESTORATION

**Restoring salt marshes can have a wide range of benefits, and the location can often determine whether these projects will be cost-effective.**

Marshes provide ecosystem services, including nitrogen removal, carbon sequestration, support for commercial fisheries, and flood protection. Costs for some restoration projects have ranged from about \$11,000 to \$18,000 per acre.<sup>1</sup> The benefits from sequestration alone do not

justify the costs; however, nitrogen removal, fisheries, and flood protection can make these projects break even in a matter of just a few years. Thus, site-specific analysis should be performed to assess the value of flood protection, particularly to determine

the benefit-cost ratio at that site. Additionally, the ability of the marsh to migrate with sea level rise is an important consideration for the longevity of the project. If there is no space to migrate, the lifetime of the benefit will be much shorter.



*Sequestration benefits, when combined with those provided from nitrogen removal, fisheries, and flood protection, can make marsh restoration projects break even in a matter of just a few years.*

<sup>1</sup> "Economic Impacts of Climate Change on Cape Cod, Technical Report" by Eastern Research Group, Inc., and Synapse Energy Economics, Inc.: [www.capecodcommission.org/ClimateAction-Plan-AppendixB](http://www.capecodcommission.org/ClimateAction-Plan-AppendixB)



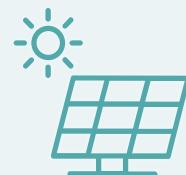
## MITIGATION STRATEGIES

A comprehensive and diverse set of strategies will be needed to meet 2030 and 2050 emissions reduction goals. The Next-generation Roadmap for Massachusetts Climate Policy bill sets an interim 2030

goal of 50% reduction in GHG emissions from 1990 levels, which ERG used to estimate actions necessary to contribute to the Commonwealth's emissions reduction goals.



### HEAT PUMPS



### RENEWABLE ENERGY



### ELECTRIC VEHICLES

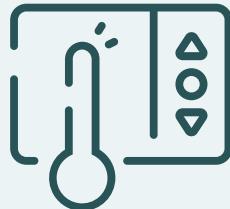


### NET ZERO BUILDING

To achieve a 50% reduction from 1990 levels by 2030 and 85% reduction by 2050 will likely require substantial action and assistance from state and federal governments. At the same

time, homeowners, drivers, and business owners on the Cape are the fundamental actors who can choose electric options for their next heating system or vehicle. Organizations

such as the Cape Light Compact can be key enablers for electric sector decarbonization, as well as for engaging customers about their energy choices.



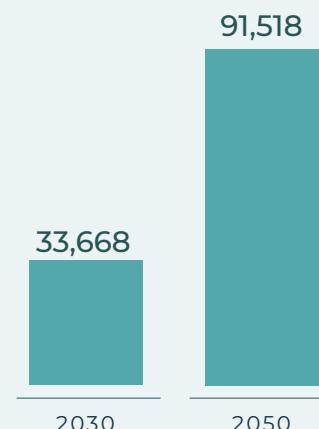
## HEAT PUMPS

*Implementation of electric air-source heat pumps is estimated to be generally cost-effective for residents, leads to substantial health benefits, and is essential to reaching 2030 and 2050 GHG emissions reduction goals.*



Adoption of heat pumps is one of the major contributors to reaching the 2030 and 2050 GHG emissions reduction goals

ERG estimated that at the consumer level, the average annual cost of operating a heat pump when considering purchase price and electricity usage is less than \$2,000 (without any incentives). This cost is comparable to natural gas and much lower than propane or fuel oil, which are about \$800 to \$900 more per year. Given this, it may be easier to push early adoption among residents who use propane or fuel oil to heat their homes.

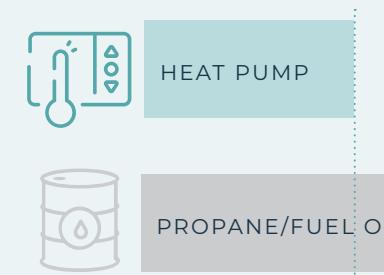


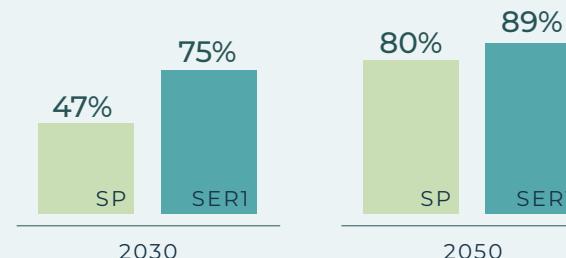
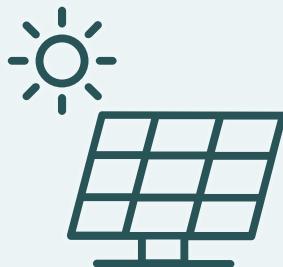
### YEAR-ROUND HOMES WITH HEAT PUMPS IN THE SERI SCENARIO

The aggressive electrification (SER1) scenario (see Chapter 4 for more in-depth description of this scenario) calls for aggressive residential electrification: 18,568 year-round residences (19% of year-round residences) with heat pump retrofits by 2030 and 45,295 (47% of year-round residences) by 2050; 15,100 year-round residences (16% of year-round residences) with whole-home heat pumps by 2030 and 46,223 (48% of year-round residences) by 2050.

\$244  
MILLION

Estimated value of cumulative health benefit between 2021 and 2050 from SER1 by reducing criteria pollutants from adopting heat pumps





### SER1 SCENARIO SHARE OF RENEWABLE ENERGY

These GHG reductions will be challenging to achieve as they require increasing the share of renewable (non-emitting) energy from 47% (sustained policy) to 75% (SER1) in 2030 and from 80% to 89% in 2050.

## RENEWABLE ENERGY

Renewable energy adoption is becoming price competitive and will be an important strategy, coupled with improved battery storage, for meeting GHG emissions reduction goals.

\$147  
MILLION

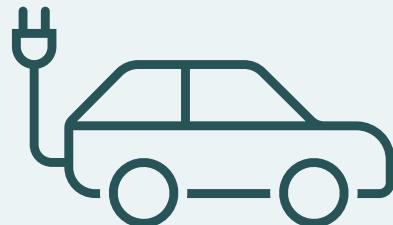
Estimated value of cumulative health benefit between 2021 and 2050 from SER1 by reducing criteria pollutants by expanding renewable energy adoption

### LEVELIZED COST OF ENERGY

price per mega watt hour (MWh), including capital and operating costs



While renewable energy was generally more expensive several years ago, the cost has fallen dramatically as renewable energy technologies have improved and become more mainstream. ERG found the levelized cost of energy (i.e., price per MWh, including capital and operating costs) is now about \$9 to \$43 per MWh for onshore wind, \$26 to \$54 per MWh for offshore wind, \$31 to \$42 per MWh for concentrated/utility-scale solar, and \$150 to \$227 for rooftop residential solar. The levelized cost of energy for natural gas ranges from about \$32 to \$105 per MWh; for coal, it ranges from about \$65 to \$159 per MWh. Increasing the share of renewable energy will require investment in battery storage infrastructure, but as the electric grid becomes cleaner, massive health benefits and GHG reduction benefits will result.



## ELECTRIC VEHICLES

*Outreach and infrastructure around electric vehicle (EV) adoption is necessary to reach emissions goals and save consumers money, and the adoption of EVs will provide health benefits.*

\$82  
MILLION

Estimated value of cumulative health benefit between 2021 and 2050 from SER1 by reducing criteria pollutants by switching to electric vehicles

### Aggressive EV adoption is necessary to reach 2030 and 2050 GHG emissions reduction goals

More aggressive state actions, such as a requirement that 100% of new vehicle sales be EVs by 2035, may allow these targets to be met more quickly.

As EVs continue to become mainstream, their incremental price relative to conventional vehicles will drop while consumers will save on operational costs related to maintenance and fuel. In the absence of any subsidies, ERG estimated that the point at which consumers will start saving money relative to purchasing a conventional vehicle occurs in the 10<sup>th</sup> year of ownership for a car purchased in 2030 (or 12<sup>th</sup> if they need to purchase another in-home charger) and in the 4<sup>th</sup> year of ownership for a car purchased in 2050 (or 7<sup>th</sup> year if they need to purchase

**TO MEET GHG EMISSIONS REDUCTION GOALS, ALL FOUR DECARBONIZATION SCENARIOS MODELED BY ERG AND SYNAPSE REQUIRE THAT:**

**63%-93%**  
of all new vehicle sales be EVs by 2030



**100%**  
of all new vehicle sales be EVs by 2050

another in-home charger). The point in time where owners start saving money for EVs will improve if subsidies become available.

From a regional standpoint, aggressive electrification results in major health benefits by reducing health impacts associated with criteria pollutants from tailpipe emissions.



Electrification will also be one of the most cost-effective mitigation strategies for reducing GHGs. To accommodate about 214,000 light-duty EVs on the road by 2050 (as required to reach 2050 emissions goals in the SER1 scenario), 8,800 public charging stations will need to be installed, which is nearly 4,000 more (at an additional cost of around \$10 million) than would be needed in the sustained policy case. However, ERG estimates that the

incremental benefit is a decrease of over 6.2 million metric tons of CO<sub>2</sub>, yielding a cost-effectiveness of \$1.60 per metric ton of CO<sub>2</sub> reduced. Additionally, the reduction in tailpipe criteria pollutants in this aggressive electrification scenario compared to sustained policy will lead to more than \$82 million in health benefits for the Barnstable County community between 2021 and 2050. Outreach surrounding the economics of



**214,000**

light duty EVs would be on the road by 2050 for the SER1 scenario



**8,800**

public charging stations would need to be installed

ownership, health impacts, and EV-friendly charging infrastructure will help encourage EV adoption.





## NET ZERO BUILDING

Incremental changes to building practices can prepare Cape Cod's housing stock for a green energy future.

The Rocky Mountain Institute (RMI) released a report on zero energy building in 2018 titled *The Economics of Zero-Energy Homes: Single-Family Insights*. The report was updated with a “cold climates” addendum in 2019. The report looked at barriers to both true Net Zero Energy (ZE) and Zero Energy Ready (ZER) building and analyzed whether the incremental costs of ZE

ZER home over traditional building standards

\$1,837 → \$658  
incremental cost increase → Yields yearly energy savings

ZE home over traditional building standards

\$21,050 → \$1,816  
incremental cost increase → Yields yearly energy savings

Source: Rocky Mountain Institute report “The Economics of Zero-Energy Homes: Single-Family Insights”

and ZER building are economically advantageous to homeowners both over the full term of a 30-year mortgage and if the homeowner decides to sell after 12 years.<sup>2</sup> The analysis also looked at consumers’ “willingness to pay” based on National Association of Home Builders research showing consumers are willing to pay an additional 4% of building costs for a ZE or ZER home. While the analysis did not include Cape Cod, the Boston area

was analyzed. The report found that the incremental cost increase in the Boston area for a ZER home over traditional building standards was \$1,837 and would yield a yearly energy savings of \$658. This was cost-effective for homeowners both over 30 years and if they decided to sell after 12 years. The incremental cost increase in the Boston area for a true ZE home was \$21,050 and would yield a yearly energy savings of \$1,816. This was only cost effective for homeowners over the life of a 30 year mortgage.

<sup>2</sup> RMI defines a ZE home as “a highly efficient home that produces as much renewable energy as it consumes over the course of the year.” RMI uses DOE ZERH program’s definition for ZER homes, which is “a high-performance home so energy efficient all or most annual energy consumption can be offset with renewable energy.” This could include scenarios such as full electrification of homes complemented by investment in nearby community solar projects.



## GREEN JOBS

Implementing aggressive electrification and renewable energy could bring green jobs into the region.

ERG estimates that installing heat pumps alone will add about 1.3 million to 1.8 million hours of labor or more than 600 job-years (i.e., 600 jobs in a year or 20 jobs that last 30 years) from 2021 through 2050, and these numbers do not include maintenance hours. Solar installation creates about 15.5 job



### Heat Pump Installation

**1.3-1.8+**

million hours  
of labor

from 2021 through 2050 (not including maintenance hours)

**600**

job-years  
(i.e., 600 jobs in a year or  
20 jobs that last 30 years)



### Solar Installation

**15.5+**

job hours per  
megawatt installed

from 2021 through 2050

**9,300**

job-years  
(i.e., 310 jobs that last 30 years)



### Offshore Wind

Developing 0.6 GW of  
offshore wind capacity on  
Cape Cod by 2050 requires  
approximately 75 jobs  
to serve the Cape's capacity

**75+**

jobs  
(Sustained over the  
life of the projects plus  
construction jobs)



### EV Charging Stations

**More jobs** + + + + + + + + + + + + + +

Additional jobs will be created by the  
installation of thousands of public charging  
stations, which the technical report does  
not quantify



hours per megawatt installed and will lead to about 9,300 job-years over this period (i.e., 310 jobs that last 30 years). ERG found that developing 0.6 GW of offshore

wind capacity on Cape Cod by 2050, requires approximately 75 jobs sustained over the life of the projects (plus construction jobs) to serve the Cape's

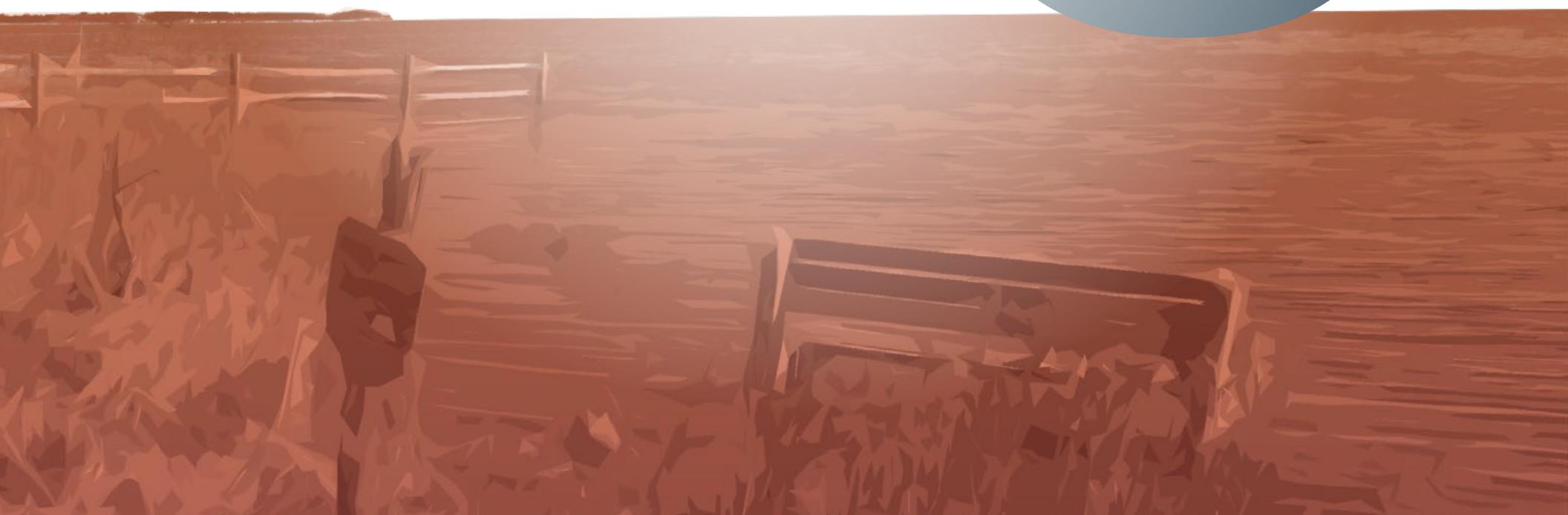
capacity. Additional jobs could be created by the installation of thousands of public EV charging stations, which the [technical report](#) does not quantify.



# Implementation

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The strategies and actions identified through the Climate Action Plan process require the region to come together to implement. Partnerships within government, and with and between non-governmental organizations, researchers, and the business community, will be critical for success. Partnerships must be forged and strengthened to advance the implementation of many actions. Implementation will require all those who live, work, and visit on Cape Cod to advance climate action.



In addition to partnerships, the region must focus on those actions which will begin to have significant impacts on reducing greenhouse gas (GHG) emissions from the sectors with the biggest contributions and those which will help improve the resilience of the region's natural and built systems. Fortunately, there are meaningful actions that the region can take. This chapter addresses how to move priority actions forward and outlines an implementation plan to tackle the first steps. It also provides detail on existing funding opportunities to support implementation, as well as new and innovative funding and financing methods that can be explored further.

A committee or task force should guide and track implementation and foster partnerships and collaboration amongst entities working to improve climate resilience in the region.

## IMPLEMENTING PRIORITY STRATEGIES

Each strategy requires engagement of a variety of actors. Governments will need to work together, across town boundaries, and across levels of government. Some entities are uniquely qualified to address certain actions; many other actions will require partnerships to best implement; yet others may present business opportunities. Coordination and cooperation are needed to forward climate resilience. The following

### Recommendation

Establish a body that incorporates a variety of perspectives to guide and track implementation of the Climate Action Plan

provides a roadmap for each of the categories of actors critical to successful implementation of the Climate Action Plan.



## GOVERNMENTAL ACTORS

### LOCAL GOVERNMENTAL ACTORS

Cape Cod communities have been actively pursuing climate change mitigation and adaption strategies, as evidenced through their efforts to become designated Municipal Vulnerability Preparedness (MVP) communities, obtain Green Communities designation, and evaluate local bylaws

As discussed in Chapter 3, the Policy Context, governmental actors play a significant role in implementing actions to reduce GHG emissions and adapt to climate hazards. While federal and state laws and initiatives

provide the framework for action, there are opportunities for municipal and regional governments to pursue actions relevant to Cape Cod communities.

and regulations to increase mitigation and resiliency measures. In some instances, technical assistance is needed for municipalities to implement actions. Many actions at the municipal level will require broad support from the community, as Town Meeting or Town Council approval will be needed. To accelerate action to address climate change in the region, Cape Cod communities should continue and

expand their efforts, with support from local Climate Action Networks, regional entities, and non-governmental actors. One element of support should include development of detailed local guidance that includes incentives and funding opportunities for specific actions, and existing resources to support implementation.





## LOCAL GOVERNMENTAL ACTORS

### OBTAIN GREEN COMMUNITIES DESIGNATION

Communities that have not yet achieved Green Communities designation should pursue this action. This includes adoption of the Massachusetts stretch building code and associated three-year updates, consistent with the requirements of the Green Communities Act. Already designated Green Communities should actively pursue strategies to reduce municipal energy use by 20%, as committed to during the Green Communities designation process.

### ADOPT COMPLETE STREETS POLICIES

Communities that have not yet adopted complete streets policies and developed prioritization plans should pursue these actions. Complete streets are ones that provide safe and accessible options for all modes of travel and can help to encourage less personal vehicle travel, a significant

source of GHG emissions, and more opportunity for walking, biking and transit.

### COMMUNITY LEADERSHIP

Municipalities can exhibit leadership on climate mitigation and adaptation through modifications to their own buildings, assets, and practices. Cape communities should work with Cape and Vineyard Electric Cooperative (CVEC) to develop solar projects on town buildings, as appropriate. Communities should prioritize energy efficiency measures in public buildings. To increase efficiency, towns should consider dedicating municipal renewable energy revenues for public building retrofits and energy upgrades, performing energy assessments on all municipal buildings, and working with Cape Light Compact to access available programs.

For public infrastructure projects, communities should utilize available tools to improve energy use. For example, as

communities continue to develop wastewater infrastructure, they should apply the U.S. Department of Energy's Sustainable Wastewater Infrastructure of the Future (SWIFT) toolkit.

Towns should also establish procurement rules for new construction that specify, at a minimum, low energy demand and solar readiness. In addition, towns should consider incorporating standards for the procurement of products and services.

Municipal vehicle fleets should be evaluated and prioritized for conversion to electric vehicles. Conversion of vehicle fleets should be included in capital planning. A feasibility study of the conversion potential of vehicle fleets could be completed at the local, county, or state scale. For fleets that will not be converted to electric in the near-term, towns should consider the use of hybrid vehicles or cleaner fuels, as available.



## LOCAL GOVERNMENTAL ACTORS

### LOCAL PLANS

Some Cape Cod communities may choose to develop their own local climate action plan. Elements of the Cape Cod Climate Action Plan can be incorporated and are intended to be utilized at the local scale, but towns that choose to develop a local plan should take into account location specific climate

challenges and engage stakeholders from their community.

When a local climate action plan is developed or as communities undertake new planning initiatives or updates to existing plans, the impacts of climate change and opportunities for adaptation and mitigation should be considered and

included. Community visioning processes and Local Comprehensive Plan development should incorporate elements relative to GHG reduction, carbon sequestration, and coastal resilience. Economic development planning should consider both the impacts of climate change and economic opportunities to contribute to climate action.

### PROCUREMENT EXAMPLES & RESOURCES

The Massachusetts Executive Office of Administration and Finance has established Minimum Standards for Sustainable Design and Construction of New Buildings and Major Renovations for Executive Agencies, which outlines different compliance standards for small and large projects.

The City of Cambridge has a Green Fleet Policy which requires the city to identify three (3) vehicle options and compare them based on fuel economy and emissions, using the US EPA Green Vehicles Guide.

The Massachusetts Environmentally Preferable Products (EPP) Procurement program has a Products and Services Guide to assist in identifying EPPs. The Guide includes energy and water efficient products, recycled content and less toxic materials, and recycling and landscaping services, to name a few.

The United Nations Procurement Practitioner's Handbook includes a section on Sustainable Procurement with discussion on the benefits of sustainable procurement and criteria to consider in purchasing.



## LOCAL GOVERNMENTAL ACTORS

Other planning efforts, such as open space and coastal access plans, should consider the impacts of climate change and incorporate efforts to mitigate and adapt to this challenge.

All Cape Cod communities have developed a list of priorities to address climate change through the MVP process and as community-wide plans are developed, these priorities should be addressed to the extent feasible and appropriate.

### COMPREHENSIVE REVIEW OF LOCAL BYLAWS AND REGULATIONS

A review of municipal bylaws and regulations should be completed by each community. The review should focus on opportunities to encourage and incentivize practices that result in emissions reduction and increase

coastal resiliency. In some cases, review should consider areas where more strict practices may be necessary. During review, communities should consider:

- opportunities to encourage solar or other renewable energy generation on commercial and industrial buildings, electric vehicle spaces and charging stations
- incentives for energy efficiency and conservation through cool roofs, green roofs, efficient appliances and systems, and sub-metering (metering by building unit)
- incentives for onsite or local renewable energy and redevelopment
- providing density bonuses or increased coverage for developments that are redeveloping or infilling
- new floodplain bylaws and/or wetlands regulations to address development and redevelopment in vulnerable areas, including reducing new development in flood hazard areas
- zoning that minimizes impervious surfaces, allows multi-story buildings, and otherwise allows for more natural area for carbon sequestration
- opportunities to maintain vegetation, revegetate disturbed areas with native species, and retain large diameter trees and specimen trees to support carbon sequestration
- methods for protecting public access to the coast as vulnerable areas become inaccessible to the broader community.

The above considerations are not an exhaustive list.



## LOCAL GOVERNMENTAL ACTORS

### CAPE COD COMMISSION MODEL RESILIENCY BYLAW

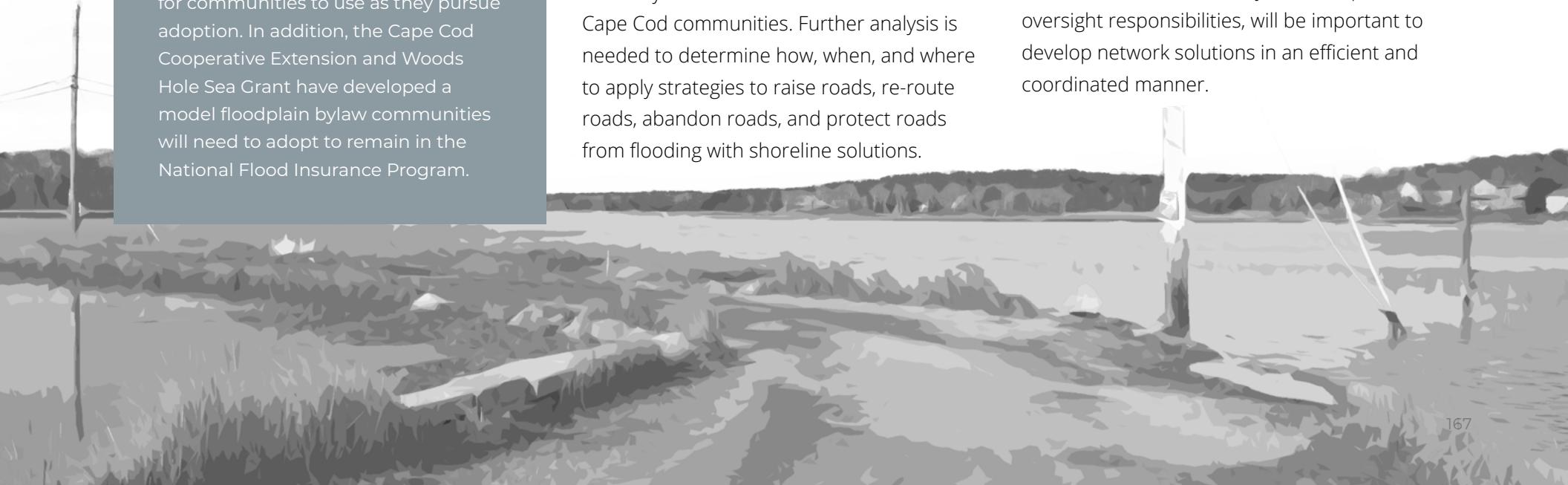
The Cape Cod Commission (Commission) is developing a model resiliency bylaw that will include a menu of options and best practices and will serve as a resource for Cape Cod communities. This model resiliency bylaw project includes development of outreach strategies for communities to use as they pursue adoption. In addition, the Cape Cod Cooperative Extension and Woods Hole Sea Grant have developed a model floodplain bylaw communities will need to adopt to remain in the National Flood Insurance Program.

#### ADDRESS VULNERABLE PUBLIC INFRASTRUCTURE

Towns should update or complete an inventory of vulnerable public infrastructure, including but not limited to wastewater, water supply, transportation, and energy infrastructure, and prioritize infrastructure improvements and pursue funding to support necessary retrofits or resiliency initiatives.

Roadways are an area of critical concern for Cape Cod communities. Further analysis is needed to determine how, when, and where to apply strategies to raise roads, re-route roads, abandon roads, and protect roads from flooding with shoreline solutions.

Analysis could assist municipalities to identify and prioritize road segments based on criteria including level of traffic and criticality for evacuation and emergency access. Longer-term retreat strategies may be appropriate in areas that are less traveled, less dense, or where access can be gained from other roadways. Coordination with the Massachusetts Department of Transportation (MassDOT) on state highway and roadway projects, and other agencies or authorities with roadway ownership or oversight responsibilities, will be important to develop network solutions in an efficient and coordinated manner.





## LOCAL GOVERNMENTAL ACTORS

### EVALUATE AND PRIORITIZE AREAS FOR SHORELINE SOLUTIONS

Certain areas of a community may be best suited for certain solutions, based on density of buildings, infrastructure present, community character, and presence of natural resources. Communities should identify areas appropriate for various solutions, prioritize investments or actions based on community need, and pursue funding, as appropriate. The following are

elements for consideration:

- Nature-based or structural shoreline solutions may be suitable in some densely developed areas with high-value assets
- In less dense areas, consider building-level solutions in the near-term, combined with longer-term retreat options
- Reserve building relocation options for historic or culturally valuable buildings that cannot be protected with shoreline solutions, as relocation is less cost-effective and identifying available parcels for the relocated buildings can be challenging

- Identify opportunities for undevelopment with willing owners and evaluate if available buy-out programs might be appropriate for reducing vulnerability in discrete areas

### SUPPORT DEVELOPMENT OF INFRASTRUCTURE TO ACCELERATE GHG REDUCTIONS

Cape Cod communities should pursue opportunities to support development of infrastructure that will reduce reliance on fossil fuels and accelerate GHG reductions. Communities should pursue resources and programs that support the development of additional public EV charging stations





## LOCAL GOVERNMENTAL ACTORS

and encourage installation of stations in areas where people park for extended periods of time, such as Community Activity Centers, transportation terminals, and public parking areas.

The Solarize Massachusetts Program is not currently offering funding, but towns may wish to pursue adoption of small-scale community solar through other grant opportunities.

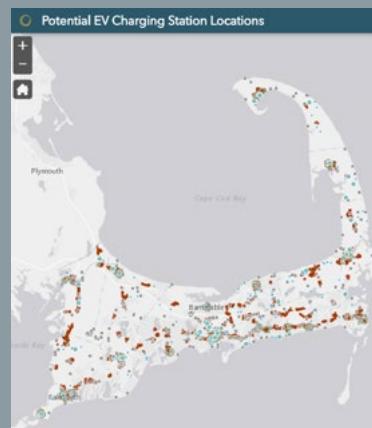
### ACCESS FUNDING

Cape Cod communities have worked to prioritize climate and coastal resiliency strategies through local planning efforts and the MVP process. There are a variety of funding sources available to communities for climate and coastal resiliency projects, including but not limited to MVP Action Grants and Coastal Zone Management Grants. Communities should continue to

pursue these funding opportunities to implement local priority actions. As funding opportunities evolve, communities should continue to evaluate new sources of funds and their applicability for local projects. In some circumstances, communities should consider new and innovative approaches to funding and financing, such as climate impact fees, or energy financing districts.

### EV CHARGING STATION ANALYSIS

Commission staff have developed a [screening analysis](#) that identifies potential locations appropriate for EV charging stations.



### SOLAR SCREENING TOOL

A Commission [screening analysis](#) illustrates areas that might be appropriate for industrial scale solar infrastructure on Cape Cod.





## REGIONAL GOVERNMENTAL ACTORS

There are opportunities for Barnstable County to assist municipalities by providing technical assistance and resources, coordinating with State and Federal agencies to access resources and address infrastructure, and promoting infrastructure to accelerate GHG reductions both in County-owned buildings and across the region.

To date, the County has served as a resource for communities and other regional partners. The Commission and the Cape Cod Cooperative Extension staff are certified MVP providers. Both advise on floodplain and coastal resiliency issues and provide resources, such as model bylaws, for use by municipalities. To support Cape Cod communities and accelerate action to reduce GHG emissions, the County should continue and expand its efforts.

There are also opportunities for regional governmental entities outside of Barnstable

County to further climate action. Entities such as the Cape Cod Regional Transit Authority, Cape Light Compact (CLC), and CVEC have opportunities to support infrastructure and services necessary to reduce reliance on fossil fuels and GHG reductions.

### REGIONAL LEADERSHIP

There are additional opportunities for Barnstable County to lead climate resilience efforts. The County should consider EVs to address the future vehicle purchases and consider a feasibility study on the potential for electrification of vehicle fleets across the region. This type of study could be conducted at the local or state scale; however, to expedite action at the local scale, Barnstable County could complete a regional study that addresses more common vehicle fleets, which would have the potential to benefit all 15 Cape Cod communities as they evaluate the future of their fleet.

Working with Cape Light Compact, Barnstable County should consider conducting energy assessments of existing buildings and identify energy efficiency improvements. The County should prioritize energy efficiency measures in public buildings and, similar to what is noted above for municipalities, the County should consider adoption of procurement rules for new construction of County buildings that specify low energy demand and solar readiness. In addition, the County should consider incorporating standards for the procurement of products and services.

The County should evaluate work with CVEC to develop solar projects and the installation of publicly available EV charging stations at County-owned buildings, as appropriate.

### INCREASE ENERGY EFFICIENCY OF BUILDINGS

The Cape Light Compact has offered no-cost energy assessments to all Cape residents and businesses for over twenty years and



## REGIONAL GOVERNMENTAL ACTORS

their energy efficiency programs continue to evolve. Cape Light Compact is in the unique position to assist residents and business in reducing their carbon footprint through energy efficiency measures such as heat pumps and by offering customers a choice in their electricity supply. They should continue

to facilitate these important activities and expand their programs.

### DATA AND INFORMATION

The Commission should continue to provide data and information to support effective community decision-making. Through

development of the Cape Cod Coastal Planner and the Regional Greenhouse Gas Emissions Inventory, the Commission provided information to help identify possible shoreline solutions in appropriate areas and identify

high emitting sectors to focus GHG reduction strategies. These tools should be updated and maintained. In addition, the Commission should develop additional tools to measure and communicate progress on climate goals and regional performance measures discussed in Chapter 10.

The Commission should continue to support existing regional datasets, development or acquisition of new data,





## REGIONAL GOVERNMENTAL ACTORS

and data accessibility. As appropriate, the Commission should seek updates to aerial imagery and planimetric data acquisition, and should pursue collection of LiDAR to support increased understanding of potential coastal risk. The Commission and the Cape Cod Cooperative Extension should collaborate

with the Center for Coastal Studies to complete the stormtide pathways analysis for the Nantucket Sound shoreline, which is currently underway, and seek funds to complete the analysis for shoreline segments along Buzzards Bay and the Atlantic Ocean.

To support opportunities for carbon sequestration, the Commission should

partner with local institutions, such as the Woodwell Climate Research Center and others, to develop a methodology to better estimate carbon sequestration from existing natural resources. In addition, the Commission should support an inventory of remaining areas available for open space protection, and prioritization of areas, in part based on their ability to sequester carbon.





## REGIONAL GOVERNMENTAL ACTORS

### MODEL BYLAWS AND DESIGN GUIDELINES

The Commission has expertise and experience developing model bylaws and design guidelines for application by towns for a variety of development and land use purposes. Most recently, the Commission engaged in development of a model resiliency bylaw, which is anticipated to provide a menu of best practices relative to sea level rise, flooding, and erosion, and development of design guidelines for buildings in the floodplain, which will help property owners and local permitting bodies better understand how to support resilient structures in the floodplain in a way that complements Cape Cod's character. This work should continue and the Commission should support communities in adopting and implementing appropriate practices and guidelines into local bylaws and project review.

The Commission should further support communities in their review and amendment of bylaws through development of a model bylaw that supports energy efficiency in buildings, a model solar bylaw, and design guidelines for solar canopies. These resources can be applied by communities, as well as through the Commission's own technical guidance, and will support efforts to reduce energy demand and develop renewable energy infrastructure that is context sensitive.

### SUPPORT EFFORTS TO ADDRESS VULNERABLE INFRASTRUCTURE

Through the MVP planning process, Cape Cod communities identified vulnerable roadways as critical infrastructure needs. While raising roads will be most cost-effective for segments that are highly traveled or critical routes, there are a variety of other approaches, such as re-routing, abandoning, and utilizing shoreline management strategies to address vulnerabilities. In areas

where there is more dense development in addition to vulnerable roads, structural shoreline solutions may be economically feasible. In any case, further analysis is needed to determine how, when, and where to apply strategies to raise roads, re-route roads, abandon roads, and protect roads from flooding with shoreline solutions.

The Commission has been working with communities to seek funding for alternatives analysis and development of conceptual designs for vulnerable roadways. In addition, the Commission was the recipient of an Economic Development Administration grant to support, in part, efforts to this end. The Commission should continue to support communities as they work to increase resiliency of critical roadways. In addition, the Commission should collaborate with towns and MassDOT to ensure critical and highly traveled state-owned roads are resilient to the impacts of flooding.



## REGIONAL GOVERNMENTAL ACTORS

### REDUCE PERSONAL VEHICLE TRIPS

The current transportation system on Cape Cod, and the geography of the region in general, requires most trips to be taken in



personal vehicles. The Cape Cod Regional Transit Authority has seen steady increases in ridership over the past decade through strategic service enhancements and implementation of innovative initiatives and partnerships. Additional investment in public transit will be needed to make this a viable option for more residents and visitors by expanding routes, expanding service days/ hours, increasing frequency, and adding new services like year-round passenger rail service.

Additional investments will also be needed in bicycle and pedestrian infrastructure that, paired with public transit, will allow for more low-carbon and no-carbon trips. Considering these investments from a regional perspective will allow strategic improvements that build towards a transportation network that is more consistent with the goals of the Climate Action Plan.

Finally, with recent advancements in communications technologies, and wider acceptance of these technologies, many vehicle trips can be eliminated entirely. The COVID-19 pandemic made remote work, virtual public meetings, telehealth, and other virtual engagements much more common occurrences, which are likely to continue in many instances. To ensure virtual connectivity occurs in an equitable manner, attention will need to be paid to economic and geographic factors that can limit access to technology and high-speed internet.



## REGIONAL GOVERNMENTAL ACTORS

### SUPPORT INFRASTRUCTURE THAT ACCELERATES GHG REDUCTIONS

There are several regional entities well-positioned to support infrastructure that accelerates GHG reductions. CVEC is responsible for developing renewable energy generation facilities.<sup>1</sup> CVEC should continue to work with member communities to develop and expand this infrastructure in appropriate locations.

Other regional entities in charge of transportation terminals and parking lots where people park for extended periods are in the position to support renewable energy production/battery storage/charging at key sites across the region. This includes the strategic development of additional public EV charging stations across the region.

These sites are identified in the [EV Charging Station Analysis](#).

### COMMUNICATION AND OUTREACH

The Commission developed a Communications Framework to support implementation of the Climate Action Plan. This resource provides pathways for a coordinated and effective strategy for delivering key messages and engaging with communities across Cape Cod about climate change and actions to mitigate its causes and adapt to its impacts. This is a resource that can be used by a variety of actors. It must evolve as the nature of both local and regional climate action continues and the Commission should maintain it as a resource into the future.

As has been previously stated, personal choices and behavior changes will be critical to successfully reducing GHG emissions in the region. Homeowners and business

owners are the fundamental actors who can choose electric options for their next heating system. If large numbers of individuals choose electric vehicles over gas powered vehicles in the coming years, their collective impact on lowering GHG emissions would be significant. Fact-based outreach on the economics of electric options, the impact on GHG reductions, and other co-benefits, such as impacts to health, will be necessary to encourage adoption.

The County, Commission, Cape Light Compact, Cape Cod Regional Transit Authority, and other regional entities, should support studies, data gathering, and resource development to better communicate the benefits and considerations of these options.

<sup>1</sup> Cape and Vineyard Electric Cooperative. "CVEC | electric cooperative." <http://cvecinc.org/>



## STATE GOVERNMENTAL ACTORS

Cape Cod is a seasonal destination that relies on its natural resources to fuel its predominately tourism-based economy. It draws visitors from elsewhere in Massachusetts, New England, and across the Country and contributes significantly to the Massachusetts economy. It is also a location that is more severely impacted by climate change than many others in the state. The Commonwealth's administration has been a leader in establishing programs and providing resources to communities to facilitate adaptation and mitigation actions, and overall climate resiliency. The state must continue to expand opportunities for communities in order to achieve the state GHG emissions reduction targets in a way that does not further exacerbate housing and economic development related challenges. Recognizing Cape Cod as a critical source of funding for the state, and as an area disproportionately impacted by climate change, the state should prioritize Cape Cod for funding and technical assistance

opportunities, such as those provided through the MVP Program and MA Coastal Zone Management.

### **EXPAND THE MVP PROGRAM**

Cape Cod communities, along with others across the state, dedicated considerable time and effort to complete the MVP planning process and become eligible for MVP Action Grants. Many communities in the region relied on the Commission to facilitate the planning process and complete their plan. The Commission, and other Regional Planning Agencies across the state, are in the unique position of being able to look at priorities across town boundaries and identify common themes and potential for regional action on priorities that transcend all or multiple communities.

MVP Action Grants are a critical source of funding for implementation of the priority actions identified through the MVP planning process. Where communities share priorities,

resources may be used most efficiently when they work together. To date, towns are the only eligible applicants for action grants. Expanding eligibility to include Regional Planning Agencies will facilitate regional projects and allow communities to more effectively and efficiently implement their priority actions. The Commonwealth should expand the eligibility criteria for access to these funding opportunities. Additionally, the MVP program should work to ensure that MVP Action Grant criteria align with the vulnerability planning priorities communities worked hard to identify.

### **Recommendation**

Communities should continue to pursue MVP Action Grants, and the County, Cape Cod Commission, and others should support communities in this effort



## STATE GOVERNMENTAL ACTORS

### DEVELOP NEW FUNDING MECHANISMS

The region will need new sources of funding to help address needed coastal resiliency and mitigation actions. Strategies for reducing the vulnerability of coastal properties and for protecting carbon-sequestering habitats will need to be multi-faceted, and cannot rely on acquisition alone. Communities should have access to funds or funding mechanisms that will help them move quickly to preserve strategically important properties when opportunities arise; and to continue in the Cape's decades-long effort to protect signature open spaces that help preserve existing landscape networks, or help restore key habitat linkages.

### FACILITATE IMPLEMENTATION OF INFRASTRUCTURE TO REDUCE GHG EMISSIONS

The state should identify and pursue opportunities to encourage and incentivize

infrastructure necessary to reduce GHG emissions, such as renewable energy installations and EV charging stations. In addition to incentives, the state can lead by example on state-owned property by incorporating EV charging stations and solar installations in appropriate areas. To promote solar installations on new and existing buildings, the state should expand solar incentive programs, such as Solarize Massachusetts, to all Cape Cod communities.

Maximizing energy efficiency in new commercial, industrial, and publicly funded construction will require state government engagement. There are a variety of steps that contribute to maximizing energy efficiency. To support this strategy, the state should expand access to and encourage home energy assessments, institute a renewable fuel standard for heating systems, and expand on EV and PV readiness within the

building code. Also through the building code, the state should encourage energy conservation through cool roofs, green roofs, and sub-metering.

### MASSACHUSETTS LEAD BY EXAMPLE PROGRAM

The [Commonwealth's Lead by Example program](#) currently has several initiatives to advance the transition to green energy: Building Energy Efficiency, Non-Building Energy Efficiency, Greenhouse Gas Reduction, Green Buildings, Renewable Energy, and Sustainable Transportation.



## STATE GOVERNMENTAL ACTORS

### PROMOTE REMOTE WORK

The COVID-19 pandemic forced many to adjust to a new way of working. Segments of the work force transitioned to working from home, in-person quorum requirements were relaxed for public bodies, and most public meetings began taking place in a virtual environment. This has resulted in fewer vehicle miles traveled by employees, elected and appointed officials, and citizens wishing to participate in public meetings. As the state emerges from the pandemic, there are opportunities for continued remote work that have the potential to reduce GHG emissions from the transportation sector in the future. The state should consider policies to promote remote work and can lead by example through the provision of remote work arrangements for state employees, as appropriate. In addition, the State could consider permanently relaxing in-person quorum requirements to allow flexibility in holding in person or virtual public meetings.

### EXPAND ACCESS TO ELECTRIC VEHICLES

Meeting the state goal of net zero emissions by 2050 will require aggressive electrification of the transportation sector. All of the emissions reduction scenarios presented in this plan require 100% of new vehicles sold to be EVs by 2050. The state's 2050 Decarbonization Roadmap includes the reduction of emissions from passenger cars and a plan to ban the sale of new gasoline-powered cars by 2035. The state should continue to pursue this aggressive approach, while also expanding incentives to address affordability concerns that may hinder the purchase of these vehicles.

The state should also support municipalities, through technical assistance and funding, as they convert municipal vehicle fleets to EVs or hybrid vehicles. State guidance on conversion potential of standard and specialized vehicle fleets, as well as

prioritizing fleets for conversion, should be developed to promote informed decision-making at the local level.

### ADAPT TO IMPACTS

Climate change has resulted in increased storm intensity and rainfall, which impacts infrastructure, emergency response, residents, and visitors. Stormwater management is a critical need to address the impacts that result from these increases. It is necessary to coordinate with the Massachusetts Department of Environmental Protection to revise stormwater regulations and guidance in order to reduce impacts. In addition, the Massachusetts Department of Transportation should coordinate with towns and the Commission to resolve areas of overlapping authority and pursue state highway and roadway projects necessary to reduce climate vulnerabilities.

Vulnerable locations that are highly critical to the operation of the transportation



## STATE GOVERNMENTAL ACTORS

system, such as the Orleans/Eastham Rotary and segments of Route 6 on the Outer Cape, should be prioritized. Some vulnerable areas of the coast are not suitable for new development and should be prioritized for permanent protection. Communities may be able to raise funds to acquire and permanently protect discrete parcels, but acquisition is not a panacea. The state should advance the implementation of transfer of development rights (TDR) programs through state guidance and model regulations, including provisions to allow for

intermunicipal TDR programs. TDR should be used to incentivize denser development in areas with the infrastructure to support new housing or mixed uses, and to discourage development in floodplains and other high-hazard areas along the coast.

Other areas along the shoreline, particularly where existing development or public infrastructure is vulnerable, may be suitable for green infrastructure, or nature-based solutions (NBS). NBS comprise many different approaches to stabilizing the

shoreline, but most blend engineered structures with habitat enhancements or restoration. Barriers to permitting NBS still exist, in addition to the need for education and funding to implement these projects. Yet other properties may be suitable for “undevelopment” or buy-outs where willing landowners and the opportunity for coastal resource restoration intersect; these projects will also require funding and permitting flexibility to execute.





## FEDERAL GOVERNMENTAL ACTORS

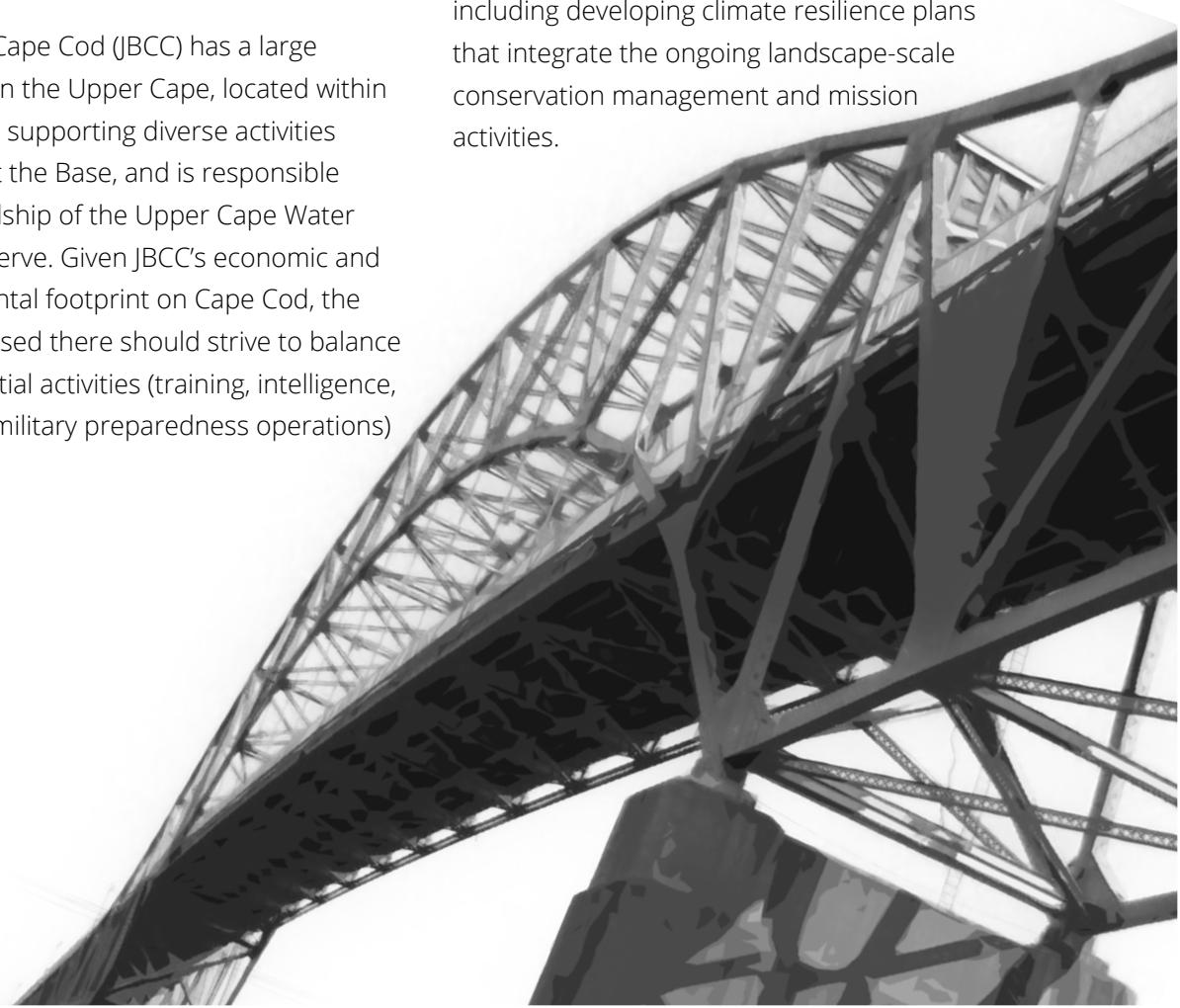
The Cape Cod National Seashore participates in the Climate Friendly Parks (CFP) program, and in alignment with the CFP has developed a GHG emissions inventory and a Climate Action Plan for the Seashore. A “Green Team” within the Seashore staff works to advance the park’s Climate Action Plan. The Seashore should continue to work with surrounding communities and regional entities in partnerships and new initiatives to advance shared goals. Specifically, the Seashore and Commission should explore areas of potential collaboration.

The United States Army Corps of Engineers’ (USACE) primary presence on Cape Cod is in maintaining the Cape Cod Canal and bridges. Canal maintenance involves dredging and disposal of sediments trapped by the canal jetties, which have significant effects on the long-term viability of down-drift coastal neighborhoods in the Town of Sandwich. The USACE should be proactive in exploring, with the Town of Sandwich, ways to reduce

the impacts of the canal infrastructure on the natural functions of coastal resources in this area.

Joint Base Cape Cod (JBCC) has a large presence on the Upper Cape, located within four towns, supporting diverse activities throughout the Base, and is responsible for stewardship of the Upper Cape Water Supply Reserve. Given JBCC’s economic and environmental footprint on Cape Cod, the Services based there should strive to balance their essential activities (training, intelligence, and other military preparedness operations)

with climate change planning and emissions reductions. Agencies and Services at JBCC should continue comprehensive planning, including developing climate resilience plans that integrate the ongoing landscape-scale conservation management and mission activities.





## NON-GOVERNMENTAL ACTORS

### PROVIDE INFORMATION

Non-governmental organizations serve as information resources. Each has a constituent base that trust the information they provide and engage in outreach efforts. All NGOs engaged on the topic of climate change have a role to play in providing fact-based data and information on its causes and impacts.

Local climate action networks and environmental advocacy organizations should provide information and raise awareness amongst the general public of the efforts by government entities to adapt to climate hazards and reduce GHG emissions. They should encourage attendance at town

The Cape Cod community has a history of active and engaged non-governmental organizations (NGOs), who have a significant role to play as the region takes action to address climate change. Non-governmental actors range from environmental

meetings and elections where votes will influence local climate action and advocate for actions at a variety of scales.

Local climate action networks and land trusts should educate the public on the role of natural resources in adapting to and mitigating climate change. Information on the importance of, and benefits provided by, tree canopy and open space, and the carbon sequestration potential and flood protection provided by open space and marshes should be communicated through a variety of means and venues. The importance of open space and undeveloped areas that allow for marshes to migrate with sea level rise is also an important concept to convey to the public.

advocacy organizations, housing advocates, civic organizations, land trusts and others. While each may have a different perspective and role, the region will benefit from a unified voice on the need for climate action.

### ENCOURAGE INDIVIDUAL BEHAVIOR CHANGE

Cape Cod homeowners, drivers, and business owners are the fundamental actors who can choose electric options for their next heating system or vehicle. Non-governmental organizations should develop and implement communications campaigns to encourage individual adoption of electric options, in addition to supporting local governmental actions to implement the infrastructure necessary to support individual actions (such as EV charging infrastructure).

It will also be important to share information and resources, such as the carbon footprint calculator linked from the Cape Cod Commission website (available at [www.](#)



## NON-GOVERNMENTAL ACTORS

[capecodcommission.org/climate](http://capecodcommission.org/climate)), to help individuals understand their carbon footprint and strategies to reduce their individual contribution to climate change.

NGOs engaged in housing, such as Housing Assistance Corporation, can support energy efficiency and climate-friendly building practices in affordable housing through their efforts to promote energy efficiency. They have historically done this through energy assessments and by providing no or low-cost energy efficient devices and they should continue to expand these efforts. In collaboration with partners, such as the Cape Light Compact and the construction and development community, they should continue to promote and utilize incentives that will allow for the development of more climate-friendly affordable housing.

### PROMOTE ENERGY EFFICIENCY THROUGH HOME SALES

The Cape Cod and Islands Association of Realtors (CCIAOR) collect and make available data on energy efficiency and other climate-friendly home features. Additional opportunities exist for home energy and efficiency data to be made more readily accessible to homebuyers. CCIAOR should continue to support the collection of energy and efficiency data for homebuyers. They should consider additional methods for collecting information on retrofits and renewable energy installations for inclusion in homebuyer information and should consider means for including home energy scorecards or efficiency data in building sale transactions.

### INCREASE OPEN SPACE, GREEN SPACE, AND TREE COVER

Land trusts have a long history of open space protection efforts on Cape Cod and their work contributes to carbon

sequestration, flood protection, and climate adaptation across the region. Recognizing that there is limited land left for either permanent protection or development, land trusts should work with other regional organizations, such as the Association to Preserve Cape Cod, to identify, prioritize, and acquire areas for protection. Prioritization should, in part, consider areas where open space is lacking and where there is the greatest potential to provide public access.

Land trusts and other non-governmental and civic organizations should work with towns to increase park and green space on abandoned or underutilized spaces and in activity centers, and should support tree planting programs, with a focus on shade-starved areas and opportunities to provide building shading or cooling benefits.



## BUSINESSES

The Cape Cod economy and its top industries—health care, retail trade, and accommodation and food services—all rely on a healthy natural environment that draws visitors and year-round residents alike. Businesses can support climate action and contribute to reducing regional GHG emissions through their day-to-day operations. Certain sectors of the economy may

benefit from climate action strategies, which have the potential to create additional jobs. The business community has a role to play in mitigating GHG emissions from business activities, and supporting broader implementation of priority climate actions that expand renewable energy, EV charging stations, and other infrastructure necessary to contribute to the state's climate goals.

### BUSINESS LEADERSHIP

Businesses should invest in renewable energy for business operations. Businesses in the hotel, restaurant, retail, service, and other industries can utilize their investment in renewable energy as a branding strategy. In addition, businesses should set an example by providing EV charging stations, incorporating climate-friendly building products and increasing energy efficiency in their buildings, as appropriate.

Furthermore, community banking partners should work with businesses to finance and install renewable energy systems.

### PROVIDE TRAINING

Organizations that support the region's business community, such as chambers of commerce, SCORE, Lower Cape Community Development Partnership, and others, should consider developing and hosting trainings to support implementation of climate-friendly business practices. Trainings could include topics such as the use of technology to manage heating and cooling in hotels and other lodging establishments, or restaurant kitchen upgrades that improve efficiency and reduce costs. The Homebuilders and Remodelers Association of Cape Cod, along with other construction trade organizations, should consider opportunities to provide

training and information on climate-friendly building practices and products.

### RESPOND TO WORKFORCE NEEDS

Cape Cod businesses, particularly those in the fields of engineering, construction, and trades, should play a role in the transition to electrification. The installation and maintenance of heat pumps, solar arrays, offshore wind infrastructure and EV charging infrastructure will create new jobs and Cape Cod businesses and those organizations that provide business assistance should work with educational institutions to prepare the workforce for these investments.



## RESEARCHERS AND EDUCATIONAL INSTITUTIONS

### WORKFORCE TRAINING

The business community will need a highly trained workforce to support the transition to electrification necessary to reduce GHG emissions. Training is needed for construction of renewable energy installations, retrofits, servicing and maintenance, among other skills. Technical high schools, Cape Cod Community College, the Cape Cod Homebuilders and Remodelers Association, Cape Light Compact, and other partners should work with the business community and organizations that provide business assistance to determine training needs and develop programming to support appropriate workforce development.

Research and educational institutions have significant roles to play in planning for and implementing climate action. Cape Cod is home to world class research institutions focused on a variety of pressing topics for the region, including climate change impacts, adaptation options, and opportunities for mitigation of GHG emissions. These

institutions also have a breadth of knowledge on the region's natural resources and can help to clarify the potential for carbon sequestration in uplands and wetlands. In addition, educational institutions can support training for new workforce opportunities to support implementation of climate actions.

### DATA AND INFORMATION

Carbon sequestration is critical to Cape Cod's response to climate change. Additional research and data are necessary to understand the carbon sequestration potential of natural resources present in the region and to identify areas with high carbon stocks. Local research organizations should play a significant role in providing data and information to support prioritization of natural resource areas that contribute to reducing the impacts of climate change and mitigating GHG emissions. Woodwell Climate Research Center is well-positioned for this research and should be a key partner in efforts to better understand carbon sequestration in the region.

### SUPPORT SALT MARSH PROTECTION AND RESTORATION

Salt marshes provide ecosystem services such as flood protection and carbon sequestration. To support protection and restoration of salt marsh resources, research institutions should analyze the costs and benefits of thin layer deposition to support salt marsh resilience, should inventory salt marsh locations, and identify specific threats. These efforts should be in collaboration with NGOs, such as the Association to Preserve Cape Cod (APCC), and governmental entities, such as the Commission.



Furthermore, research institutions should collaborate with NGOs, such as APCC, and governmental entities, such as the Commission and Woods Hole Sea Grant to

provide public education on the salt marsh ecosystems, services they provide, methods property owners can apply to protect and restore salt marshes on their property, and

the need for space to allow for salt marsh migration with sea level rise.





## FUNDING RESOURCES

In consideration of significant federal assets like the Cape Cod National Seashore, and the business activity and tourism revenues that Cape Cod's economy generates, the federal and state governments have a vested interest in helping the region realize

### Recommendation

**Identify funding sources.**  
Some funding will come from federal or state grant funds, but municipalities must identify areas where municipally funded investments can reduce GHG emissions or adapt to climate hazards

Strategies and actions to reduce GHG emissions and adapt to the impacts of climate change across Cape Cod will require significant funding to implement. As with other

its climate goals. Additionally, Cape Cod will have to commit its own financial resources toward making the necessary investments, and will have to successfully compete for grant funds. Alternate public or private funding sources such as Green Banks could help finance projects. Cape businesses may also capitalize on the need to shift to climate-friendly solutions. Another potential tool for incentivizing energy efficiency and creating a revenue source to support other climate adaptation efforts is climate impact fees.

Funding opportunities will evolve with state and federal policies and budgets, and identifying and developing new sources and strategies for funding should be an ongoing effort.

aspects of this plan, implementation will require partnerships across levels of government, and between the private and public sectors.

Following is a brief exploration of potential funding sources, though much more needs to be done to identify equitable means to pay for the infrastructural and other changes that are needed to transition to a more carbon-neutral environment.





## FEDERAL AND STATE FUNDS

### Green Banks

A green bank is a tool designed to accelerate investment in and construction of green energy projects. The bank is seeded with public funds and then attracts partners and investors to fund clean energy projects, improving access and affordability of green energy. There are several green banks around the country, the first established in 2011 by Connecticut's General Assembly.

- <https://meetingoftheminds.org/social-equity-through-clean-energy-30837>
- <https://www.ctgreenbank.com/about-us/>

### Green Bonds

Green bonds are like other municipal bonds issued on the bond market, but the funds generated are used for green projects such as water protection, habitat restoration, river restoration, infrastructure investment to support renewable power development,

energy efficiency in buildings, and other preservation projects. Massachusetts issued green bonds in 2013, and again in 2014 following the success of the first issue.

### Federal and State Buy-out Programs

With more properties becoming vulnerable to erosion or flooding, and potentially becoming hazards along the coast, the federal and state governments are allocating funds and setting up programs to buy-out properties, with willing sellers, and remove the development from the shoreline. Communities in California are using another innovative approach; buying coastal properties, renting them for a time to help fund the program, and then removing the structures and retreating from the coast.

### Local Business Opportunities and Investment

Local businesses will find opportunities to capitalize on the transition to renewable sources of energy, green products, and energy efficiency. Cape businesses have an opportunity to rebrand and market to tourists as a green business. Some businesses may find a niche marketing to eco-tourists. Other businesses may find areas to develop or expand businesses, supporting green or net zero construction, supplying low-energy products, or providing service to green technologies (e.g. cold climate heat pumps, solar installations, EV charging stations). The Cape Cod Chamber of Commerce and local chambers should identify areas of need, capital, or other support.



## TOWNS

### FUNDING

#### Municipal Vulnerability Preparedness Action Grants

Action grants are available to communities that have a certified Municipal Vulnerability Preparedness (MVP) Plan following completion of the MVP community planning process. Action Grants offer financial assistance to towns to implement priority actions to address the impacts of climate change identified during the community planning process. All towns on the Cape are certified MVP communities, eligible to receive funding under this program.

- <https://www.mass.gov/service-details/mvp-action-grant>

As of April 2021, projects receiving Action Grant funding have been completed in Falmouth, Sandwich, and Yarmouth. Currently, projects are also being funded in Falmouth and Provincetown.

- <https://www.mass.gov/doc/mvp-action-grant-project-descriptions/download>

#### Coastal Resilience Grant Program

The Massachusetts Office of Coastal Zone Management (CZM) Coastal Resilience Grant Program offers financial and technical assistance to address coastal flooding, erosion, and sea level rise. Eligible projects include vulnerability and risk assessments, public education and communication, planning, municipal infrastructure redesign and retrofits, and shoreline restoration.

- <https://www.mass.gov/service-details/coastal-resilience-grant-program>
- <https://www.mass.gov/files/documents/2020/09/18/2021-coastal-resilience-grants.pdf>



## Massachusetts Electric Vehicle Incentive Program

The Massachusetts Department of Environmental Protection offers several financial incentives through the Massachusetts Electric Vehicle Incentive Program (MassEVIP). One program, MassEVIP Fleets, offers financial assistance to eligible public entities to acquire EVs for their fleets.

- <https://www.mass.gov/how-to/apply-for-massevip-fleets-incentives>

## Electric Vehicle Charging Infrastructure Programs

The MassEVIP also includes funding for certain charging station infrastructure for public access, multi-unit dwellings, educational campuses, and workplaces for employees and fleet vehicles.

- <https://www.mass.gov/service-details/massdep-air-quality-grants-assistance>
- <https://www.mass.gov/doc/matrix-of-massevip-grant-programs/download>

Eversource also provides incentives to customers for certain EV charging infrastructure and rewards for those who enroll in their Connected Solutions program.

- <https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles>

## Transportation Improvement Program

Transportation projects in the region that are funded in part by the Federal Highway Administration or the Federal Transit Administration are included in the Cape Cod Transportation Improvement Program (TIP). Municipal projects are eligible to be awarded TIP funding if selected by the Cape Cod Metropolitan Planning Organization.

- [www.capecodcommission.org/tip](http://www.capecodcommission.org/tip)

Within the TIP, Congestion Mitigation and Air Quality (CMAQ) funding is available for projects that reduce congestion and improve air quality.

- <https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm>

There are a variety of funding categories in the TIP, such as the Transportation Alternatives Program (TAP), for projects that include pedestrian, bicyclist, and transit facilities.

- <https://www.fhwa.dot.gov/fastact/factsheets/transportationalternativesfs.cfm>



## State Transportation Grant Programs

There are several competitive grant programs administered by the state that provide transportation funding to municipalities for projects that promote low-carbon and no-carbon transportation options. The majority of these programs are state-funded, but some leverage federal

funding as well. While the specifics of each program vary, most are aimed at the construction of infrastructure for bicyclists and pedestrians. These programs include the Complete Streets Funding Program, Mass Trails Program, Municipal Americans with Disabilities Act Grant Program, the Safe Routes to School Funding Program.

- <https://www.mass.gov/complete-streets-funding-program>
- <https://www.mass.gov/guides/masstrails-grants>
- <https://www.mass.gov/municipal-americans-with-disabilities-act-grant>
- <https://www.mass.gov/safe-routes-to-school>





## Green Communities

The Green Communities program under the Department of Energy Resources offers funding and technical assistance through multiple programs to eligible designated communities to implement energy efficiency projects, support renewable energy use, and the purchase of fuel-efficient vehicles.

- <https://www.mass.gov/guides/becoming-a-designated-green-community>
- <https://www.mass.gov/info-details/being-a-green-community#grant-opportunities>
- <https://www.mass.gov/doc/table-of-2020-competitive-grant-awards/download>

## Climate Impact Fees

A climate impact fee is a monetary charge imposed by a local government on new developments to recoup or offset a proportionate share of public costs associated with mitigating GHG emissions caused by that new development. In other words, a climate impact fee shifts some portion of the financial burden to mitigate new carbon contributions from the public to the private sector. A climate impact fee takes into account the overall development

project's size and expected emissions, to the extent measurable, and the costs of other negative consequences borne by the public. The result is to incorporate the full social and environmental costs of new development into the impact fee.

An evaluation of various innovative funding mechanisms should be completed, and should include, at a minimum, an evaluation of the steps required to create, implement, and administer a regionally or locally-based climate impact fee.

anticipate selling the property before the savings from the improvements compensate for the up-front costs.

## Cape Light Compact

Cape Light Compact offers rebates to residents and business for energy efficiency upgrades including insulation, efficient heating systems, LED lighting and zero-interest residential loan program to help finance these upgrades.

- <https://www.capelightcompact.org/>

## Energy Financing Districts

An Energy Financing District allows municipalities to raise money through the issuance of bonds to fund energy projects. Property owners who choose to participate in the program pay a property tax assessment, which is used for repayment. Participating property owners pay little to no up-front costs for energy-related improvements and the obligation for repayment, along with the financed improvement, transfers with the property. This approach may offset concerns of property owners who may hesitate to make energy efficiency improvements if they

## Recommendation

Evaluate climate impact fee and other innovative funding mechanisms. An evaluation of various innovative funding mechanisms should be completed, and should include, at a minimum, an evaluation of the steps required to implement a regionally or locally-based climate impact fee

## Massachusetts Clean Energy Center

The Massachusetts Clean Energy Center provides grants, funding and technical assistance through residential, commercial, and municipal programs for energy efficient equipment and renewable energy projects.

■ <https://www.masscec.com/>

## Grant Programs offered by the Massachusetts Division of Conservation Services

Local Acquisition for Natural Diversity (LAND) grants are available to town conservation commissions to acquire land for conservation and passive recreation, or for conservation restrictions. Eligible land may include forests, fields, wetlands, wildlife habitat, unique natural, cultural or historic resources, and certain farmland.

- <https://www.mass.gov/how-to/apply-for-a-local-acquisitions-for-natural-diversity-land-grant>

Parkland Acquisitions and Renovations for Communities (PARC) grants are available to park or recreation commissions of certain towns with a current Open Space and Recreation Plan to acquire parkland, build a new park, or renovate an existing park.

- <https://www.mass.gov/how-to/apply-to-the-parkland-acquisitions-and-renovations-for-communities-parc-grant-program>





## PUBLIC ORGANIZATIONS

(State agencies, public universities and colleges)

### Massachusetts Electric Vehicle Incentive Program

The Massachusetts Department of Environmental Protection offers several financial incentives through the Massachusetts Electric Vehicle Incentive Program (MassEVIP). One program, MassEVIP Fleets, offers financial assistance to eligible public entities to acquire EVs for their fleets.

- <https://www.mass.gov/how-to/apply-for-massevip-fleets-incentives>

### Electric Vehicle Charging Infrastructure Programs

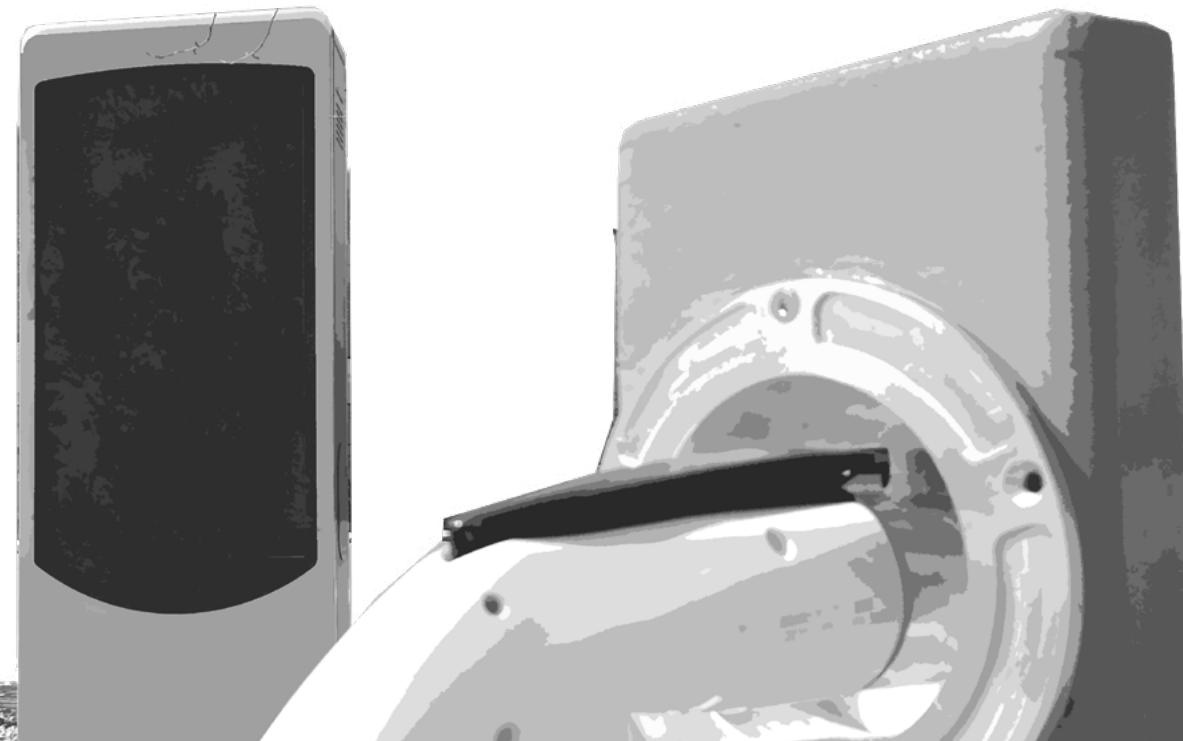
The MassEVIP also includes funding for certain charging station infrastructure

for public access, multi-unit dwellings, educational campuses, and workplaces for employees and fleet vehicles.

- <https://www.mass.gov/service-details/massdep-air-quality-grants-assistance>
- <https://www.mass.gov/doc/matrix-of-massevip-grant-programs/download>

Eversource also provides incentives to customers for certain EV charging infrastructure and rewards for those who enroll in their Connected Solutions program.

- <https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles>





## INDIVIDUALS, BUSINESSES, AND NON-PROFITS

### Coastal Resilience Grant Program

The Massachusetts Office of Coastal Zone Management (CZM) Coastal Resilience Grant Program offers financial and technical assistance to address coastal flooding, erosion, and sea level rise. Eligible projects include vulnerability and risk assessments,

public education and communication, planning, municipal infrastructure redesign and retrofits, and shoreline restoration.

- [https://www.mass.gov/service-details/  
coastal-resilience-grant-program](https://www.mass.gov/service-details/coastal-resilience-grant-program)
- [https://www.mass.gov/files/  
documents/2020/09/18/2021-  
coastal-resilience-grants.pdf](https://www.mass.gov/files/documents/2020/09/18/2021-coastal-resilience-grants.pdf)

### Massachusetts Offers Rebates for Electric Vehicles Program

The Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program, funded through the Department of Energy Resources, offers rebates towards the purchase or lease of certain eligible vehicles, including commercial and nonprofit fleet vehicles.

- <https://mor-ev.org/>



## Electric Vehicle Charging Infrastructure Programs

The MassEVIP also includes funding for certain charging station infrastructure for public access, multi-unit dwellings, educational campuses, and workplaces for employees and fleet vehicles.

- <https://www.mass.gov/service-details/massdep-air-quality-grants-assistance>
- <https://www.mass.gov/doc/matrix-of-massevip-grant-programs/download>

Eversource also provides incentives to customers for certain EV charging infrastructure and rewards for those who enroll in their Connected Solutions program.

- <https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles>

## Property Assessed Clean Energy

Property Assessed Clean Energy (PACE) is a financing mechanism that funds energy improvements on commercial, industrial, or non-profit buildings through a betterment assessment on the property that is used to repay the financing. This program gives property owners the ability to undertake

energy improvements that might have a longer timeframe and to spread out the costs of those improvements. Towns must opt into the state program, administered by MassDevelopment and the Department of Energy Resources, for commercial properties to be eligible. A current list of participating towns can be found at the following link.

- <https://www.massdevelopment.com/pace>

## Cape Light Compact

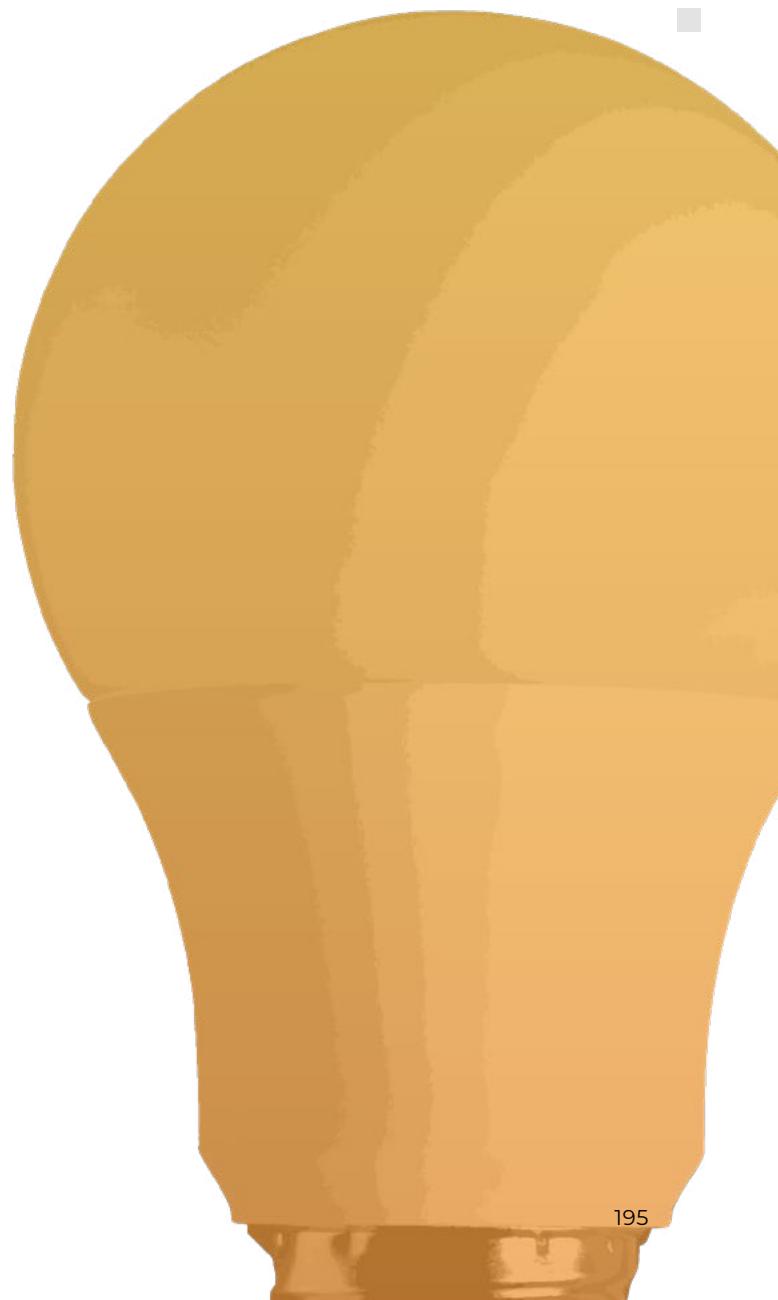
Cape Light Compact offers rebates to residents and business for energy efficiency upgrades including insulation, efficient heating systems, LED lighting and zero-interest residential loan program to help finance these upgrades.

- <https://www.capelightcompact.org/>

## Massachusetts Clean Energy Center

The Massachusetts Clean Energy Center provides grants, funding and technical assistance through residential, commercial, and municipal programs for energy efficient equipment and renewable energy projects.

- <https://www.masscec.com/>





## INCENTIVE DATABASES FOR MULTIPLE APPLICANTS

### Department of Energy Resources Incentives Clearinghouse

The Massachusetts Department of Energy Resources (DOER) hosts a guide to energy-related rebates and incentives available in Massachusetts, including but not limited to programs aimed at energy efficiency, renewable energy, heating and cooling, and transportation. <https://www.mass.gov/guides/massachusetts-energy-rebates-incentives>

DOER also hosts a searchable database of incentives, known as the Commonwealth Energy Tool for Savings, or

energyCENTS. <http://public.dep.state.ma.us/Doer/mesa/#/home>

### Database of State Incentives for Renewable Energy

The Database of State Incentives for Renewable Energy (DSIRE), operated by the North Carolina State University N.C. Clean Energy Technology Center, is a national database of federal and state rebates and financial incentives, including personal, property, and corporate tax incentives. <https://www.dsireusa.org/>

### EPA Diesel Emissions Reduction Act (DERA) Funding

The Diesel Emissions Reduction Act (DERA) Program funds grants and rebates that protect human health and improve air quality

by reducing harmful emissions from diesel engines. The active funding program and eligible entities change periodically. <https://www.epa.gov/dera>

### USDA Rural Development Programs & Services

USDA Rural Development provides many programs and services that may assist portions of the Cape community in implementing the Climate Action Plan. Some programs which merit investigation include Business and Industry Loan Guarantees, Rural Energy for America and Renewable Energy systems, and Energy Efficiency Improvement Guaranteed Loans.

- <https://www.rd.usda.gov/programs-services>
- <https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program>





## Recommendations

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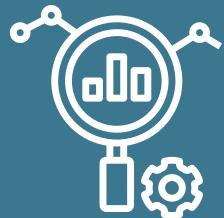
The actor-specific climate actions detailed in the previous chapter provide pathways for climate resiliency on Cape Cod that encourage both adaptation to existing and increasing threats and hazards and mitigation of the greenhouse gas (GHG) emissions that will continue to exacerbate the problem. This chapter summarizes recommendations to support broad implementation of the Climate Action Plan.

Throughout the plan is a series of recommendations that are critical to addressing climate challenges faced by the region and contributing to the state's GHG emissions reduction goals. This chapter captures those recommendations and groups them into four categories: data and information, resources and technical support, funding, and continued engagement.

## PLANNING PRINCIPLES

As with this planning process, implementation and next steps should be guided by the principles discussed in this plan:

- Reducing emissions and increasing resiliency to current and future hazards
- Taking actions that address GHG emissions from all sources, with emphasis placed on those targeting the region's highest emitting sectors
- Recognizing the relationship between climate change and other regional challenges, and prioritizing actions that provide co-benefits
- Considering economic impacts associated with implementation of actions, as well as the costs of inaction
- Prioritizing communication and engagement to convey the urgency of the challenge and gain support for the range of solutions
- Incorporating equity considerations to ensure a successful implementation strategy



## DATA AND INFORMATION

### **Maintain aerial photography, planimetric data, and LiDAR data:**

Aerial photography, planimetric data, and LiDAR data allow for a better understanding of vulnerabilities and help to measure performance and track progress. Aerial photography has been collected regionally approximately every five years, and is used for planimetric data acquisition and analysis. Region-wide LiDAR will be collected in 2021 and has been previously collected for segments of Cape Cod at various times. Consistent collection and analysis of aerial photography and LiDAR should be prioritized and maintained in a regional, accessible database.

### **Complete storm tide pathways analysis:**

Storm tide pathway analyses have been completed for areas along the Outer Cape

Development of the Climate Action Plan relied on data, information, and analysis, all of which are critical to implementation. The collection of data, and development of tools that make data easier to use and understand, will support climate action and documentation of progress. Ongoing efforts to collect and analyze data should

and Cape Cod Bay. The Nantucket Sound shoreline from the Mashpee/Barnstable town line to the Harwich/Chatham town line is currently underway. Funding should be secured to analyze the remaining segments of Nantucket Sound and the Buzzards Bay shoreline, to complete the regional data layer.

### **Create tools to track performance:**

Chapter 10 identifies a series of performance measures for tracking progress on Climate Action Plan implementation and in meeting regional goals. Some measures rely on updates to the GHG inventory and some on other locally and regionally available data sets. To encourage continued action and inform decision-making, performance measures should be tracked through an easily accessible database and user interface.

provide information necessary to support actions to reduce GHG emissions from the region's highest emitting sectors and to support and enhance carbon sequestration from existing natural resources. Data and information should be easily accessible to inform decision-making and advocacy efforts region-wide

Town-level data will be presented where available.

**Calculate sequestration potential:** Better understanding the sequestration potential of natural resources in the region will provide for a more accurate estimation of regional carbon sequestration and will help to target investments in natural resource protection and restoration. A methodology for calculating sequestration potential of regional natural resources, with a particular focus on salt marshes and freshwater wetlands, should be developed and a baseline sequestration analysis should be completed in advance of, or in tandem with, the first comprehensive update to the GHG inventory.



## RESOURCES AND TECHNICAL SUPPORT

### Maintain legal and jurisdictional analysis:

The legal and policy context described in Chapter 3 represents the roles of different government actors at the time this Climate Action Plan was drafted. A detailed legal and jurisdictional analysis supports the content of that chapter but will evolve with changes to state and federal policy and regulation. The legal and jurisdictional analysis should be evaluated as new state and federal policies and regulations are released, and an up to date understanding of the roles of government actors should be maintained. To the extent necessary, the implementation plan should be amended to appropriately reflect the changes to policy and regulations.

Much of the action to address climate adaptation and mitigation happens at the local scale, and requires support from a variety of other actors. Development of resources that can be applied locally, and more direct technical support,

is warranted and necessary. Support in the form of local guidance, identification of resource availability and funding opportunities, and model bylaws will support ongoing and future action at the local and regional scale.

### Provide local guidance:

The local implementation plan described in Chapter 8 includes actions that may be taken at the municipal scale to address climate adaptation and mitigation. Detailed local guidance that includes elements such as incentives and funding opportunities for specific actions, and existing resources to support implementation, should be developed.

**Develop equity metrics:** Development of metrics to track integration of equity considerations into planning, decision-making, and implementation of actions identified in the Climate Action Plan will help understand and minimize impacts of climate

change and climate action on vulnerable populations.

### Develop a model bylaw for siting large and small scale solar projects:

Development of a model bylaw for siting large and small scale solar projects will provide an additional resource for communities as they seek to enhance renewable energy opportunities in appropriate areas. The model bylaw should be developed and should consider opportunities to encourage co-location on built or disturbed sites, and discourage green-field development.

**Develop design guidelines for solar projects:**

Historic and community character are critical to Cape Cod's economy and way of life. Renewable energy projects are sometimes at odds with concerns over historic and other culturally significant resources. Design guidelines should be developed to provide guidance on how to develop solar projects in a way that complements an area's historic and

community character, while also addressing concerns over energy use and its impact on the region's GHG emissions.

**Develop a model bylaw for energy efficiency:**

Development of a model bylaw that includes options for increasing energy efficiency in buildings will provide an additional resource for communities as they seek to address GHG emissions

from the energy sector. The model bylaw should be developed and should consider opportunities to encourage or require energy assessments, among other best practices.





## FUNDING

**Identify funding sources:** Chapter 8 identifies funding sources currently available for climate actions, but opportunities will evolve with state and federal policies and budgets. Identifying funding sources should be an ongoing effort. Funding may come from federal or state grants, and municipalities must identify areas where municipally funded investments can reduce GHG emissions or adapt to climate hazards.

### **Increase accessibility of Municipal Vulnerability Preparedness (MVP) Program Action Grants:**

Communities should continue to pursue MVP Action Grants, and the County, Cape Cod

The upfront cost of climate action is significant. To successfully increase climate resilience and reduce GHG emissions from the region, financial resources will need to come from

Commission, and others should support communities in this effort. Furthermore, the state should expand eligibility for MVP Action Grants to other entities, such as Regional Planning Agencies, which provide critical support to local communities, can identify and support implementation of regional actions and/or intermunicipal priority climate actions, and may relieve communities from the grant administration requirements on projects that span more than one town. Additionally, the state should work to ensure the MVP Action Grant criteria align with the vulnerability planning priorities communities worked hard to identify.

a variety of sources, including the local, state, and federal level; and new and innovative financing strategies will need to be explored.

### **Evaluate climate impact fee and other innovative funding mechanisms:**

Funding for climate mitigation and adaptation strategies must, in part, be the responsibility of local entities. An evaluation of various innovative funding mechanisms should be completed, and should include, at a minimum, an evaluation of the steps required to create, implement, and administer a regionally or locally-based climate impact fee. Other strategies to be considered could include the use of green banks, green bonds, and the development of energy financing districts.



## CONTINUED ENGAGEMENT

**Establish a body to guide and track implementation:** A committee or task force should be established to guide and track implementation of the Climate Action Plan. A task force should coordinate and foster partnerships amongst entities working to improve climate resiliency, and those that need to incorporate climate-friendly practices into their work. The body should incorporate a variety of perspectives, including those with technical expertise on climate impacts and practices, the housing and development community, those who represent vulnerable communities, and sector specific expertise in natural resources, energy, transportation and other sectors.

Significant stakeholder engagement contributed to development of this Climate Action Plan. Implementation of the plan will require continued and expanded engagement, as actions will require broad community support. Perspectives of those that will be

impacted by climate actions must be incorporated, particularly in situations where climate action is anticipated to, or perceived to, exacerbate challenges associated with other critical local or regional needs.

**Engage an equity working group:** Specific attention must be given to the impacts of both no action and implementation of actions on vulnerable populations. An equity working group should be established to provide feedback on potential disproportionate impacts and to help ensure that the implementation process incorporates all members of the Cape community. The equity working group should be engaged in developing solutions and adapting strategies to address issues of climate justice and equity.

**Convene stakeholder groups to further progress on overlapping priorities and opportunities:** Topic specific and cross-sectoral stakeholder groups should

continue to inform climate action on Cape Cod. There are opportunities to align efforts to grow the Cape Cod economy with climate action. Efforts should be made to work with partners to advance actions that are found in both the Climate Action Plan and the Comprehensive Economic Development Strategy. This could be facilitated through conversations with the Barnstable County Economic Development Council. Additionally, and more specifically, stakeholders should be convened to continue conversations on the intersections and impacts of energy efficient and net zero building on the region's housing challenges. Emphasis should be placed on opportunities to further both priorities and incentives that will support successful implementation.

**Develop an online engagement tool:**

During development of the Climate Action Plan, online engagement was imperative to maintain safety of participants during the COVID-19 pandemic. Online engagement will likely continue, in some form, into the future out of necessity and convenience. Developing new resources to educate and engage a wide range of stakeholders on climate action will assist in garnering broad community support for implementation of this plan. Methods and platforms for an online engagement tool should be evaluated and an approach should be identified that will allow more people to participate remotely and outside of a formal stakeholder process and meetings. The engagement platform should incorporate data and information and provide ample opportunity to gather feedback and input from participants.

**Continue and expand the Climate**

**Ambassadors Program:** In 2021, the Commission initiated the Climate Ambassadors Program to engage students during development of the Climate Action Plan. The 5-month Program attracted students from all regions of Cape Cod and

Martha's Vineyard; informed students about climate impacts, regional GHG emissions, and potential actions; and gathered student input and opinion. The Climate Ambassador Program should be continued and expanded, and efforts should be made to work with educators, past Climate Ambassadors, and others to incorporate climate change education into school curriculums.



# Measuring Performance

Measuring progress towards meeting the goals of the Climate Action Plan will require both long-term tracking of regional performance measures and shorter-term tracking of the implementation of specific strategies and actions. This chapter describes how updates to the regional greenhouse gas emission inventory, tracking of regional performance measures, and communication of regional progress will be key in ensuring effective implementation.



## UPDATES TO THE REGIONAL GREENHOUSE GAS EMISSION INVENTORY

To determine how individual, local, and regional actions are impacting the greenhouse gas emissions from the region, it will be necessary to update the inventory from time to time. Tracking changes in our regional greenhouse gas emissions will allow the region to track progress toward reducing greenhouse gas emissions in support of state goals and targets, and plan for future action.

Tracking greenhouse gas emissions for the region involves the compilation of hundreds of data inputs from dozens of entities. Some data sources are updated more frequently than others, while some are updated less regularly. Additionally, looking at regional greenhouse gas emissions at the regional scale may reflect modest changes in the short-term, which will add up to more significant changes in the long-term. There will be two facets to updating the inventory: a comprehensive update, which will occur

approximately every five years and will provide new metrics across all sectors and data points in the inventory; and targeted updates, which may be provided more regularly for certain data points and sectors where the data is available more frequently.

The greenhouse gas emissions inventory completed in 2020 used the most up-to-date data available at the time, which was for the year 2017. The next comprehensive update is anticipated to occur once 2022 data is available and collected.

## MEASURING CLIMATE IMPACT RESILIENCE

In determining how individual, local, and regional actions are impacting the region's resilience to the effects of climate change, additional metrics will need to be tracked. Unlike the tracking of greenhouse gas emissions, there is no single metric that represents the region's resilience to climate impacts. Climate change resilience, as well as coastal resilience, are reflected in a number of regional data sets that are updated periodically. Observed erosion

### Recommendation

Develop equity metrics for climate action implementation

rates, flood prone areas, and areas subject to storm surge from hurricanes may change over time and should be tracked and updated. Changes to development in the floodplain are also an indicator of resilience. Inventories of buildings and infrastructure proximate to the coast and in the floodplain will help to understand the extent of vulnerabilities at the local and regional scale, and how they change over time. Each of these data sets should be reviewed from time to time and updated as new data becomes available.



TRACKING

## Mitigation

Tracking greenhouse gas emissions for the region involves the compilation hundreds of data inputs from dozens of entities.

Some data sources are updated more frequently than others, while some are updated less regularly. Additionally, looking at regional greenhouse gas emissions at the regional scale may reflect modest changes in the short-term, which will add up to more significant changes in the long-term.

There will be two facets to updating the inventory: a comprehensive update, which will occur every five-years or so and will provide new metrics across all sectors and data points in the inventory; and targeted updates, which will be provided more regularly for certain data points and sectors where the data is available more frequently.



TRACKING

## Adaptation

Climate change resilience, as well as coastal resilience, are reflected in a number of regional data sets that are updated periodically.

Observed erosion rates, flood prone areas, and areas subject to storm surge from hurricanes may change over time and should be tracked and updated. Changes to development in the floodplain are also an indicator of resilience. Inventories of buildings and infrastructure proximate to the coast and in the floodplain will help to understand the extent of vulnerabilities at the local and regional scale, and how they change over time.

Each of these data sets should be reviewed from time to time, and updated as new data becomes available.



## HOUSING AND DEVELOPMENT

## Reduce GHG Emissions from the Built Environment

### Percent of homes/businesses heated by electricity

- New construction with electric heat
- Homes/businesses converted to heat pumps

### Percent of homes/businesses with improved energy efficiency

- Homes/businesses receiving weatherization assistance
- Number of new homes/businesses receiving a specific HERS rating
- Homes with energy audits completed

### Smart/Green Development Indicators

- Housing density in Community Activity Centers
- Ratio of new development inside and outside of Community Activity Centers
- Number of housing units located within ½ mile of transit
- Number of communities with Complete Streets Programs
- New zoning adopted that supports mixed use and/or multifamily development





## HOUSING AND DEVELOPMENT

**Reduce GHG Emissions from Waste Management Systems**

**Tons of waste per capita transported off-Cape to:**

- Landfill
- Incinerator
- Recycling



## HOUSING AND DEVELOPMENT

**Improve and advance the resilience of the built environment****Indicators of Resiliency of Built Environment**

- Number of up-to-date Hazard Mitigation Plans
- Number of homes/businesses in the floodplain
- Number of new developed lots and expansion of footprints in the floodplain
- Land developed and land protected within FEMA A and V zones
- Number of homes/businesses with resiliency measures in place
- Number of green infrastructure projects
- Miles of utilities placed underground



## TRANSPORTATION

## Reduce Emissions from the Transportation Sector

### Reduction in Vehicle Miles Traveled

- Percent of trips by transit, bicycling, and walking
- Public transit ridership
- Population within a ½ mile of fixed route transit service
- Miles of sidewalks, multiuse paths, and bike lanes
- Parcels connected to the sidewalk network
- Percent of signalized intersections with pedestrian signal heads
- Homes/businesses connected to broadband

### Percent of vehicles powered by electricity

- Percent of new vehicle purchases that are EVs
- Number of EVs
- Number of EVs in municipal fleets
- Number of EV charging stations



## TRANSPORTATION

## Improve the Resilience of the Transportation System to the Impacts of Climate Change

### Indicators of Resiliency of the Transportation System

- Low lying road segments remediated
- Number of culverts replaced
- Stormwater projects implemented

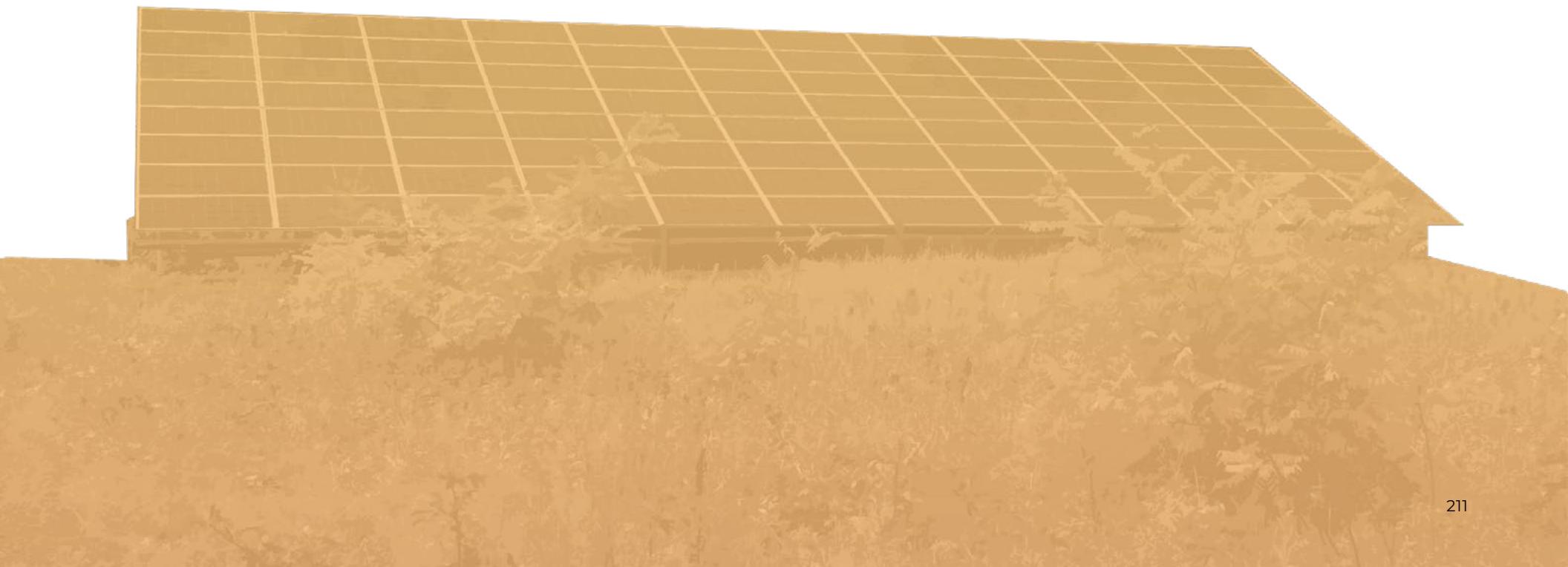


## ENERGY

## Increase the Production and Use of Clean Local Energy

### Percent of Electricity from Green Sources

- Percent of electricity from non-utility scale, distributed sources
- Megawatt of solar energy generation on Cape Cod (non-roof generation)





## NATURAL RESOURCES AND WORKING LANDS

**Support and Promote Protection, Preservation, and Restoration of Natural Ecosystems****Conservation and Resiliency of the Natural Environment**

- Acres of BioMap 2 Core Habitat and Critical Natural Landscapes protected
- Number of green infrastructure projects designed and/or implemented
- Funding secured for restoration projects



## NATURAL RESOURCES AND WORKING LANDS

**Increase Carbon Sequestration in the Natural Environment****Natural Sequestration**

- Acres of open space preserved
- Number new parks created
- Acres of upland habitat restored
- Acres of salt marsh restored or allowed to migrate



## NATURAL RESOURCES AND WORKING LANDS

## Protect the Ability of Working Lands and Waters to Provide Essential Social and Economic Services While Protecting the Environment

### Resiliency of Built Environment

- Acres of agricultural lands
- Number of farmers markets
- Acres of aquaculture lease areas
- Harbors with commercial fishing activity
- Number of active fishing boats on Cape Cod

## COMMUNICATING PERFORMANCE

It is important to communicate progress to the wide variety of stakeholders and actors identified in the Climate Action Plan. The Cape Cod Commission should develop an online tool to track and communicate progress on the regional performance measures discussed in this chapter.

To communicate progress to a wide audience, it will be important to be able to describe regional progress in terms of a set of key performance measures. These measures are indicators of how well the

### Recommendation

Create tools to track performance through an easily accessible database and user interface to encourage continued action

region is doing in terms of meeting the overall goals of the Climate Action Plan:

- Percent of Vehicles Powered by Electricity
- Percent of Homes/Business Heated by Electricity
- Percent of Electricity from Renewable Sources
- Acres of open space preserved (sequestration indicator)
- Development within the floodplain

Additionally, equity considerations and key performance measures that support other regional priorities will be reviewed and presented. This will allow for an analysis of whether climate goals are being achieved without disproportionate impacts on any groups or the achievement of other critical regional goals.

## DYNAMIC ACTION

The Cape Cod Climate Action Plan details the actions necessary to slow the effects of climate change and improve the region's resilience to its impacts.

The plan was based on the best information available at the time of plan development and input from a wide range of technical experts and community voices.

As the plan enters the implementation phase, and as regional performance measures are tracked, more will be learned about the effectiveness of individual actions and the region's ability to meet the challenge of climate change. There are also likely to be significant technological and societal changes that may present new challenges and opportunities. The plan will need to be implemented in a dynamic manner with the ability to adjust priorities to meet the plan's goal and objectives.

# List of Appendices

## APPENDIX A: CLIMATE ACTION PLAN LITERATURE REVIEW

[www.capecodcommission.org/ClimateActionPlan-AppendixA](http://www.capecodcommission.org/ClimateActionPlan-AppendixA)

## APPENDIX B: ECONOMIC IMPACTS OF CLIMATE CHANGE ON CAPE COD, TECHNICAL REPORT

[www.capecodcommission.org/ClimateActionPlan-AppendixB](http://www.capecodcommission.org/ClimateActionPlan-AppendixB)

## APPENDIX C: LEGAL AND JURISDICTIONAL ANALYSIS

[www.capecodcommission.org/ClimateActionPlan-AppendixC](http://www.capecodcommission.org/ClimateActionPlan-AppendixC)

## APPENDIX D: CAPE COD REGIONAL GREENHOUSE GAS EMISSIONS INVENTORY

[www.capecodcommission.org/ClimateActionPlan-AppendixD](http://www.capecodcommission.org/ClimateActionPlan-AppendixD)

## APPENDIX E: CAPE COD CLIMATE CHANGE ACTION PLAN SURVEY ANALYSIS

[www.capecodcommission.org/ClimateActionPlan-AppendixE](http://www.capecodcommission.org/ClimateActionPlan-AppendixE)

## APPENDIX F: CAPE COD CLIMATE ACTIONS DATABASE

[www.capecodcommission.org/ClimateActionPlan-AppendixF](http://www.capecodcommission.org/ClimateActionPlan-AppendixF)

## **2021 CAPE COD CLIMATE ACTION PLAN**

JULY 2021



**CAPE COD  
COMMISSION**

P.O. Box 226 (3225 Main Street),  
Barnstable, Massachusetts 02630  
Phone: 508-362-3828  
Email: [frontdesk@capecodcommission.org](mailto:frontdesk@capecodcommission.org)  
[www.capecodcommission.org](http://www.capecodcommission.org)

