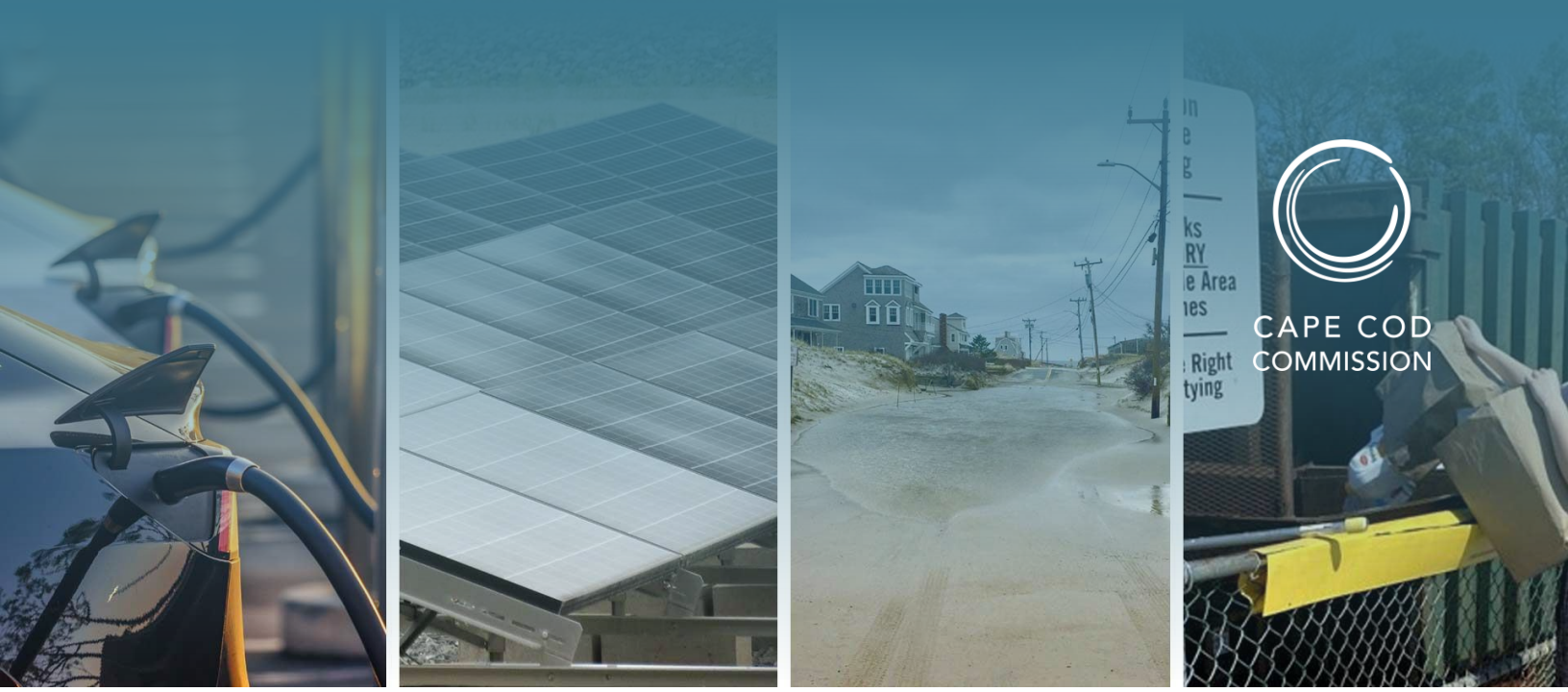

Municipal Climate Action Toolkit

CLIMATE ACTION FACT SHEETS

2023

Prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

CLIMATE ACTION FACT SHEETS

Contents

Overview of the climate action fact sheets

This overview of the climate action fact sheets serves as a primer or "read me" to help understand what is included across the 15 climate action fact sheets. This primer presents each fact sheet section followed by text about the type of content included in that section. Below is a list of all 15 strategies. Fact sheets for all can be found at: capecodcommission.org/our-work/climate-action-toolkit-municipal.

Housing
- Net Zero New Non-municipal Buildings
- Net Zero Existing Non-municipal Buildings
- Net Zero Municipal Buildings
- Waste Diversion
- Address Vulnerable Structures

Energy
- Clean Electricity

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Transportation
- Complete Streets
- Municipal EVs
- Infrastructure Resilience
- Reduce Vehicle Miles Traveled
- Residential EV Adoption

Natural Resource Working Lands
- Stewarding Open Space
- Supporting Coastal Wetlands
- Agricultural Practices

INTRODUCTORY CONTENT

These fact sheets are developed for municipal decision-makers in Barnstable County who want to learn more about specific climate adaptation or mitigation strategies, but they also provide useful information to a variety of audiences. Each fact sheet includes an introduction summarizing the benefits of implementing that specific resiliency strategy and also provides a general content overview. Additionally, each fact sheet provides a side text box with a consistent set of costs and benefits that may be applicable to each strategy. The boxes are checked if those attributes are applicable to that fact sheet.

KEY FINDINGS

Each key findings section includes icons and key takeaways for equity, financial benefits, non-market benefits, greenhouse gas (GHG) reductions, and ease of implementation. Below are the criteria for achieving a certain number of icons.

Criteria for Number of Icons

The number of icons for each key finding indicates how the strategy rates for each category, where more icons represent a better ranking. Equity and financial benefits icons are scaled on defined/absolute criteria while non-market benefits, GHG reductions, and ease of implementation are based on relative scales compared to the remaining strategies.

Equity: Includes a ranking that blends consideration of benefits to vulnerable populations and opportunities to engage and work with these populations.

- **3 Icons:** These projects provide clear benefits (e.g., reduced climate impacts, expanded social and economic benefits, job development, increased food security, increased access to natural areas and open space) to vulnerable populations and/or opportunities to engage and work with vulnerable populations.
- **2 Icons:** These projects may provide some benefits to or opportunities for engagement with vulnerable communities, though benefits and opportunities are less defined.
- **1 Icon:** These projects provide limited benefits or opportunities to engage with vulnerable communities and/or could result in disproportionate costs or loss of opportunities for vulnerable populations.
- **0 icons:** Project provides no benefits or opportunities to engage with vulnerable communities and/or will result in disproportionate costs or loss of opportunities for vulnerable populations.

Financial benefits: This includes financial costs and benefits only (e.g., capital costs, other up-front costs, maintenance costs, operational costs, and costs savings) and excludes job creation and non-market benefits such as increased recreation, increased health benefits, or decreased environmental benefits.

- **3 Icons:** These projects have a clear positive financial return on investment (e.g., there will be a cost savings of implementing a strategy versus the traditional/baseline approach; the reduced damage will exceed the cost of building and maintenance).
- **2 Icons:** These projects have an ambiguous financial return on investment. These are typically beneficial to society with moderate to high non-market benefits.
- **1 Icon:** These projects provide financial benefits, but the costs will exceed the financial benefits or cost savings. These strategies, however, can often be beneficial to society with moderate or high non-market benefits.
- **0 Icons:** These projects provide no financial benefits or cost savings, and the costs will greatly exceed the benefits to the point that non-market benefits will not make this beneficial to society.

Non-market benefits: This captures the contribution of health benefits from reduced air pollution, health benefits from increased recreation, ecosystem service values, reduced environmental impacts from GHG reductions, and other non-market benefits. High contributions from non-market benefits can make strategies quite favorable for a community even when financial costs may exceed financial benefits or cost savings.

- **3 Icons:** Relative to other projects, these produce the highest levels of societal benefits.
- **2 Icons:** Relative to other projects, these produce moderate levels of societal benefits.
- **1 Icon:** Relative to other projects, these produce lower levels of societal benefits.
- **0 Icons:** These projects produce no societal benefits.

GHG reductions: This captures the potential reductions in greenhouse gas emissions. The ranking does not incorporate the "cost-effectiveness" (i.e., cost per metric ton of CO_2 reduced); however, some strategies can be quite cost effective but may not have the potential to reduce GHG emissions.

- **3 Icons:** These projects have the potential for relatively high levels of GHG reductions.
- **2 Icons:** These projects have the potential for relatively moderate levels of GHG reductions.
- **1 Icon:** These projects have the potential for relatively low levels of GHG reductions.
- **0 Icons:** These projects do not lead to GHG reductions (e.g., a resilience strategy).

Ease of implementation: This captures the relative ease for municipalities to implement the strategy in each fact sheet.

- **3 Icons:** These projects require the least level of effort for municipal staff and fewest municipal resources.
- **2 Icons:** These projects require a moderate level of effort for municipal staff and moderate municipal resources.
- **1 Icon:** These projects require the greatest level of effort for municipal staff and most municipal resources.

BENEFIT COST ANALYSIS

When feasible this section of each fact sheet includes both market (i.e., money exchanging hands) and non-market benefits (e.g., benefits from reduced GHGs, benefits from increased recreation) into the results. This includes a mix of case studies that could be informative to municipalities as well as information and outputs that could be used by municipalities to make their own estimates (e.g., the benefit per kWh of moving to green energy).

EQUITY

This section of each fact sheet includes implementation benefits to vulnerable populations and ways to optimize equity throughout the implementation process itself.

While all of us experience the impacts of climate change, not all populations experience these impacts equitably. Equity considerations must be integrated into climate actions to ensure no one population is disproportionally affected by climate impacts and to promote solutions that provide broad benefits without being overly burdensome to any population.

For the purposes of these fact sheets, "vulnerable communities" broadly refers to populations who are disproportionately impacted by the effects of climate change and who are less likely to have the resources needed for recovery (City of Boston, CAP 2019). A population's exposure to climate hazards, access to resources, and ability to recover after a climate event all factor into climate change vulnerability (MAPC).

Vulnerable populations are traditionally identified through existing designations, such as socially vulnerable populations and environmental justice populations as defined by the Environmental Protection Agency and the Massachusetts Executive Office of Energy and Environmental Affairs, respectively. These designations are used to identify populations disproportionately impacted by climate change and include, but are not limited to, communities of color, low-income individuals and families, indigenous peoples, immigrants and refugees, people with disabilities, children and youth, people with limited English language proficiency, and those facing socioeconomic and health inequities.

Equity may be addressed in ways that vary by location, 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. We encourage exploration of the population mapping resources available through Data Cape Cod and to apply local knowledge and context while considering, identifying, and engaging with vulnerable communities within a municipality.

STATE OF PRACTICE

This section of each fact sheet includes an overview of the state of the practice nationally (or in general) as well as the context on Cape Cod (e.g., how many municipalities may have implemented it). This also includes a short case study detailing the success and/or challenges of implementation.

IMPLEMENTATION

This section includes a set of steps or key considerations for successful strategy implementation. It also includes a text box with required expertise needed for the implementation stage. This section ends with a table of links to financial and technical support as well as resources for more information.

CITING THIS WORK

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group, Inc. (ERG) with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

CLIMATE ACTION FACT SHEET

Strive toward net zero energy buildings: Existing non-municipal buildings

INCREASE ENERGY EFFICIENCY OF EXISTING NON-MUNICIPAL BUILDINGS

Housing & Development

Description and purpose of strategy: In the U.S., commercial and residential buildings are responsible for roughly 40% of all energy consumption. Many buildings have outdated water and space heating systems, high air infiltration, and poor insulation, leading to high financial and environmental burdens. Building performance standards (BPS) are one policy measure that can increase building efficiency within a municipality. Additionally, technologies like air-source heat pumps (ASHPs) should be considered as retrofits for residential and commercial buildings.

Content of fact sheet: Energy saving strategies for non-municipal buildings (residential, commercial, and industrial) and a county-specific cost benefit analysis of switching to ASHPs.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property value
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Adopting heat pumps and other energy efficient retrofits can improve health outcomes and lessen the financial burden of home heating for all. In addition, installing these systems can provide economic opportunities that could benefit low-income communities.

Financial benefits: Retrofits may have high capital inputs, but many of the costs can be defrayed through rebates, and over time can lead to cost savings due to decreased operating costs.

Non-market benefits: Improvements in health from reduced pollutants are an additional benefit of non-combustion heating systems. Retrofits that address heating can also reduce the use of space heaters and window air conditioning units, which can lead to increased safety and less work for the homeowner.

GHG reductions: Energy efficient retrofits represent a significant opportunity to reduce GHG emissions. For example, ASHPs are estimated to reduce between 2.77-megatonne (MT) CO_2e and 6.89 MT CO_2e per household per year depending on the home's original heating source.

Ease of implementation: Awareness of rebate programs and the financial/environmental benefits of retrofits encourage building owners to increase their energy efficiency, but municipal programs are also necessary to develop building performance standards and spread awareness of these strategies.

BENEFIT COST ANALYSIS

BPS for Non-Municipal Buildings

BPS policies establish specific performance outcomes that commercial, industrial, and multifamily residential buildings must achieve within a certain time frame. Metrics used to determine energy efficiency fall into two broad categories: energy metrics and GHG metrics. Compliance approaches differ depending on the municipality. For example, in Washington, D.C., building owners have multiple ways to comply with the standards, such as reducing site energy usage by 20%, implementing specific cost-effective efficiency measures, or reaching a set standard for a given property type. This type of flexibility is important when designing standards for a given region and population. BPS policies are mostly outcome based as opposed to prescriptive (though in some instances they are both), and as such they may not require specific retrofits. However, the below retrofits and technologies should all be considered as potential energy savings options that could be addressed through BPS policies.

POTENTIAL RETROFIT ACTIONS FOR NON-MUNICIPAL BUILDINGS

ELECTRIFICATION	AIR SEALING AND INSULATION	LED LIGHTING
Heat pump water heaters are 2–3 times more efficient than conventional water heaters, and can reduce water heating costs, which account for 17% of household energy use in New England. ASHPs and electric appliances can reduce energy use and GHG emissions, as well as improve indoor air quality.	Air sealing and insulation have been shown to reduce leakage by 50% in multifamily buildings. Additionally, air sealing and insulation can reduce moisture in unwanted spaces, improve air quality, and improve HVAC equipment performance.	According to the Department of Energy, lighting accounts for 15% of an average home's energy use. LED lighting is cost-effective, and saves energy compared to conventional alternatives.

Air Source Heat Pumps for Residential Use

On Cape Cod, residential energy use accounts for roughly twice as much usage as commercial and industrial energy use. The majority of houses in Barnstable County are heated with natural gas, followed by fuel oil, and then electricity. These homes have a significant opportunity for financial operating savings if they switch heating systems. Census data from the American Community Survey estimates the current fuel usage in Barnstable County, with "Utility Gas" representing Natural Gas.

HOUSE HEATING FUEL IN BARNSTABLE COUNTY

HEATING TYPE	PERCENT OF HOUSES
Utility Gas	61%
Fuel oil, Kerosene, etc.	19%
Electricity	12%
Other	8%
Total	**100%**

Capital costs for different oil boilers, natural gas boilers, and ASHPs vary, but according to Mass Clean Energy Center (MassCEC), there were 541 ASHPs installed in Barnstable County in 2019 (the last year these data were available) with a median cost of $3,733 per heating ton. A home with 2,000+ square feet would require a 4-ton ASHP (though this number is variable depending on a building's ability to retain heat), resulting in a capital cost of $14,900. However, costs will vary depending on the existing HVAC and envelope conditions of the house, and can also be offset with Mass Save rebates.

HEATING SYSTEM ANNUAL AND LIFETIME COSTS

UNIT TYPE	CAPITAL COSTS	LIFE SPAN (YEARS)	ANNUAL FUEL COSTS	LIFETIME ANNUAL COSTS	ANNUAL GHG EMISSIONS (MT CO_2e)
Heating oil boiler	$6,500	15	$2,320	$2,753	7.62
Natural gas boiler	$8,150	15	$1,010	$1,553	3.50
ASHP	$14,900*	12.5**	$320	$1,512	0.73

* Homeowners replacing their entire heating system are eligible for rebates up to $10,000, which can significantly lower this number.
** ASHPs have variable lifespans, but most research shows likely lifespans to be between 10–15 years; 12.5 was chosen as a midpoint, but shorter or longer lifespans would change the cost effectiveness of ASHPs.

Using cost and GHG savings per household with county-specific heating data yields potential savings across Cape Cod under various adoption scenarios. Below, three adoption scenarios are presented with their associated financial savings and GHG reductions.

FINANCIAL AND ENVIRONMENTAL BENEFITS OF ASHP ADOPTION FROM NATURAL GAS AND HEATING OIL

SCENARIO	ORIGINAL HEAT SOURCE	NUMBER OF HOMES	TOTAL FINANCIAL SAVINGS ($)	TOTAL GHG SAVINGS (MT CO_2)	SO_2 REDUCTION (LBS.)	NO_X REDUCTION (LBS.)	$PM_{2.5}$ REDUCTION (LBS.)
100% adoption	Heating oil	31,127	$38,638,640	214,401	162,404	403,895	33,495
	Natural gas	101,297	$4,186,926	280,389	(2,935)*	284,330	49,737
75% adoption	Heating oil	23,345	$28,978,980	160,801	121,803	302,921	25,121
	Natural gas	75,972	$3,140,194	210,292	(2,201)*	213,247	37,303
50% adoption	Heating oil	15,563	$19,319,320	107,200	81,202	201,947	16,748
	Natural gas	50,648	$2,093,463	140,194	(1,468)*	142,165	24,868

Note: Annual savings per home stemming from the switch to ASHPs from heating oil are estimated to be $1,241, with associated CO_2e reductions to be 6.89 MT per year. The same changes associated with switching from a natural gas system are $41 per year, and a reduction of 2.77 MT of CO_2e.
* Parentheses denote an increase rather than a reduction.

Savings are dependent on a few variables, such as air-sealing and size of home, and ASHP lifespan. As heat pump technology improves it is expected that ASHP lifespan will increase, which will decrease the amortized cost of the system, and result in greater savings over oil and natural gas systems.

Along with cost savings and GHG reductions, changing energy types affects the amount and type of criteria pollutants shown to affect human health in the air.

HEALTH BENEFITS FROM CRITERIA POLLUTANT REDUCTION FOR ASHP ADOPTION SCENARIOS

ASHP ADOPTION SCENARIO	HEALTH SAVINGS FROM CRITERIA POLLUTANT REDUCTION
100% adoption	$363,025–$820,618
75% adoption	$272,268–$615,466
50% adoption	$181,512–$410,311

Note: Health savings are for Barnstable County, estimated using EPA's COBRA tool.

Although this fact sheet addresses ASHPs in detail, geothermal heat pumps (GHPs) should also be considered as a potential alternative heating source. GHPs can be more efficient than ASHPs, but require between 400 and 8,000 square feet of clear land space. GHPs also have a higher capital cost, which can be a barrier to installation.

Another important factor for home efficiency as it relates to heating and cooling is air sealing and insulation. The U.S. Environmental Protection Agency (EPA) estimates that proper air sealing and insulation can reduce the average energy bill of houses in climatic zone five by 16%. Home envelopes should be evaluated regardless of heating system to realize these potential savings. Requirements for blower door testing and thermal imaging could be helpful tools to evaluate a home's envelope as a prerequisite to HVAC retrofits in order to ensure the retrofit's benefit is maximized. Mass Save offers no-cost home energy assessments as well as 75% off insulation costs, and is a great resource for homeowners looking to save money and energy.

EQUITY

BPS and retrofits, in particular heat pump technologies, have the potential to make heating more affordable and reduce GHG emissions. Potential equity benefits of increased efficiency buildings are:

- **Reducing heating costs.** More efficient energy systems can lower annual heating costs, which is beneficial to all residents, but especially for those who spend a large portion of their income on utilities. Spending less on heating could allow residents to reallocate their spending and reduce financial hardship.
- **Strengthening the local green economy and increasing grant opportunities.** Increases in energy-efficient heating sources represent a positive step as more cities and towns become designated as Green Communities in Massachusetts. This designation provides communities with access to grant opportunities for green initiatives, which receiving towns could direct toward low-income communities to ensure that efficient and affordable heating practices are available to everyone.
- **Reducing GHG emissions and criteria pollutants**. Reducing emissions is a powerful tool to collectively alleviate the burden of climate change. Historically, negative impacts of poor environmental practices have disproportionately affected low-income communities and communities of color; thus, a reduction in criteria pollutants could have important implications for the health of vulnerable communities.

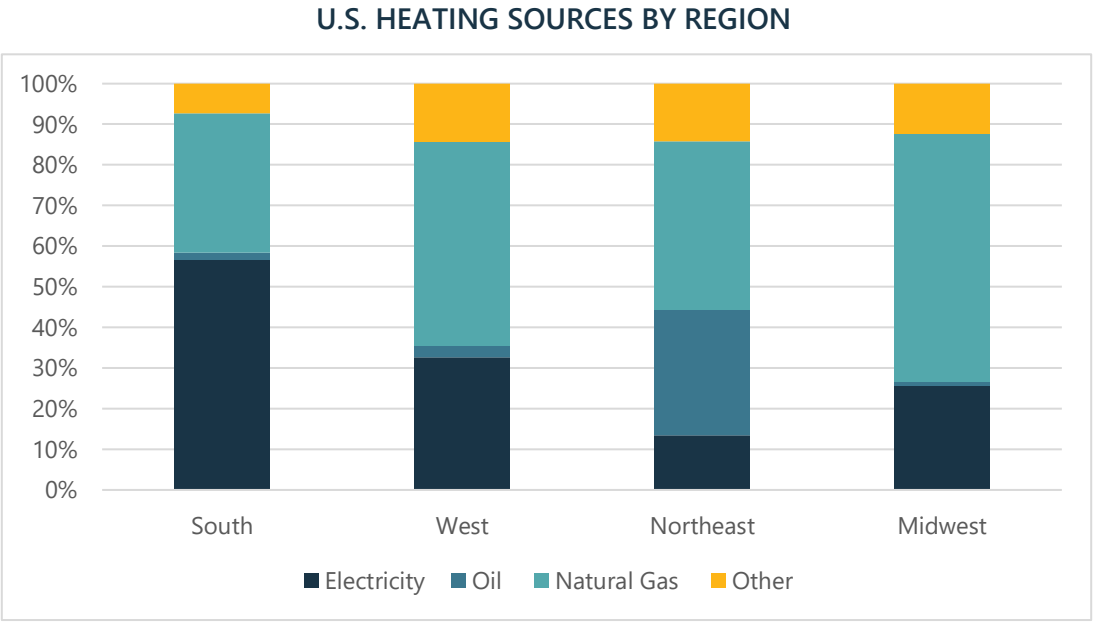
Optimizing Equity During Implementation

Equity considerations for tenants and building owners are important when implementing any strategy that seeks to lower GHG emissions, particularly when it's associated with higher capital costs. Some programs to lessen the burden of retrofits, such as the Mass LEAN program and the Cape & Vineyard Electrification Offering, already exist; however, these efforts can be augmented with additional municipal policies to ensure that all aspects of retrofitting are accessible to everyone. For equitable implementation of building performance standards, EPA's Benchmarking and Building Performance Standards Policy Toolkit (Section 2) provides for considerations of compliance accommodations and exemptions for certain factors, such as financial hardship or under-resourced buildings like affordable housing.

STATE OF PRACTICE

General State of Practice

The Northeast is lagging behind the rest of the country in terms of adopting electric heating sources. According to a 2020 study, 47% of Northeast homeowners had never heard of heat pumps. However, they have been growing in popularity over recent years. The State of Maine currently has a goal of installing of 100,000 heat pumps by 2025, and is well on its way; in 2021 alone, they installed 27,000 new heat pumps. Outcomes from this initiative have thus far been overwhelmingly positive.



Cape Cod Context

In Barnstable County in 2019, the last year these data are available, MassCEC reported that 541 ASHPs were installed. Across Massachusetts, 7,100 heat pumps were installed in 2021, and that number more than doubled to nearly 18,000 in 2022. While this represents significant growth, it is well short of the state goal of 100,000 average annual installations for the next 25-30 years.

CASE STUDY: CAMBRIDGE, MA

Through citywide efforts, Cambridge became one of the first Green Communities designated by MA in 2010. One effort is the Cambridge Energy Alliance (CEA), a program offered to assist homeowners in adopting energy-efficient projects. Among other programs CEA connects individuals to Mass Save and offers no-cost heating assessments. One example of energy-efficient retrofitting in Cambridge is the 98-unit apartment community Finch Cambridge, which received a $147,000 grant enabling it to be 70% more efficient than the average multifamily building. Plenty of similar examples, and the city's exemplary support of energy efficiency, make Cambridge a good case study on citywide adoption and promotion of energy-efficient retrofits.

IMPLEMENTATION

Local and state-sponsored efforts are important to support retrofits and create BPS. Different state and national programs offer financial and logistical assistance to create BPS and encourage residential retrofitting. Along with state programs, programs offered by Cape Cod's Cape Light Compact should be considered for energy efficiency. To maximize the GHG reductions and financial savings from this strategy, municipalities on Cape Cod should:

- **Engage the community.** Create townwide programs to increase awareness for heat pump technology, emphasizing cost and GHG savings.
- **Evaluate opportunities.** Create a task force to further evaluate energy saving strategies to be included in a potential BPS.
- **Provide assistance.** Support residents with applications for rebates on heating systems, air sealing and insulation quotes, and other measures to reduce GHG emissions.

REQUIRED EXPERTISE

Internal: Town committees and working groups on sustainability, policymakers, building departments

External: HVAC service providers

Resources that may assist with implementing strategies to increase energy efficiency in non-municipal buildings are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
Air Source Heat Pump Rebates, Mass Save	Provides information about ASHPs and rebates for qualifying homes. Rebates from Mass Save are up to $10,000 for full-home heating, and $1,250 per heating ton for partial-home heating.
Air Source Heat Pump Installers in Massachusetts	Repository from MassCEC with air source heat pump installers.
Mass.gov Green Community Designation and Grant Program	Information about the Massachusetts Green Community designation and resources to apply for the designation and related grants.
ENERGY STAR Air Source Heat Pumps Tax Credit	Provides additional information on tax credits for air source heat pumps.
Weatherization for Air Sealing and Insulation, MassCEC	Information on weatherization for homeowners
LEAN Multifamily Program	A program that financially assists low-income homeowners with retrofits.
Building Performance Standards Technical Assistance	A resource that provides technical assistance in designing and implementing BPS.
Cape & Vineyard Electrification Offering	Assists low- and middle-income individuals with electrification.
Cape Light Compact Income Eligible Savings	A program from the Cape Light Compact with two income tiers that are eligible for reduced energy costs.

ADDITIONAL INFORMATION	
Energy.gov Air-Source Heat Pump Information	Information from Energy.gov on ASHPs, different types of equipment, how they work, and what is best for different homeowners.
Are Air Source Heat Pumps Right for You?—EnergySage	Considerations for prospective heat pump installers.
Building Performance Standards, New Buildings Institute	Background information on BPS.

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Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Strive toward net zero energy buildings: New non-municipal buildings

Housing & Development

INCREASE ENERGY EFFICIENCY IN NEW NON-MUNICIPAL BUILDINGS BY ADOPTING THE SPECIALIZED CODE

Description and purpose of strategy: Municipalities can take action to reduce energy use in newly constructed non-municipal buildings by adopting the Municipal Opt-In Specialized Code, which ensures new construction is consistent with Massachusetts GHG limits set every five years from 2025 to 2050. The Specialized Code sets stricter building requirements than the current Stretch Code. By adopting it, municipalities can reduce environmental impacts such as greenhouse gas (GHG) emissions, while also increasing local jobs, promoting equity, and realizing cost savings.

Content of fact sheet: Overview of the costs and benefits of energy efficiency practices in new non-municipal buildings (private, commercial, and industrial), equity considerations, implementation steps, and resources available including by adopting the Specialized Code and achieving the broader "Green Community" designation.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Socially vulnerable and low-income populations can benefit from increased economic opportunities and better air quality, though care is needed to ensure burdens (utility costs, increased housing costs) are not disproportionately placed on low-income renters.

Financial benefits: Compared to Stretch Code construction projects, Specialized Code projects can have lower operational costs as a result of decreased energy use and may have lower capital and other up-front costs due to incentives currently available for energy-efficient new construction. Increased job opportunities from energy-efficient new construction can also provide financial benefits to the community.

Non-market benefits: Promoting energy-efficient construction can yield improvements in health from reduced pollution.

GHG reductions: Energy-efficient new construction in accordance with the Specialized Code can ensure new construction is consistent with state GHG limits set in the forthcoming years, providing significant reductions relative to the baseline energy code.

Ease of implementation: Adopting the Specialized Code ensures that energy efficiency is considered during the design and construction of all new buildings in a way that is consistent with state GHG limits.

KEY TERMS DEFINED: STRETCH CODE, SPECIALIZED CODE, PASSIVE BUILDINGS, AND GREEN COMMUNITIES

The **Stretch Code** is an opt-in energy code that ensures energy efficiency is considered during the design and construction of new residential or commercial buildings, or during major renovations. The Stretch Code includes requirements for ventilation and insulation, and it requires electric vehicle wiring for at least 20% of spaces in multi-family parking lots.

The **Specialized Code** builds off the Stretch Code but is even stricter. It requires new construction to meet net zero building performance standards. To meet the net zero standard, new construction must be either fully electrified, pre-wired for future electrification, or built to meet the passive buildings criteria.

Passive buildings are a specific type of building certification. These buildings are built with similar energy-efficient methods to the ones outlined in the Stretch and Specialized Codes, including reducing heating and cooling demands through improved insulation. To comply with the Specialized Code, passive buildings must be constructed in accordance with the Phius ZERO requirements, which requires that annual energy use be net zero.

Achieving a **Green Community** designation provides the community with access to resources, including exclusive financial and technical support, to increase clean energy use and decrease energy use. There are five criteria that a community must meet to receive the designation—adopting the Stretch Code is one of the five criteria.

BENEFIT COST ANALYSIS

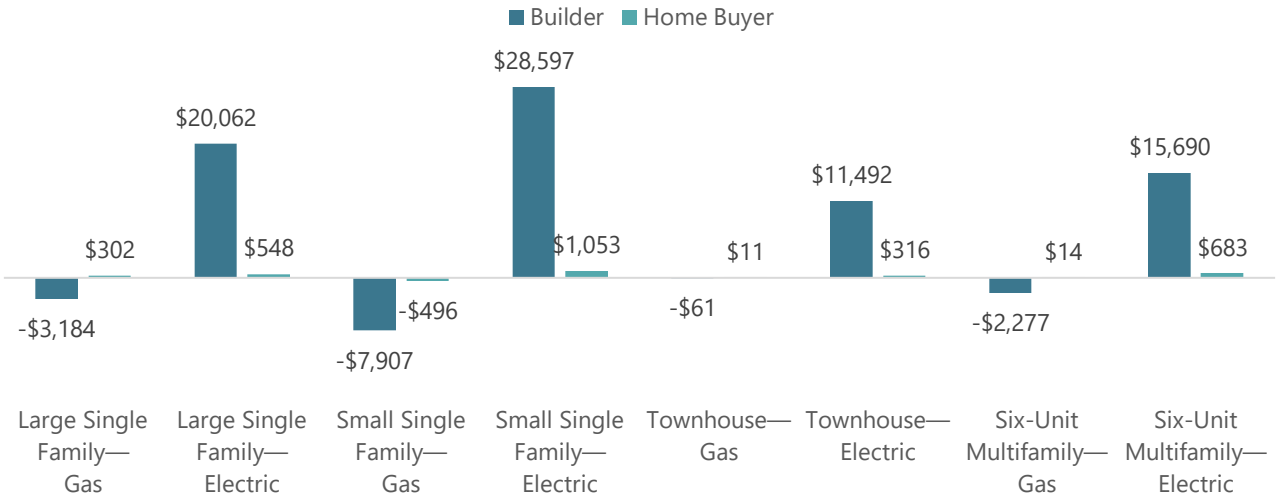
The capital and other up-front costs of developing and constructing energy-efficient non-municipal buildings fall in large part to the builders, but may be passed on to owners and renters. Higher energy efficiency can lead to lower operational costs, which can provide a benefit to those paying energy bills, including owners and renters.

The Massachusetts Department of Energy Resources (DOER) has conducted a "Residential Cash Flow Analysis" (MA DOER, 2022) through an independent building energy consulting firm to assess the cost and benefit implications of new residential buildings (of various sizes and housing types) constructed under the 2023 Stretch Code as compared to the base code. Given that the Specialized Code implements the Stretch Code but with additional requirements, this analysis provides a basis for understanding the costs and benefits of adopting a building code focused on energy efficiency. The assessment took the following features into consideration:

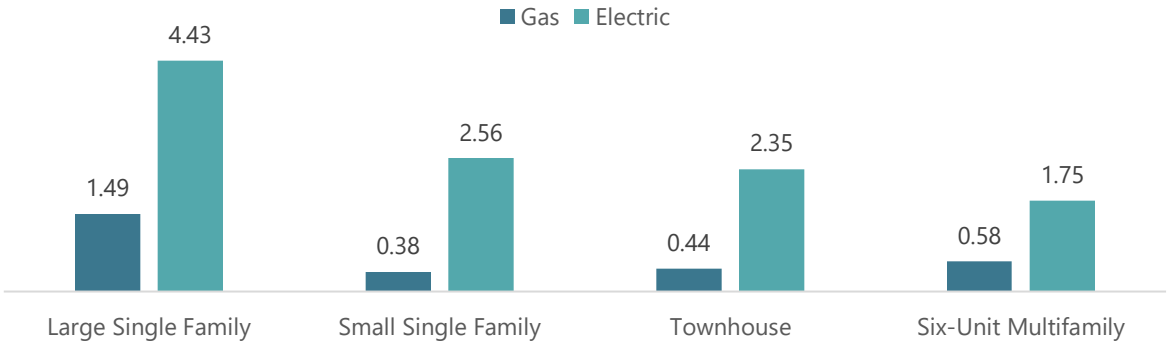
- Rebates from the Mass Save new construction program pay-for-savings incentive calculations
- Tax credits
- High-efficacy lighting
- Heating and cooling
- Hot water
- Windows
- Mechanical ventilation
- Duct leakage to outside
- Insulation (foundation, floor, walls, and ceiling)
- Air infiltration

The figures below show the results of the Stretch Code cash flow analysis, including the annual tons of GHG emissions saved as compared to the baseline energy code. The Specialized Code would likely lead to greater net benefits for builders when considering financial incentives, as well as for home buyers due to lower operational costs. The Specialized Code would also lead to greater GHG emissions saved due to restrictions on combustion heating equipment.

NET BENEFIT TO BUILDERS AND ANNUAL NET BENEFIT TO HOME BUYERS OF STRETCH CODE RESIDENCES



ANNUAL TONS OF GHG EMISSIONS SAVED: STRETCH CODE COMPARED TO BASELINE CODE



The rebates and tax incentives currently available for energy-efficient new construction help make these cost-effective options for builders. Those paying energy bills, such as home buyers or renters, will generally save annually as well. Though construction capital costs may be higher than costs for Stretch Code projects, financial incentives are available that may make them—and other up-front costs—lower in practice. Operating costs under the Specialized Code should also be lower, given the increased energy efficiency (and decreased energy demand) of buildings meeting the Specialized Code requirements.

Financial benefits can also be realized through increased jobs related to energy-efficient new construction, including new opportunities for construction workers, electricians, and engineers. An analysis of Massachusetts job creation from investments in energy efficiency and building retrofits found that this sector supports 3.5 times as many jobs per dollar as the state's 10 largest industries (Climate XChange).

Given that the Specialized Code is stricter than the Stretch Code, adopting it can be expected to yield greater environmental benefits. Homes built with electric heat pumps provide greater GHG emissions reductions than gas-heated homes and are in line with the Specialized Code requirements that specify using electrically heated

CRITERIA POLLUTANT REDUCTIONS

An economic analysis for the Town of Acton assessed the health savings from reductions in criteria pollutants (SO_2, NO_x, and $PM_{2.5}$) from LEED certified homes and found annual cost savings can be as high as $30–$67 for natural-gas-heated homes, and as high as $117–$264 for oil heated homes.

buildings. Energy-efficient construction can provide further benefits by reducing criteria pollutant emissions. (See the text box for an example.)

EQUITY

Newly constructed, energy-efficient non-municipal buildings can provide a number of benefits, if carefully implemented, to low-income and socially vulnerable populations. Some of the benefits include:

- **Targeted resource distribution.** Exclusive grants and technical assistance are available for designated Green Communities. These funds can be allocated to areas with socially vulnerable populations, which could provide community benefits by ensuring that new construction incorporates energy-efficient practices and technologies. These grants and technical assistance can be accessed through the Green Communities Designation and Grant Program webpage.
- **Increased economic opportunity.** Construction of energy-efficient buildings could be an opportunity for job growth, and thus economic opportunity for socially vulnerable and low-income communities. "Green economy" job trainings could be targeted toward these populations to provide a clear avenue for socially vulnerable and low-income populations to have skills for, and access to, new job opportunities and associated benefits.
- **Improved air quality.** Socially vulnerable populations are often more likely to reside in areas with poorer air quality. Given that energy-efficient practices have been shown to improve the health of residents (Maidment et al., 2014), socially vulnerable populations serve to benefit the greatest from the improved air quality.

Optimizing Equity During Implementation

Special consideration must be given to ensure that low-income communities and socially vulnerable populations reap the benefits of newly constructed energy-efficient buildings. Increasing energy efficiency in new buildings often has stratified economic effects that benefit landlords, owners, and developers, but create burdens for renters and low-income communities as rents often increase (read more about these disproportionate burdens in the American Council for an Energy-Efficient Economy's 2016 report). "Greening of neighborhoods" can mark the beginning of gentrification as it increases an area's desirability and may increase rent prices, which could price low-income households out of the area. To avoid these potential burdens, municipalities must ensure that affordable housing options are included within newly constructed energy-efficient buildings. The State of Maine has explored these important equity considerations in detail in its Equity Assessment (p. 15), which can be used as a starting point to understand the challenges related to Cape Cod.

CASE STUDY: MULTIFAMILY PASSIVE HOUSING

Passive housing can provide significant energy emissions reductions for new construction, meeting the standards outlined by the Specialized Code. In 2022, Simmons and McKneally assessed five completed multifamily passive housing projects in Massachusetts; they found that these projects cost 1.5% to 4.3% more than projects built to the base code, though the analysis did not take into account incentives from Massachusetts Clean Energy Center (MassCEC) or Mass Save, which can provide significant cost reductions. Simmons and McKneally (drawing on their 2020 energy use analysis) also reported that the energy use of multifamily passive housing was less than half that of multifamily housing built to the base code.

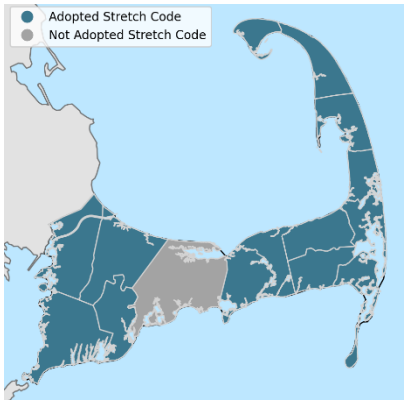
STATE OF PRACTICE

General State of Practice

With the passing of the Stretch Code in 2009, Massachusetts became the first state to adopt an above-code appendix to its base building energy code. Since 2009, the Stretch Code has been updated multiple times, with the most recent update to take effect in 2023. It has been adopted by 300 towns, representing over 95% of all towns in the state. Expanding on the Stretch Code, the Climate Act of 2021 required the development of the Specialized Code. Finalized in December 2022, the Specialized Code goes beyond the Stretch Code by ensuring that new construction is consistent with Massachusetts GHG emissions limits and building sector sub-limits set every five years from 2025 to 2050, aligning with the state goal of achieving a net zero emissions economy by 2050. As of late January 2023, Brookline, Cambridge, and Watertown had adopted the Specialized Code.

Cape Cod Context

As of late 2022, the Town of Barnstable was the only remaining town on Cape Cod that had not adopted the Stretch Code. Except for Sandwich and Barnstable, all of the other towns on Cape Cod have been designated as Green Communities. Nearly all of these Stretch Code adoptions and Green Community designations have been made in the last five years, demonstrating the recent and rapid progress by Cape Cod towns. With the new Specialized Code, Cape Cod towns have the opportunity to ensure new construction aligns with the state's goal of a net zero emissions economy by 2050.



IMPLEMENTATION

The actions below outline the process for implementing the Specialized Code. The process for adopting the code, including sample language for a town meeting or town council warrant article, town meeting or town council motion, and bylaw, are provided by DOER.

REQUIRED EXPERTISE

Internal: Building officials, town planners, housing departments

External: Builders, architects

- **Educate the community.** Garner support for adopting the Specialized Code by educating the community about its benefits (e.g., increases energy efficiency of new construction; helps achieve GHG emissions reduction goals, including a net zero economy by 2050).
- **Adopt the Specialized Code.** Seek adoption of the Specialized Code as a general bylaw through a town meeting or town council vote. Municipalities that have already adopted the Stretch Code may choose to amend their existing Stretch Code bylaws in accordance with the Specialized Code. **Recommendation:** Specify an effective date (suggested either January 1 or July 1) to ensure all know when it takes effect.
- **Advertise training resources.** Advertise energy code trainings provided by Mass Save (open to all and free for building officials). Other trainings specifically related to passive buildings and all-electric homes are also available (read more here).

Resources for improving energy efficiency in newly constructed, non-municipal buildings through adoption of the Specialized Code are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
Massachusetts Green Communities Grants	Grants and technical support for local energy efficiency initiatives available for designated Green Communities.
Massachusetts Energy Code Training	Mass Save trainings on building energy codes available to all, designed to serve building officials and other building professionals (e.g., builders and architects). Free training for building officials. Counts toward a new Board of Building Regulation and Standards requirement that building officials be trained in energy efficiency.
Cape Light Compact	Provides financial and technical assistance to homeowners, renters, and businesses to improve energy efficiency in buildings.
ADDITIONAL INFORMATION	
Summary of 2023 Stretch Code Update and Specialized Code	Summarizes 2023 Stretch Code update and Specialized Code. Outlines requirements by building type.
Specialized Code Adoption Process	Instructions for municipalities on the process of adopting the Specialized Code, developed by DOER's Green Communities Division.
Stretch Code Adoption Process	Instructions for municipalities on the process of adopting the Stretch Code, developed by DOER's Green Communities Division.
Mass Save Passive House Incentives	Incentives and assistance for constructing Passive House multi-family buildings (five units or more).
Mass Save Passive House and All-Electric Homes Training	Training supports workforce development and market transformation in the energy efficiency and building construction industries.
Mass Save Residential New Home Construction Incentives	Financial incentives for residential new construction that exceeds the Massachusetts building energy code.
MassCEC Funding for Equity Workforce Training	Grant funds and technical support valuing up to $1.2 million across two to three years for programs that provide job training and support services to underserved people seeking employment in the clean energy sector.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Strive toward net zero energy buildings: Municipal buildings

REDUCE ENERGY USE IN MUNICIPAL BUILDINGS BY ADOPTING EFFICIENCY MEASURES

Housing & Development

Description and purpose of strategy: Municipalities have a direct incentive to reduce energy use, with financial and technical resources exclusively available to municipalities that pledge to cut municipal energy use by an ambitious but achievable goal of 20% over five years and meet additional criteria established in the Green Communities Act. By leveraging exclusive resources and grants, Green Communities can help finance net zero energy projects in new and existing municipal buildings.

Content of fact sheet: An overview of the Massachusetts Green Community designation, as well as the economic and equity implications, best practices, and the state of practice of achieving net zero energy in new and existing municipal buildings.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property value
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: There are opportunities to reduce GHG emissions and pollution through net zero energy buildings, but ensuring municipalities can finance net zero energy emission projects in low-income communities is imperative.

Financial benefits: Available grant funding for net zero energy is multiple orders of magnitude less than what would be required to achieve net zero energy across all municipal buildings. To bridge the financing gap, municipalities should consider energy savings performance contracts (ESPCs).

Non-market benefits: Improvements in health from reduced pollutants are major benefits of Green Communities projects.

GHG reductions: Green Communities striving for net zero energy in new and existing municipal buildings have the potential to reduce a large portion of municipal energy use.

Ease of implementation: Preliminary implementation actions include creating an inventory of existing municipal buildings, designating an employee to coordinate municipal energy efficiency efforts, and conducting energy emission audits.

BENEFIT COST ANALYSIS

Municipal buildings often account for most municipal energy use. For example, in the cities of Somerville and Falmouth, municipal buildings make up 72% and 65% of all municipal energy use, respectively. Strategies to reduce energy use in these buildings include electrifying heating, ventilation, and air conditioning (HVAC) systems, achieving Leadership in Energy and Environmental Design (LEED) certification, and transitioning to or building net zero energy municipal buildings. In 2022, the Town of Acton commissioned a study by an engineering firm to estimate the costs of electrifying their existing municipal buildings. To assess the potential costs and benefits of electrifying existing buildings, selected Town of Acton estimates are presented below, in lieu of estimates specific to Barnstable County, due to similarities regarding the ages and types of buildings in Acton and Barnstable.

Net zero energy: For the purposes of this fact sheet, we define net zero energy as a building that "balances its energy needs with energy produced from renewable, zero-emission sources" (USGSA, nd). This definition is from the U.S. General Services Administration, which identifies two characteristics that distinguish net zero energy from previous energy efficiency approaches: (1) the baseline and target are "zero," and (2) energy use must be supplied from renewable energy.

ELECTRIFYING SELECTED ACTON MUNICIPAL BUILDINGS: AVERAGE ATTRIBUTES, COST, AND GHG REDUCTIONS

BUILDING	AREA	ENERGY USE REDUCTION	CONVERSION COST	GHG REDUCTION	CONVERSION COST
	FT^2	%	$	%	$ PER FT^2
Acton Town Hall	24,144	70%	$845,040	65%	$35
Acton Memorial Library	48,259	68%	$1,689,065	63%	$35
Acton Public Safety Facility	26,033	64%	$911,155	64%	$35
Average	**32,812**	**67%**	**$1,148,420**	**64%**	**$35**

Building conversion costs presented in the above table include:

- Removing mechanical equipment served by high-temperature hot water and replacing it with equipment sized to meet building heating loads at the low-temperature hot water design temperature.
- Replacing central equipment, including air handling units and rooftop units.
- Replacing terminal equipment, including finned tube radiators, reheat coils, and fan coil units.

Building conversion costs are based on the age of each building and HVAC system, the type of HVAC system, building use, and historical status. All municipal buildings evaluated were estimated to have "high" conversion costs, which is $35/ft^2, due to their age and heating systems. Medium- and low-cost scenarios were $22/ft^2 and $10/ft^2, respectively. Though these projects are a net cost after upgrading the system and factoring in yearly energy costs, they provide benefits in the form of GHG reductions and reduced criteria pollutants. Costs per megatonne (MT) CO_2e reduced and non-market benefits specific to the Town of Acton can be found in the table below (Town of Acton, 2022).

BENEFITS AND COSTS OF ELECTRIFICATION

BUILDING	NET COST PER MT CO_2 REDUCED $ PER METRIC TON CO_2	ANNUAL HEALTH BENEFIT $	ANNUAL SOCIAL COST OF CARBON BENEFITS $
Acton Town Hall	$851	$673–$1,516	$4,265–$12,979
Acton Memorial Library	$504	$1,495–$3,369	$9,867–$30,025
Acton Public Safety Facility	$378	$1,162–$2,619	$7,512–$22,858
Average	**$578**	**$1,110–$2,501**	**$7,214–$21,954**

Creating an inventory of building energy use can support an effective cost-benefit analysis of electrifying municipal buildings. Adding solar arrays to municipal buildings can also reduce emissions and should be investigated. To estimate conversion costs for electrifying municipal buildings, a cost of $35 per square foot can be multiplied by the area of a municipal building (though a medium- or low-cost scenario could change the cost per square foot, as described below).

In addition to electrification of municipal buildings, net zero energy buildings could help further reduce municipal energy use. Multiple studies have shown constructing net zero energy buildings is similar in cost to constructing "conventional" buildings. A California study found that net zero energy buildings incur a 0–7% new construction cost premium, and a Vermont study found similarly that net zero energy commercial buildings incur a 7% new construction cost premium. According to a Massachusetts study that reviewed net zero emissions K–12 school buildings, projects break even after 15 years and have a total cost savings of $20 per square foot over 30 years relative to a conventional building baseline (USGBC MA, 2019). Due to the important connection between educational buildings and equity within communities, costs related to educational buildings are of particular importance.

Switching to a local green energy provider is another important opportunity for municipalities to consider. For example, Cape Light Compact Local Green offers an option to match electricity use with 100% Massachusetts RPS Class I renewable energy certificates (RECs) for approximately $0.2540 per kWh (Cape Light Compact, 2023). For comparison, Eversource offers its Basic Service (22% from MA RPS Class I RECs) at rates ranging from $0.26176 - $0.3996 per kWh (MA Power Choice, 2023). For a benefit cost analysis of switching to 100% renewable energy sources, please see the fact sheet titled "Generate and increase the use of clean electricity", which covers the total benefit cost per kWh.

EQUITY

Green Communities have the potential to result in a variety of outcomes that would strengthen equity and reduce burdens on vulnerable populations. Potential benefits include:

- **Enhanced economic opportunity.** Green Communities policies may lead to increased job opportunities related to new construction projects and renovations on existing buildings. For equity benefits to accrue, municipalities would need to ensure community members have access to these jobs and possess requisite skills, which might require targeted incentives, training, and other accessibility measures. Municipalities could also prioritize hiring local, women- or minority-owned contractors.
- **Improved air quality.** Green Communities policies could lead to a reduction in GHG emissions and pollution. Ensuring that potential energy efficiency options are available to low-income communities could result in air quality benefits for these populations.

Optimizing Equity During Implementation

Despite the benefits mentioned above, there can still be equity-related impacts for low-income communities and renters. Ensuring municipalities can finance net zero energy emission projects in low-income communities is critical, particularly for jurisdictions with a limited tax base. Energy savings performance contracts (ESPCs) should be considered by municipalities as an alternative to using municipal capital to fund these projects. According to the U.S. Department of Energy's Office of State and Community Energy Programs, ESPCs offer a well-established, budget-neutral approach to financing energy efficiency projects. By entering an ESPC with an energy service company, municipalities can finance energy efficiencies projects with future energy savings, all while leaving their capital budget untouched. More broadly, municipalities seeking to optimize equity will need to balance municipal building actions with other energy-efficiency strategies that provide more direct equity benefits.

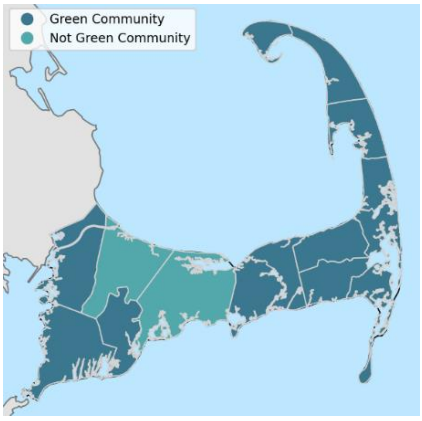
STATE OF PRACTICE

General State of Practice

The Green Communities Division of the Massachusetts Department of Energy Resources (DOER) was created by the Green Communities Act of 2008. By 2012, 100 communities had received the Green Community designation. As of December 2022, 290 communities were designated as Green Communities. Given that Massachusetts has a total of 312 cities and towns, this program has grown rapidly.

Cape Cod Context

To date, all Cape Cod municipalities except Sandwich and Barnstable are designated Green Communities. Several communities have received Green Communities grants for municipal projects. Notably, projects on Cape Cod funded by these grants have focused on energy conservation measures for existing municipal facilities. Green Communities grants have not yet been used to fund net zero energy construction of new municipal buildings on Cape Cod, which may be due to the relatively modest average award amount. However, municipalities may combine grants to fill the gap.



GREEN COMMUNITIES FUNDING PROGRAM AWARDS

DATE	TOWN	PROJECT	AWARD
Feb 2020	Chatham	Energy conservation measures such as LED lighting in municipal facilities, including the library, Department of Public Works, and town annex.	$134,040
Feb 2020	Dennis	Energy conservation measures (indirect hot water heaters, weatherization, Wi-Fi thermostats, lighting) in municipal facilities including the golf clubhouse and senior center.	$160,170
Jan 2022	Harwich	Energy conservation measures, including HVAC upgrade and chiller installation, in municipal facilities including the community center.	$160,952
Aug 2020	Provincetown	Energy conservation measures, including chiller replacement with fuel conversion, and administrative assistance in municipal facilities including the town hall.	$138,350

Source: MA Department of Energy Resources, 2022.

CASE STUDY: CITY OF CAMBRIDGE, MA

Cambridge was designated as a Green Community in 2010 and has emerged as a leader in its efforts to pursue net zero emissions in new and existing municipal buildings. Net zero emissions buildings achieve an "overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere" (Climate Council, 2020). Cambridge launched its transition to net zero energy in existing municipal buildings with a comprehensive energy audit. Next came retro-commissioning, weatherization, and water treatment plant retrofits. Existing municipal buildings underwent major renovations, with upgrades to lighting and HVAC systems. These measures were made possible by almost $950,000 in grants awarded by the Division of Green Communities, and generally had a payback period of less than seven years. In six years, these projects decreased the city's energy consumption by 20%, reducing its annual energy costs by $1.4 million as of 2016. To ensure ongoing support for energy efficiency projects, Cambridge increased resident parking sticker fees by $12 in 2010, designating $150,000 in revenue to these efforts on an annual basis (MA DOER, 2016). In 2019, Cambridge completed its first net zero emissions project with the construction of the King Open and Cambridge Street Upper Schools. While net zero emissions differ from net zero energy, where building energy needs are balanced with energy produced from renewable, zero-emission sources, the Green Communities Division elevates several best practices employed by the City of Cambridge that can be transferred to net zero energy projects. Best practices include engaging municipal staff at all levels, managing expectations, planning for operations and maintenance, and communicating benefits to the public. For more best practices, explore the case studies on the division's website (Green Communities Division, 2016).

IMPLEMENTATION

Below are recommended actions for reducing energy use in municipal buildings:

- **Become a designated Green Community.** Green Communities gain access to exclusive financial and technical resources to support reducing energy use.
- **Inventory municipal buildings.** Create an inventory of existing municipal building energy use to analyze the costs and benefits of electrification.
- **Consider staffing availability.** Designate an employee to coordinate the town's energy efficiency efforts.
- **Consider ESPCs.** Enter into an ESPC with an energy service company for a budget-neutral approach to financing energy improvements for existing buildings.
- **Conduct energy emission audits.** Use the Department of Energy's Better Buildings Emissions Reduction Planning Framework to audit municipal buildings and, where possible, partner with energy service companies to share costs.
- **Select energy reduction measures.** Identify and prioritize measures that lead to emissions reductions.

REQUIRED EXPERTISE

Internal: Energy manager, facilities superintendent, head of maintenance, head custodian

External: Energy manager, energy service company, energy auditor

- **Implement emissions reduction measures.** Track the progress of emissions reductions against municipal goals.
- **Conduct retro-commissioning.** Evaluate and optimize existing base systems no less than every 10 years to ensure proper operation for a cost-effective approach to increasing energy efficiency.

Resources that may assist with implementation of energy reduction measures in municipal buildings are included below.

FINANCIAL AND TECHNICAL SUPPORT	
Green Communities Division	Provides regional coordinators, education, project guidance, technical assistance, and exclusive funding opportunities.
MassEnergyInsight	Free web-based tool that tracks energy use and identifies municipal buildings for assessment.
Cape Light Compact	Supports towns in implementing energy efficiency measures in municipal buildings.
ADDITIONAL INFORMATION	
Efficient Buildings—Identify Efficiency Measures	Guide to identifying opportunities for energy efficiency measures in municipal buildings.
Efficient Buildings—Implement Efficiency Measures	Considerations for implementing energy efficiency measures in municipal buildings, including financing resources.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

SCLIMATE ACTION FACT SHEET

Promote waste reduction and diversion

DIVERT RECYLABLE AND ORGANIC WASTE FROM LANDFILLS FOR ALTERNATIVE MANAGEMENT OR REUSE

Housing & Development

Description and purpose of strategy: Waste reduction and diversion through reuse and recycling can support a local circular economy, reduce the need for new raw materials, and reduce environmental impacts. Diverting organic waste from landfills also reduces emissions of methane, a potent greenhouse gas (GHG).

Content of fact sheet: Information on economic and equity implications, best practices, and the state of practice of diverting materials from landfills in the short term and eliminating the sending of waste to landfills in the long term. Actions within this strategy include expanding pay-as-you-throw trash programs; expanding compost collection programs; and promoting overall waste reduction through reuse, at-home composting, and increased recycling.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property values
- ☐ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☑ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Unlike many landfills and waste management facilities in the U.S., most landfills on the Cape are not located near vulnerable communities. However, reducing waste sent to landfills—as well as ensuring all residents and visitors have access to proper waste disposal and recycling facilities—could contribute to positive environmental and health outcomes for nearby communities.

Financial benefits: Changing waste management practices to increase recycling and organic waste management would require near-term costs related to operational changes, connecting to recycling markets and processing facilities, and building new facilities, depending on the program(s) implemented.

Non-market benefits: Waste reduction results in improved health, reduced emissions from waste management and processing, and improved environmental quality, including reduced risk of contamination and exposure to pollution and GHG emissions, all with associated equity benefits.

GHG reductions: While waste reduction and diversion are effective at reducing GHG emissions from waste, waste-related emissions are a small percentage (3%) of total community-wide GHG emissions. Even with the additive benefits of compost production from diverted organic waste, the potential GHG reduction impact is low.

Ease of implementation: Collection of organic waste and recyclables may be relatively easy (if not already in place) but management may be more challenging, requiring new facilities for composting or anaerobic digestion of organic waste and identification or creation of markets for end products such as compost. For non-organics, material recovery facilities and aggregating, sorting, and processing facilities could be built.

BENEFIT COST ANALYSIS

Waste reduction and diversion generates public benefits that include cost savings, reduced GHG emissions, improved environmental quality for communities adjacent to waste processing facilities, and keeping materials in the economy longer. Locally, about half of GHG emissions from waste are generated by closed landfills, primarily from the decomposition of organic matter. This section presents estimated benefits and costs of two existing residential waste diversion programs: a pay-as-you-throw program and compost pickup.

Pay-As-You-Throw Program

Residential pay-as-you-throw (PAYT) programs can reduce waste disposal by incentivizing residents to reduce the amount of waste they send to landfills. As of July 2022, PAYT programs have been established in 155 Massachusetts municipalities, including three on the Cape—Brewster, Sandwich, and Wellfleet. All three of these towns have drop-off programs, meaning residents must transport their waste to a transfer station for disposal (elsewhere in the state, some PAYT programs feature curbside pickup). Other Cape towns use sticker programs, for which residents paid an average of $106.27 per year in 2019/2020 (Geosyntec, 2021); PAYT would replace those programs. Under a PAYT program, residents pay by the amount of waste disposed of, typically using pre-printed trash bags in various sizes and costs. Access to recycling is often included. The price of the bags and other costs such as access fees varies from municipality to municipality; however, an analysis of statewide PAYT programs shows that PAYT programs reduce waste disposal by 25%–50% (MassDEP, 2021). This represents a potentially significant savings to municipalities in disposal costs and offers a fair cost structure based on the amount of waste disposed of as opposed to a flat annual fee.

In the near term, PAYT programs may cost residents more than an annual sticker program, but cost municipalities less due to higher revenues from program fees and lower disposal costs as less waste goes to landfills. However, costs associated with traditional waste management practices are likely to increase as space for landfills becomes limited and environmental regulations on landfills become more stringent. The cost for residential stickers increased an average of 9.2% between 2017 - 2021 (Geosyntec, 2021). A waste reduction economy can also decrease disposal costs, generate opportunities for small businesses supporting zero-waste alternatives and hosting refill, repair, and reuse opportunities.

Compost Pickup Program

Residential compost pickup programs, such as the program run by Black Earth, can increase the diversion of organic waste by making it easier for residents to participate. The analysis below presents the county-wide impacts of the program if adopted by half of residents who currently participate in sticker programs. About 30,000 of the current 85,000 tons (36%) of municipal solid waste generated in Barnstable County each year are organic waste that could be composted instead of being added to landfills. It is estimated that participation in the composting program would cost about $131 per year per household based on current pricing for the Black Earth program. The exact costs and benefits depend on contracts, tipping fees, and other aspects that could vary by municipality and are likely to change in coming years as tipping fees increase. Based on the U.S. Environmental Protection Agency's (EPA) Waste Reduction Model (WARM), benefits from the scenario could result in about 6,600 metric tons of CO_2 equivalent of avoided emissions annually (EPA, 2022), assuming 15,000 tons of organic waste (half of the 30,000 tons of available organic waste) are diverted from landfill to composting.

Other Waste Reduction Efforts

Municipalities can also help residents and businesses reduce the amount of waste that is sent to landfills through outreach and education on opportunities for building material reuse, at-home composting, and increasing recycling efforts. Many resources are available to support activities that can add up to real impacts in reducing our reliance on expanding landfill capacity.

EQUITY

Nationally, landfills and other waste facilities in the U.S. have been disproportionately located in low-income communities and communities of color. Due to the location of landfills on the Cape—with only one next to an environmental justice community, according to the Massachusetts' identified environmental justice populations—there are very limited disproportionate community impacts from landfills locally. However, generally diversion of waste from landfill facilities could reduce the burden from landfill-related impacts like pollution and associated health risks (e.g., through reduced emissions and reduced water pollution from polluted runoff from landfills). Diversion of waste from landfills could thus result in positive environmental and health outcomes for adjacent communities.

Additionally, waste diversion through recycling, reuse, and composting could generate new local employment opportunities for individuals and communities throughout the Cape. Municipal waste facilities, recycling efforts, and other circular economy employment can maximize benefits through gainful, safe, and stable employment. The availability of incentives or training programs for vulnerable populations could increase access to these jobs.

Optimizing Equity During Implementation

Municipalities should consider equity implications when investing in new alternative waste management facilities or investing in changes to existing facilities to avoid impacts to vulnerable communities such as pollution, noise, and odors. They should also consider indirect operational practices such as waste hauling traffic and take steps to eliminate vehicle idling at transfer stations.

Vulnerable communities often have less access to recycling programs; efforts to divert waste need to ensure proper access to both waste management and diversion facilities. The use of vouchers for waste services, establishing accessible hours for waste management facilities, and incentives for vulnerable populations can increase access and share benefits of waste diversion with historically excluded communities. For example, in Oak Bluffs, residents 60 years and older are charged a reduced fee of $10 per year per sticker (Geosyntec, 2021). Adapting educational materials about recycling services, rules, and goals to reflect the language and cultural needs of the communities is essential.

In communities that experience a high fluctuation in seasonal tourism, additional equity implications may stem from improper disposal of waste by visitors and associated challenges and costs for municipal waste operations. Considering incentives that promote proper waste disposal and recycling from short- and long-term visitors (e.g., access to recycling stickers and receptacles) could help overcome these challenges and decrease potential pollution, improper waste disposal, and resulting community impacts.

STATE OF PRACTICE

General State of Practice

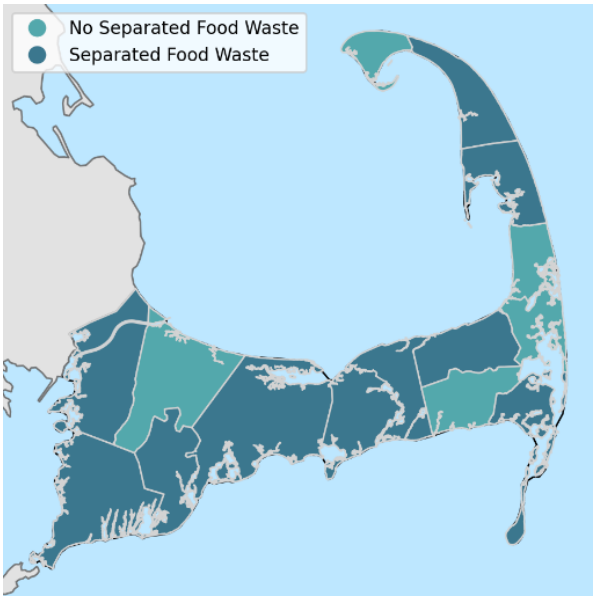
The state Solid Waste Master Plan is updated every 10 years. The latest plan includes information on statewide waste reduction and diversion policies; technical assistance; and funding available to cities, towns, and businesses. Statewide policies that enable recycling and diversion activities include waste bans and caps on commercial organic and food waste meant to reduce disposal, capture resources, reduce reliance on landfills and incinerators, and boost recycling. In 2014, the Massachusetts Department of Environmental Protection (MassDEP) implemented regulations that ban disposal of food and other organic wastes from businesses; in 2022, this ban was updated to lower the limit from 1 ton per week to 0.5 tons per week for commercial and institutional food waste generators and also add mattresses and textiles to the list of materials banned from disposal or transport for disposal in Massachusetts. The food waste ban aims to encourage diversion of 35% of food waste from disposal. The latest Solid Waste Master Plan strives to divert 30% of the waste stream from disposal to recycling and reuse by 2030 and 90% by 2050; it also aims to reduce solid waste to 4.0 million tons in 2030 and to 570,000 tons in 2050 (MassDEP, 2021). The reuse economy in Massachusetts is estimated to generate $7.3

billion in sales every year (Eassa et al., 2021). As of July 2022, 155 municipalities have implemented PAYT programs (MassDEP, 2022).

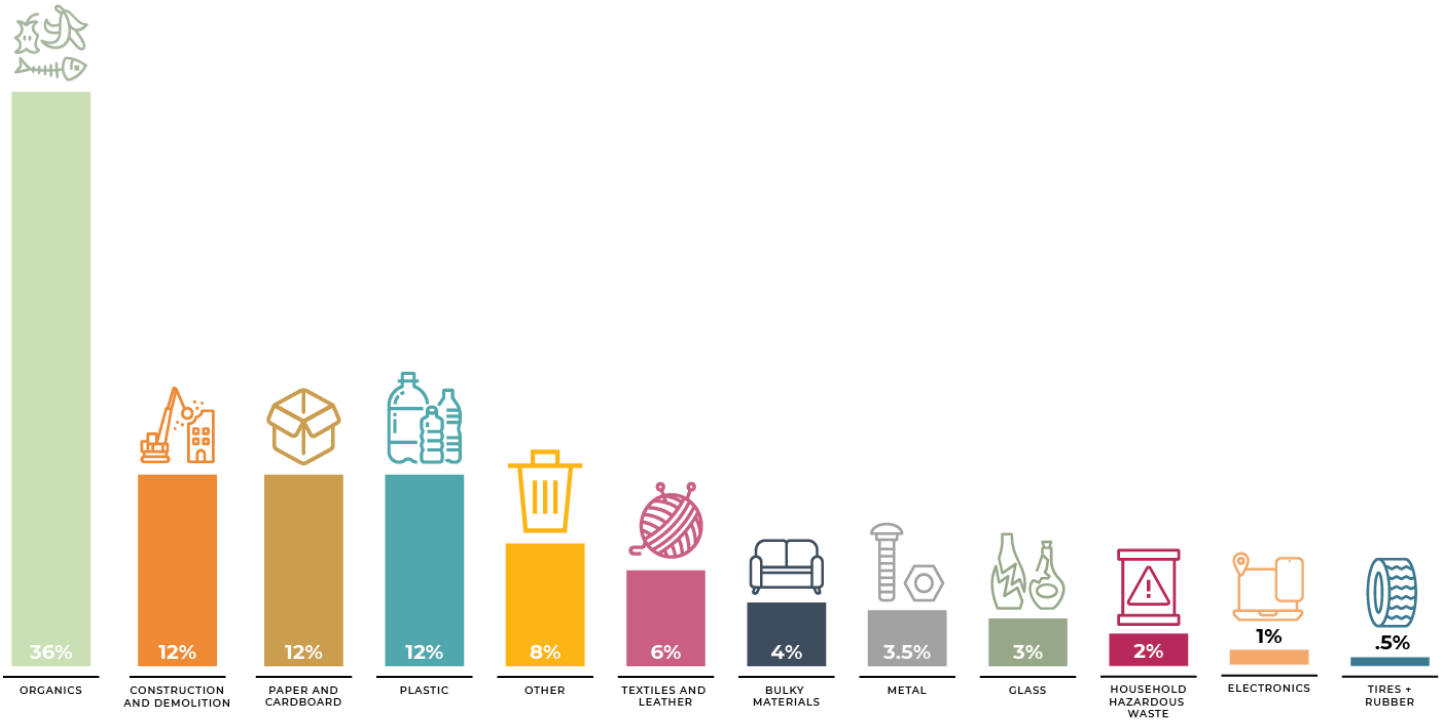
Cape Cod Context

There is only one active landfill on the Cape, in Bourne. Of the other towns, about half send their waste to the Covanta SEMASS waste-to-energy facility and half send waste to off-Cape landfills. As noted above, 85,000 tons of municipal solid waste are generated on Cape Cod each year, about 30,000 tons of which are organics that could be separated for on-Cape composting (Geosyntec, 2021). On average, the waste stream doubles between May and September due to seasonal tourism (Tetra Tech, 2021).

The Cape Cod Regional Policy Plan aims to reduce waste and waste disposal by promoting waste diversion and zero-waste initiatives. Related services already available on Cape Cod vary by municipality and local capabilities. Several municipalities on the Cape have composting programs, including Barnstable, Dennis, and Mashpee. Many towns are serviced by businesses that support waste reduction and diversion activities, such as Black Earth Composting for food waste, Habitat for Humanity for building materials, and recycling services (e.g., Harvey Waste and Recycling, Republic, Nauset Disposal).



COMPOSITION OF CAPE COD'S MUNICIPAL SOLID WASTE



CASE STUDY: DIVERSION OF RESIDENTIAL ORGANIC WASTE

Food waste collection programs on the Cape started in 2013, when Compost With Me began collecting residential food scraps from about 100 households in Falmouth, diverting about 1,600 pounds of residential food scraps from the waste stream each week. Black Earth Compost, a full-service compost company based in Manchester-by-the-Sea, acquired the company in 2020 and has expanded service to other towns, offering drop-off locations as well as residential pickup service. For example, it has partnered with Bourne's integrated solid waste management facility, providing composting carts at the facility for residents' food waste and scraps. From there, Black Earth typically hauls the food waste off-Cape, though discussions are ongoing about establishing a regional food waste composting facility.

IMPLEMENTATION

The following actions should be considered to further the expansion of waste reduction and diversion activities on Cape Cod. Note that they require a high degree of partnership, community participation and awareness, and collaboration with external business partners to succeed.

REQUIRED EXPERTISE

Internal: Town planner, grant writer, department of public works staff

External: Waste management businesses, community drop-off locations

- **Partner with composting companies.** Municipalities can partner with composting companies to launch or expand compost collection programs.
- **Establish compost drop-off locations.** Centralized collection centers, where residents can bring food waste for composting by a composting company, can make it easier to participate in composting programs. Involving local businesses, especially the hospitality sector and landscaping companies, and leveraging community events like farmers markets for drop-off centers during the visitor season can increase participation.
- **Promote participation in compost collection.** In addition to centralized collection centers, curbside compost pickup services offer convenience to residents, visitors, and local businesses. Some compost companies offer pilot programs to test viability before fully committing to a program.
- **Transition to a PAYT program.** Municipalities can consider drop-off or curbside PAYT programs, which may be operated through purchase of designated trash bags or stickers that are placed on trash bags.
- **Expand and promote community recycling programs.** The State of Massachusetts has resources to support municipalities with planning, financing, and technical assistance to implement, enforce, and leverage waste bans (mattresses, organics, metals, and others). The state also supports at-home composting bins and water collection and makes information on recycling opportunities available online.

Additional resources for waste reduction, diversion, and management, including assistance with implementation and equity considerations, are provided in the following table.

FINANCIAL AND TECHNICAL SUPPORT	
Pay-A-You-Throw (PAYT)/Save-Money-And-Reduce Trash (SMART)	Provides information about successes and documented savings that Massachusetts cities and town have achieved by implementing PAYT/SMART programs.
Recycling & Reuse	Resources for learning how to throw away less, recycle more, and donate items that others can use.
Solid Waste Infrastructure for Recycling Grant Program	Provides funding of $275 million through fiscal year 2026 for Solid Waste Infrastructure for Recycling grants authorized under the Save Our Seas 2.0 Act. Part of Justice40. Funds are available to political subdivisions (like municipalities), states, and tribal and intertribal consortia.
Consumer Recycling Education and Outreach Grant Program	Provides funding of $75 million from fiscal year 2022 to fiscal year 2026 for grants to fund recycling education and outreach.
Woods Hole Boat Shrink Wrap Recycling Program	Free recycling for boat plastic wraps sponsored by Woods Hole Sea Grant and Barnstable County; AmeriCorps Cape Cod; and Bourne, Chatham, Dennis, Eastham, Falmouth, or Wellfleet.
MassDEP Recycling Dividends Program	Payment to municipalities that implement programs and policies to maximize reuse, recycling, and waste reduction.
ADDITIONAL INFORMATION	
Commercial Food Material Disposal Ban	Information on MassDEP regulations that ban disposal of food and other organic wastes from businesses and institutions that generate more than half a ton of these materials per week.
EPA's National Recycling Strategy	Strategy designed to increase equitable access to recycling services, reduce environmental impacts on underserved communities, and stimulate economic development.
Massachusetts 2030 Solid Waste Master Plan	Establishes the Commonwealth's policy framework for reducing and managing solid waste that is generated, reused, recycled, or disposed of by Massachusetts residents and businesses.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Address vulnerable private and public buildings

ENHANCE RESILIENCY BY RETROFITTING AND RELOCATING VULNERABLE BUILDINGS

Housing & Development

Description and purpose of strategy: Support approaches to develop resilient structures through relocation and retrofitting to address vulnerable buildings and structures threatened by flooding and erosion. This may include raising, floodproofing, and moving buildings out of the floodplain. Historic building preservation is also considered to maintain the Cape Cod character.

Content of fact sheet: Information on economic and equity implications, best practices, and the state of practice for retrofitting and relocating buildings within the community located in vulnerable areas.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☐ Greenhouse gas (GHG) emissions reductions or sequestration
- ☐ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☐ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☑ Less damage to infrastructure
- ☑ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☑ Higher maintenance costs
- ☑ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Strategies to foster equitable transitions that favor close community collaboration and focus on reducing potential risks and losses from climate hazards should be considered, which can be particularly burdensome for vulnerable communities.

Financial benefits: Preventive actions can reduce damage to building infrastructure and lessen losses to property value and tax revenue, in addition to providing job and economic growth if local companies carry out the retrofitting and relocating projects.

Non-market benefits: These projects can help preserve historic buildings that are part of the iconic Cape Cod character; they also enhance coastal resilience, with benefits to natural habitats from decreased development and relocation of structures out of the floodplain.

GHG reductions: There are no expected GHG reductions, as this is a resilience-only activity.

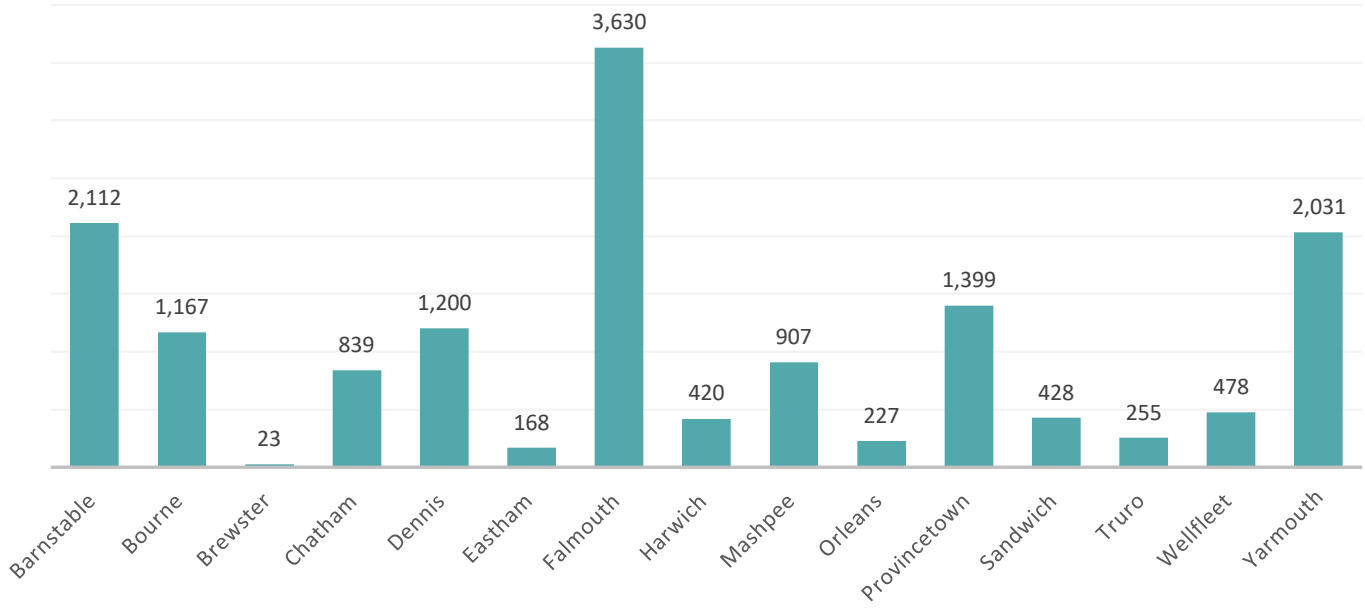
Ease of implementation: Adoption of floodplain and building design guidelines that local towns can use to foster preservation while adding resilient design features to historic buildings can assist with implementation.

BENEFIT COST ANALYSIS

Cape Cod communities have billions of dollars of private property, businesses, and critical public infrastructure along the shorelines and within coastal hazard areas. Without adaptations in place, many properties could be lost to permanent flooding and many more could be exposed to storm surge damage. Sea level rise and storm surge are expected to damage buildings and undeveloped land, with associated impacts on local tax revenues.

The cumulative projected damages to buildings on Cape Cod between 2021 and 2100 are estimated to be $15.3 billion. In addition, sea level rise is estimated to result in over $5 billion in damage to undeveloped land. Damage to buildings and land have further implications as local governments are expected to lose almost $200 million in tax revenue due to sea level rise, with Barnstable and Falmouth expected to experience the highest losses: nearly $38 and $27 million, respectively, in lost tax revenue from 2021 to 2030.

CUMULATIVE DAMAGE 2021–2100 (IN THOUSANDS OF 2020 USD)



Planning and action to protect buildings within floodplains will increase resiliency during storm events and protect against damage due to rising sea levels. Retrofitting and relocating vulnerable buildings will reduce expected damage. However, the costs of various approaches can be significant, as outlined below.

ESTIMATED CAPITAL AND OTHER UP-FRONT COSTS

ADAPTATION STRATEGY	TOTAL ESTIMATED CAPITAL AND OTHER UP-FRONT COSTS PER BUILDING
Relocation	$349,000
Floodproofing	$100,000
Elevating	$192,000
Ringwalls—commercial/apartment building	$3,680,000
Ringwalls—industrial building	$4,840,000

Note: Relocation, floodproofing, and elevating primarily pertain to coastal houses.
Source: (U.S. Army Corps of Engineers, 2015)

Relocating buildings is not currently practical on a large scale, but it may be a viable path for individual property owners and historic buildings—cases in which cost may be a significant obstacle, but relocation is deemed to be worth it. Building relocation requires extensive planning and is more complex and time-consuming in more densely developed areas.

Retrofitting is often a more feasible approach, despite operational and maintenance costs such as material management. New concrete ringwall foundations, which are installed at ground level and commonly designed to fit storage tanks, should only be put in place when the foundation or foundation wall of a building is not salvageable. For other retrofitting options, the Cape Cod Commission has been working to develop guidelines for floodproofing and elevating structures, including for housing of different styles. The guidelines include design considerations aimed at preserving the iconic Cape character by including a belt line to differentiate between historic and new building elements, flood vents matching window fenestration with contemporary details, new entry stairs that face the street, and fences and landscaping across the front to minimize visual impacts. The total capital and other up-front costs associated with raising a 1,400-square-foot building by 8 feet are estimated to be $208,385.

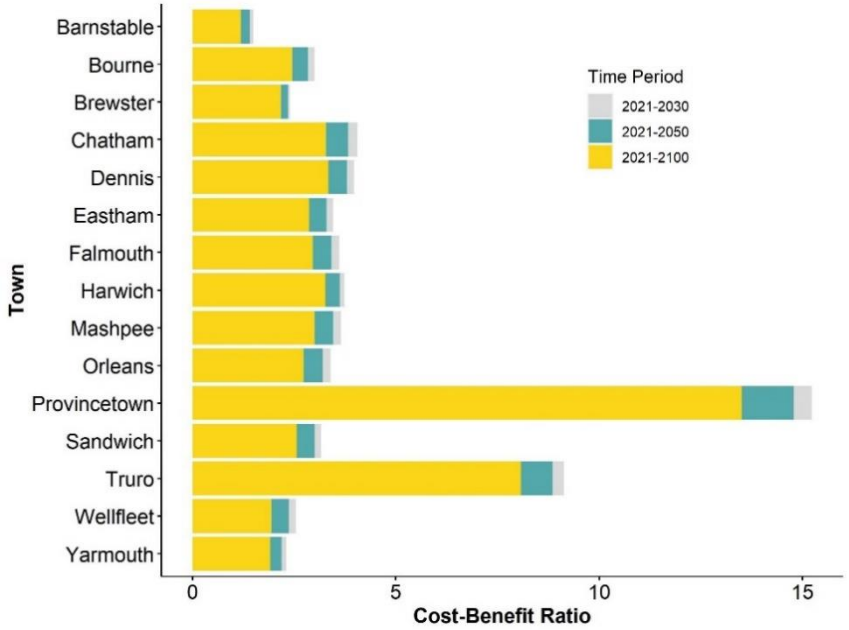
COSTS OF RAISING A 1,400-SQUARE-FOOT BUILDING 8 FEET (IN 2020 USD)

CATEGORY	TOTAL COST
Elevation*	$132,837
Temporary housing	$10,835
Contingency**	$35,918
Construction and management†	$17,959
Engineering and design	$10,835
Total	**$208,385**

* Calculated assuming $94.88/square foot.
** Typically around 25% of the combined subtotal for temporary housing and elevation costs.
† Another 10% of the new subtotal including contingency costs.
Source: (U.S. Army Corps of Engineers, 2015)

The benefit cost ratio for raising buildings increases over time as avoided damages increase, ultimately climbing to $3 to $5 of avoided damages through 2100 per dollar spent. This strategy is especially successful in Provincetown and Truro due to the large amount of damage that raising buildings can prevent, such as the sizeable pier in Provincetown that would be economically beneficial to raise.

BENEFIT COST RATIO FOR RAISING BUILDINGS BY TOWN



The appropriateness of different strategies will depend on the context. A more economical approach for towns with densely developed areas may be investments in shoreline solutions (establishing a boundary along the shoreline). Areas with less density per mile of shoreline may benefit from building-level strategies (e.g., floodproofing and raising buildings) in the near term to prevent damage from single events. Meanwhile, state and local governments often use buyouts to move residents out of flood zones and then use the acquired land to improve community resilience, rather than relocating buildings as a community-wide strategy.

SUMMARY: RECOMMENDED ADAPTATION STRATEGIES

ADAPTATION STRATEGY	RECOMMENDED USE
Relocation of buildings	Historic/high-priority buildings in especially vulnerable/environmentally sensitive settings (not practical on a large scale)
Retrofitting of buildings	Less densely populated areas and historic buildings
Shoreline solutions	Densely developed areas
Buyouts	Areas with severe and frequent flooding; an alternative to relocation

EQUITY

Retrofitting and relocating vulnerable buildings can reduce burdens on communities who face disproportionate impacts from climate hazards. The risk of coastal floods damaging or destroying low-income homes is projected to triple by 2050; Massachusetts is the third-highest state in terms of exposed affordable housing (Climate Central, 2020), with 4,817 units of housing exposed. Applying these principles can:

- **Reduce potential loss.** Enhanced building resiliency is crucial to reduce risks and potential losses. Climate hazards can be particularly burdensome for vulnerable communities, who may have fewer available resources to address property damage or loss when it occurs. Residents in flood zones can experience profound disruptions to their properties and vehicles, which hinders getting to work, school, or medical care.

- **Protect economic and natural resources.** Actions related to this strategy could increase protection of economic and natural resources that communities rely on for their livelihoods and wellbeing, such as income generated from tourism, wetland health (from enhanced zoning[1]), and water quality (from reduced debris[2]).
- **Preserve cultural and social value.** Retrofitting, as opposed to relocation, offers the opportunity to preserve the cultural and social value of the existing properties and communities that constitute the iconic Cape character. Similar to the above, preservation can help sustain existing sources of revenue and economic opportunities that communities across Cape Cod rely on—such as tourism to historical and cultural sites and buildings.

Optimizing Equity During Implementation

Prominent or expensive properties often receive headline attention or permitting for shoreline structures, which can overlook structures at risk of significant damage from flooding. For actions to be equitable, though, the region's priority strategies must include all vulnerable properties. It is also critical to consider potential impacts to low-income or vulnerable residents from retrofits/repairs and building relocation, because additional community resources could play a role in a smoother transition. Increased support could include provision of alternative housing during a retrofit or moving process, along with transportation cost assistance to account for potentially longer travel times to reach work or essential services. In making decisions and allocating resources, municipalities need to be aware that strategies such as elevating buildings are costly and may not be available to everyone in the community, and that government housing security programs often overlook renters.

Best practices for retrofitting and relocation strategies include working closely with communities from the start of discussions and ensuring sufficient funds and resources are allocated for the community engagement process. Designing phased processes, not just short-term and standalone efforts, is another key part of facilitating more equitable transitions (Georgetown Climate Center, 2023). A multi-stage planning process is especially important because building relocation could cause secondary impacts to populations adjacent to climate-vulnerable areas. These potential impacts include further displacement within neighborhoods, gentrification, and increased housing costs.

STATE OF PRACTICE

General State of Practice

Federal Emergency Management Agency (FEMA) provides a manual to support planning, constructing, and maintaining residential buildings in coastal areas. For Massachusetts in particular, the Boston Planning and Development Agency provides coastal flood resilience design guidelines, with guidance for retrofits and new construction.

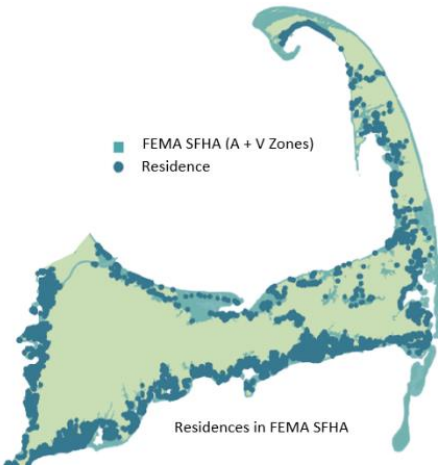
[1] A Cape Cod Commission project aims to develop complementary model wetlands and zoning regulations for coastal floodplains that help communities regulate development in high-hazard areas, while ensuring long-term protection of natural coastal systems.

[2] Proactive building retrofits and relocation could reduce structural damage and debris in waterways following hazard events.

Cape Cod Context

Working with four communities—Bourne, Sandwich, Brewster, and Eastham—the Cape Cod Commission and partners have developed a model coastal resiliency bylaw that identifies strategies to mitigate risk in the floodplain and adapt to sea level rise. Any town can adapt the bylaw to fit its needs, or have its conservation commission adopt elements of the bylaw (e.g., performance standards) as local regulations. The bylaw identifies natural resource protection, flood protection, and land use strategies to further protect the natural and built environment within the Cape Cod region.

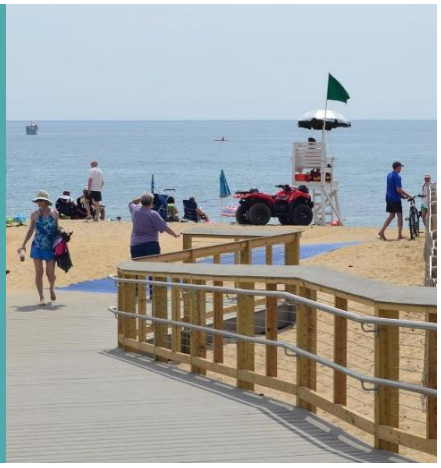
The Cape Cod Commission has also contributed to a guide to floodplain regulations and historic structures in Massachusetts and is currently developing guidelines that local towns can use to ensure consistency in flood hazard areas across the region.



19% of the region is in the FEMA Special Flood Hazard Area (SFHA)
Source: Cape Cod Climate Action Plan

CASE STUDY: CAPE COD NATIONAL SEASHORE, MA

Damaged by a storm in 2011, the Herring Cove visitor center needed a collaborative effort to design replacement facilities that avoid permanent infrastructure placement in highly vulnerable areas. In July 2013, the bathhouse was removed and replaced with moveable structures to reduce vulnerability to sea level rise. Green design techniques included a 2-foot freeboard above base flood elevation and sustainably harvested wood. This project illustrated some important practices: incorporating climate change considerations into plans to enhance resiliency; conducting vulnerability assessments; implementing an adaptation plan; and public awareness, education, and outreach efforts (Borrelli, 2015).



IMPLEMENTATION

Municipalities can take the following actions to protect vulnerable buildings:

- **Develop regulatory tools.** Tasks to aid development in the floodplain include identifying regulatory measures to support the model wetland bylaw, drafting and completing wetlands regulations, developing a model zoning bylaw for floodplain development, and conducting public outreach.
- **Design approach and estimate costs.** Work with the Army Corps of Engineers to model floodproofing measures and create cost estimates and design recommendations for historic buildings within the floodplain.
- **Draft floodplain design guidelines.** Ensure consistency in flood hazard areas across the region by developing design guidelines that local towns can use.
- **Community outreach.** Increase awareness among private property owners of strategies to prevent property damage due to sea level rise and storm surge.

REQUIRED EXPERTISE

Internal: Town planner, conservation commission, building officials, grant writer

External: Structural engineer

Resources that may assist in retrofitting and relocating vulnerable buildings are listed below.

FINANCIAL AND TECHNICAL SUPPORT	
Hazard Mitigation Assistance (HMA) Grant Programs	Describes annual sub-grant programs from Massachuestts Emergency Management Agency (MEMA) for the federal Hazard Mitigation Grant Program, Flood Mitigation Assistance grants, Pre-Disaster Mitigation grants, and Building Resilient Infrastructure and Communities grants.
Coastal Resilience Grant Program	Offers retrofits and construction projects that upgrade or adapt vulnerable public facilities and infrastructure to withstand flooding and erosion over the design life given higher tides, greater storm surges, and more intense precipitation. Projects that relocate public facilities and infrastructure outside hazardous areas, where feasible, are strongly encouraged.
Federal Historic Preservation Tax Incentives Program	National Park Service program that encourages private sector investment in the rehabilitation and reuse of historic buildings.
ADDITIONAL INFORMATION	
Cape Cod Commission's Coastal Resiliency Bylaw	Includes the model bylaw (which focuses on risk reduction in the floodplain), communication frameworks for the four partner towns, and a catalog of regulatory and non-regulatory best practices.
Cape Cod Commission's Floodplain Regulations	Guide to floodplain regulations and historic structures in Massachusetts, provided by the Cape Cod Cooperative Extension, Woods Hole Sea Grant, and Cape Cod Commission.
Cape Cod Commission Sea Level Rise Viewer	Web mapping application intended to illustrate vulnerability to climate change and hazards related to significant meteorological events.
Cape Cod Coastal Planner	Online decision-support tool to explore tradeoffs associated with different coastal management strategies. Includes coastal hazard planning data layers.
Standards for the Treatment of Historic Properties	Standards from the Secretary of the Interior, with guidance for historic building owners and building managers, preservation consultants, architects, contractors, and project reviewers before they begin work.

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Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Energy

Generate and increase the use of clean electricity

PURCHASE, GENERATE, AND INCRASE THE USE OF SAFE, RELIABLE, AND CLEAN ELECTRICITY AND DEVELOP ENERGY INFRASTRUCTURE

Description and purpose of strategy: Generate more safe, reliable, renewable electricity and make the electric grid more resilient to peak demand and outages. Municipalities can invest in electric infrastructure, including solar photovoltaic (PV) panels and battery storage. They can also increase the use of renewable electricity by facilitating the expansion of transmission and distribution investments, particularly for offshore wind development.

Content of fact sheet: Overview of the costs and benefits, equity implications, and state of the practice of clean electricity. Focuses on what municipalities can do for their own buildings and properties, with some guidance on residential support, as well as how they can support connections to potential offshore wind projects.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☐ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Intentional community engagement and siting of new projects can promote equitable outcomes. Outreach, siting, and implementation should prioritize populations that would be disproportionately impacted by infrastructure projects.

Financial benefits: Renewable energy resources are cost-competitive with conventional electric generation and often can result in increased cost stability and significant cost savings in the medium to long term.

Non-market benefits: Renewable electricity can improve health from reduced pollution, increase resilience from battery storage facilities, and increase employment opportunities from local contracting.

GHG reductions: Renewable electricity reduces GHG emissions from fossil-fuel-powered electric generation.

Ease of implementation: Many tools are available to identify sites for solar installations. Established, cost-effective implementation options include Power Purchase Agreements (PPAs), although there is still significant contracting and project management effort. However, solar projects require transmission, distribution, and storage to contribute large shares of renewable electricity.

BENEFIT COST ANALYSIS

As described below, municipalities can both generate their own renewable electricity and procure it from outside sources. In either case, renewable energy resources are increasingly cost-competitive with conventional electric generation. Renewable electricity can have additional benefits for local employment and pollution reduction. Municipalities can also incorporate energy storage, which can result in cost savings and important resilience benefits.

Solar Generation

Municipalities can generate electricity on-site with solar PV. If a PV system produces more or less electricity than the facility needs, its electricity can be sold to or bought from the electricity grid through net metering (Massachusetts Electric Power Division, n.d.).

It is important to note that not all locations are right for PV installations: PV requires a suitable surface—typically a roof, open field, or carport—with ample sunlight. The Cape Cod Commission provides a Solar Siting Tool to help identify suitable locations.

An established, cost-effective option for on-site electricity generation is the PPA, in which private developers own, operate, and maintain the PV system and sell the electricity at an established rate to the client. PPAs do not require up-front capital to implement, and can result in cost savings because private developers (unlike municipalities) can claim tax incentives for solar and battery installations (Solar Energy Industries Association, n.d.). Rates for PPAs depend on site conditions, the size of the installation, and whether the contract includes battery storage or only solar. Municipalities can also purchase PV systems outright, although this comes with high up-front costs and maintenance costs throughout the life of the system.

Renewable Electricity Procurement

Municipalities also have several choices of electricity supply from the retail market, including several renewable electricity suppliers. Options include the default plan from Eversource, plans from third-party marketplace providers (options listed on the Massachusetts Department of Public Utilities website), and community choice aggregation through the Cape Light Compact (CLC). Some electricity choices also emit air pollution, including GHG and local air pollutants.

The table below shows electricity supply costs from solar PV projects and selected providers. For solar generation, the table displays average national rates for PPAs and PPA rates from 2020 installations on Cape Cod by Cape and Vineyard Electric Cooperative (CVEC, 2023). The table also includes the total cost after accounting for the estimated damages from CO_2, NO_x, and SO_2 pollution from electricity plans with fossil-fuel-powered generators (Eversource Default and conventional marketplace plans).

ELECTRICITY COSTS FROM SELECT PROVIDERS AND SOLAR PPA

PROVIDER	SUPPLY RATE (CENTS/KWH)	TONS CO2 PER KWH	POUNDS SO2 PER MWH	POUNDS NOX PER MWH	TOTAL COST (CENTS/KWH)
Eversource default	26.18	327	0.04	0.25	28.09
Marketplace rate: conventional	12.97	327	0.04	0.25	14.89
Marketplace rate: 100% green	13.70	0	0	0	13.70
CLC 100 Green	21.80	0	0	0	21.80
CLC Local 100 Green	25.40	0	0	0	25.40
Average national solar PPA	4.57	0	0	0	4.57
Solar PPA from CVEC	7.49	0	0	0	7.49

Energy Storage

Municipal solar installations can also include energy storage, which has important resilience and cost savings benefits. Resilient electricity supply is important during extreme heat or cold events, particularly as more buildings electrify their heating systems. Municipalities should consider adding energy storage to sites used as heating and cooling centers to provide a clean, resilient source of electricity during system outages. Battery storage can yield significant savings through programs that reward using batteries to reduce overall electricity demand (Mass Save, n.d.). For large electricity consumers, battery storage can lead to additional savings by reducing electricity delivery costs from the maximum electricity demand and time-of-use charges (Solect Energy, 2020). Costs of energy storage can vary with scale and technology, but options typically result in savings. When purchased directly, storage costs over $1,400 per kilowatt hour (kWh) on average in Massachusetts (Energy Sage, 2023). As with PV systems, municipalities can implement battery storage either by direct purchases or through PPAs. PPAs have lower up-front costs, and can have lower overall costs if developers can claim tax benefits.

Community and Regional Projects

Municipalities can influence community and regional renewable energy projects by encouraging rooftop PV in communities and supporting the appropriate siting of renewable energy projects. These programs will cost municipalities time to plan and implement but can result in savings for community members, reductions in GHG emissions, and resiliency benefits. Large energy projects in the Cape Cod region (including utility-scale batteries, expanded transmission and distribution infrastructure, and offshore wind projects) will have substantial benefits for reducing GHG emissions and/or increasing system resilience. Municipal staff play a critical role in these projects by identifying sites for necessary infrastructure, which can also require community engagement to build support or avoid harming vulnerable communities. Municipalities can encourage solar PV in their communities by informing residents about options for installing PV, including information about how these programs can lower energy bills without up-front costs. The U.S. Department of Energy (DOE) offers details on how municipalities can design equitable solar outreach programs (DOE, 2022).

Additional Benefits

Renewable energy will provide employment opportunities on Cape Cod and the region overall. It is estimated that installing 0.6 gigawatt (GW) of solar capacity (the amount needed to meet 2050 Barnstable County electrification and GHG reduction goals) will translate to 9,300 additional job-years (Cape Cod Commission, 2021). PPAs that involve local developers and the CLC Local 100 Green plan both ensure that renewable energy will provide local jobs. CLC Local 100 Green includes electricity generated throughout New England.

Renewable electricity can also reduce air pollution generated from burning fossil fuels. Much of the electricity generated on Cape Cod is from renewable sources, but there is one fossil-fuel-powered generator: the Canal Generating Plant in Sandwich. Since 2010, this plant has mainly served to provide electricity during peak system demand: it often generates no electricity in a given month, but sometimes produces over 200,000-megawatt hour (MWh) of electricity per month. Before 2010, the plant was used more regularly and generated between 200,000 and 600,000 MWh per month. Local pollutants (NO_x and SO_2) from this generator cost Barnstable County around $2–$5 million per year in health impacts. A combination of renewable generation and storage could reduce or eliminate the need for fossil-fuel use at this facility, substantially reducing health damages.

EQUITY

Renewable electricity has the potential to benefit the entire population of Cape Cod. However, research finds that the benefits of renewable energy programs are not equitably distributed. Nationally, access to employment opportunities, involvement in decision-making, and access to low-carbon electricity are unevenly spread across populations and socioeconomic groups (Carley and Konisky, 2020).

If renewable energy programs are designed to increase equity, they can have important benefits such as the following:

- **Decreased energy costs.** More renewable energy options could decrease costs and reduce energy burden to vulnerable populations. A more resilient energy grid could also decrease power outages due to hazards, thus decreasing risks for populations that are at higher risk.
- **Air quality improvements.** Reduced air pollution could be particularly beneficial to vulnerable populations that are more likely to reside in areas with poorer air quality, or to people with underlying health conditions.
- **Economic opportunity.** Increased jobs related to renewable energy development could result in increased economic opportunity, particularly if there are opportunities for "green economy" job trainings and other incentives that help ensure equitable access to new job opportunities.

Optimizing Equity During Implementation

Renewable energy projects should be planned so that vulnerable communities benefit from improved infrastructure, lower electricity rates, and increased economic opportunity and do not bear greater costs from the siting of new development projects. There are well-documented disparities in the locations of energy infrastructure components (Welton and Eisen, 2019). To address them, municipalities need to carefully consider the potential impacts to surrounding communities of siting additional electricity infrastructure—and make sure they do not put disproportionate burdens on vulnerable populations. This includes siting transmission equipment for offshore wind development (CleanEnergy States Alliance, 2022). To address inequities in employment opportunities, municipalities should engage local developers for renewable energy projects, particularly ones that owned by or employ women and underrepresented races and ethnicities (Said et al., 2021).

Municipalities can also contribute to energy justice by actively and equitably promoting PV systems. Low-income residents would benefit as PV systems lower energy bills. Historically, higher-income households are far more likely to adopt community solar than low-income families, despite higher energy burden among low-income households and high rooftop solar potential in low-income neighborhoods (Said et al., 2021). This is largely due to high up-front costs, low access or information about financial incentives, and a lack of homeownership. Municipalities can promote community solar uptake by providing information about financial incentives (including tax benefits for owners of rental properties) and installation options without up-front costs. Municipalities should engage low-income residents while planning these information campaigns.

STATE OF PRACTICE

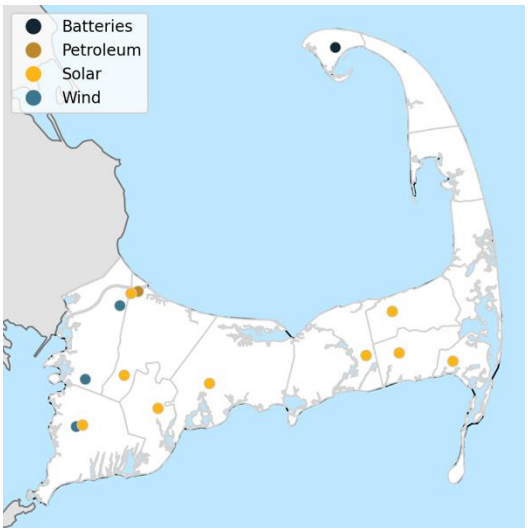
General State of Practice

Renewable electricity is widespread in the United States, including for municipal electricity supply. In 2021, 20% of the nation's electricity generation came from renewable sources (EIA, 2022). Wind and solar make up roughly half this amount, a sharp increase from less than 2% of renewable generation in 2000. The C40 Cities Climate Leadership Group identifies building-scale clean electricity deployment as the largest action cities can take to reduce emissions from energy use (C40, 2016). Cities throughout the world and the U.S. use rooftop PV systems for part of their electricity supply. Cities have also begun installing energy storage capacity for resilience and load shifting, including the City of Sterling, Massachusetts (Clean Energy Group, 2018). Costs of energy storage and renewable electricity generation are decreasing, opening new opportunities for renewable electricity and storage solutions (Kaps et al., 2021). However, even with broad deployment of rooftop PV systems, most municipal buildings still need to procure off-site renewable electricity because on-site generation is rarely strong or consistent enough to meet all electricity needs.

There are several challenges to incorporating more renewable electricity at the national scale. First is the lengthy approval process for new renewable electricity projects. There is a substantial queue of new generators waiting for approval to join the electric interconnection (LBNL, 2022). Second is the need for further transmission and distribution investment; a report by the International Energy Agency finds that transmission spending worldwide would need to triple by 2030 to meet 2050 climate goals (IEA, 2021). Additionally, the intermittence of renewable electricity will require greater capacity to store electricity or to shift electricity consumption to avoid periods of peak demand (Guerra, 2021). Current utility-scale storage solutions are costly, although technological improvements may result in more cost-effective solutions (Mauler et al., 2021). Incentivizing end users to shift consumption (including via building-scale battery storage) may be the most cost-effective way to incorporate more intermittent electricity sources into the grid.

Cape Cod Context

Solar energy and wind energy resources are found throughout Cape Cod, including some of the nation's largest offshore wind resources. The figure at right shows the location of current utility-scale electric generators in Cape Cod. All except the Canal Generating Station use either utility-scale PV, wind, or battery storage. The Outer Cape battery storage project in Provincetown is Cape Cod's only utility-scale battery storage project, brought online in 2022 to increase resilience in the Outer Cape. This project cost about $49 million and provides 24.9 MW of energy storage (Blander, 2022). Cape Cod's first offshore wind facility is in construction, with permitting of all necessary components including transmission recently completed (McCarron, 2023). Vineyard Wind first submitted state and federal permit applications for this project in 2017 (The Barnstable Patriot, 2021). Several more projects are currently pending approval in the interconnection queue, including eight utility-scale battery and solar projects and 20 offshore wind projects (LBNL, 2022).



Electric generators on Cape Cod. Source: EIA.

Residential and municipal solar facilities are found throughout Cape Cod. The Cape and Vineyard Electric Cooperative (CVEC) lists over 60 rooftop PV installations throughout the region, with the first projects in 2010 and several projects pending (CVEC, 2023).

CASE STUDY: UPPER CAPE COD REGIONAL TECHNICAL HIGH SCHOOL, BOURNE, MA

Completed in 2016, this project installed 663-kilowatt (kW) of PV panels in a parking lot shelter at a public technical high school. Upper Cape Tech partnered with Green Seal Environmental to design and permit the array, and Solect Energy financed the project, built the shelter, and installed panels. The plan was implemented through a PPA, with zero up-front costs to the school. During summer months, panels generate more electricity than the school uses. A portion of this energy is distributed to the town's Recreational Authority (Solect Energy, n.d.).

IMPLEMENTATION

To increase the use of clean energy, municipalities should take the following actions to develop energy resources for their own buildings and to promote clean energy use in the community.

- **Determine sites to install solar PV.** Municipalities should identify rooftops, fields, or carports with plenty of sunlight as potential sites for solar PV. If installing on a rooftop, municipalities should consider the remaining useful life of building roofs to minimize disruptions to generation from roof work during the 20-year life of a PV installation. Facility condition assessments can help identify suitable rooftops. Municipalities should consider PPAs to implement installation projects. Typical procurement approaches involve putting out a request for proposals, establishing a list of prequalified vendors, inviting vendors to bid on bundles of solar sites, and choosing vendors for each bundle.
- **Consider incorporating battery storage.** Battery storage has large benefits for the grid overall, and can result in significant savings for municipal buildings. It can be most cost-effective when combined with solar PV. Implementing battery storage through PPAs can reduce up-front costs and take advantage of tax incentives.
- **Encourage community solar through public outreach.** Municipalities should conduct outreach and information campaigns to promote the adoption of rooftop PV systems in the community. To optimize equity, public outreach should include members of disadvantaged communities and inform residents of PV installation options with energy savings and low up-front costs.
- **Support siting of electric infrastructure.** New infrastructure is needed to support renewable electricity projects, including offshore wind development. Municipalities play a critical role by permitting these projects. When siting electric infrastructure, municipalities should ensure that projects do not place disproportionate burdens on socially vulnerable populations.

REQUIRED EXPERTISE

Internal: GIS analysis, building management, public outreach, Department of Public Works staff

External: Solar design and construction

Below are some resources that may help implement clean energy projects.

FINANCIAL AND TECHNICAL SUPPORT	
Solar Estimate	Finds solar providers for a specific address and provides preliminary cost estimates for solar or battery + solar installation.
Cape Cod Commission's Solar Screening Tool	Identifies areas on Cape Cod that may be suitable for large-scale solar sites and those where solar sites may have an undesirable impact on natural resources or may have inadequate solar resources.
PVWatts Calculator	Tool from the National Renewable Energy Laboratory to help identify potential solar resources. Incorporates average cloud cover and some features of the solar array, such as size, angle, and array type.
Project Sunroof	Tool to identify solar panel sites, based on 3D models of roof surfaces and surrounding buildings and satellite imagery of cloud cover. Limited coverage in Barnstable County; most recently updated in 2016.
Green Communities Designation and Grant Program	Funds green energy projects for towns with Green Community designation; this includes all towns in Cape Cod except Sandwich and Barnstable (both of which are eligible to apply). Has been used to fund battery storage and solar PV projects.

ADDITIONAL INFORMATION	
Energy Switch Massachusetts	A program from the Massachusetts Department of Public Utilities to help residential and commercial customers choose between electricity suppliers. Offers cost information for various electricity suppliers, with options to sort by the amount of renewable energy offered.
Local Government Guide for Solar Deployment	A resource from the U.S. Department of Energy on how to enable community solar projects, with a focus on designing projects and community engagement to equitably distribute benefits.
Massachusetts Solar	Webpage from the Solar Energy Industries Association with an interactive map of solar companies (manufacturers, installers, other) in Massachusetts.
Cape and Vineyard Electric Cooperative	Public electricity supplier that supports development of renewable electric resources throughout Cape Cod, including the development of renewable energy sites and the purchase of electricity on behalf of municipalities.
Cape Light Compact	Public electricity supplier that administers community choice aggregation plans (including CLC Local Green). Also provides resources for energy efficiency programs.
Database of State Incentives for Renewables & Efficiency (DSIRE)	List of financial incentive programs in Massachusetts that can support solar PV installations. Many are implemented as tax savings, so tax-exempt entities like municipalities are not eligible. Private developers can typically use these incentives.
Mass Save Connected Solutions	Program that provides financial incentives for electricity customers to install battery storage facilities. Site includes details on the application process and a list of eligible technology.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Transportation

Enhancements to achieve Complete Streets

EXPAND AND IMPROVE BICYCLIST, PEDESTRIAN, SHARED, AND PUBLIC TRANSPORTATION OPTIONS AS AN ALTERNATIVE TO PERSONAL VEHICLE USE

Description and purpose of strategy: Complete Streets provide safe, accessible options for all modes of travel and encourage less personal vehicle travel (a significant source of greenhouse gas [GHG] emissions) by providing opportunity for walking, biking, and transit. A complete street may include sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable and accessible public transportation stops, frequent and safe crossing opportunities, median islands, accessible pedestrian signals, curb extensions, narrower travel lanes, roundabouts, and more.

Content of fact sheet: Overview of the costs and benefits of Complete Streets, example of the benefits of a sidewalk project in Sandwich, and information on the process and resources available for advancing Complete Streets initiatives.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☑ Increased recreation
- ☐ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property values
- ☐ Increased resilience
- ☑ Job and economic growth

COSTS

- ☐ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Strategies to reduce potential economic burdens, including siting Complete Streets projects near vulnerable communities, could help maximize potential benefits to these populations and ensure equitable distribution of outcomes.

Financial benefits: A Complete Streets effort can be cost-effective as part of a larger planned project, depending on local context and project characteristics.

Non-market benefits: Improvements in health from reduced pollutants and increased recreational opportunities are major benefits of Complete Streets projects.

GHG reductions: Providing opportunities for alternative modes of transit can reduce vehicle miles traveled, with associated reductions in GHG emissions.

Ease of implementation: Complete Streets policies provide guidance for a wide range of transportation projects, ultimately becoming incorporated in normal practice. Community engagement should ensure that projects are designed to maximize equity benefits.

BENEFIT COST ANALYSIS

The diversity of project types and local contexts presents a challenge for estimating benefits and costs of Complete Streets projects. To help communities estimate the benefits, Smart Growth America has developed the Benefits of Complete Streets (BCS) Tool, which is composed of several modules (with associated outputs):

- Equity (age, race, educational attainment, English proficiency, poverty)
- New cyclists (additional adult cycling trips over 20 years)
- Cycling environmental impacts (vehicle miles traveled, reduction in GHG and criteria pollutants)
- Pedestrian intersection safety (fatalities, injuries)
- Speed reduction (fatalities)
- Tree planting (monetized 20-year estimate of the benefits of environmental services, aesthetic beauty, and comfort)
- Cycling and pedestrian health (reduction in health-related deaths)
- Economic impacts (percent change in property tax base, dollar change in property tax revenue)

For example, in 2022, the Town of Sandwich began to undertake a project at the intersection of Forestdale and Meetinghouse Roads to include resurfacing, adding bicycle lanes, reconstructing sidewalks, and adding countdowns to crosswalk signals. Using local data on population characteristics, bicycle and pedestrian trips, traffic incidents, property values, and tax rates, the BCS tool calculates the following benefits over a 20-year horizon.

20-YEAR IMPACTS OF A COMPLETE STREETS PROJECT IN SANDWICH, MASSACHUSETTS

NEW CYCLISTS	
Additional adult cycling trips	246,549 trips
CYCLING ENVIRONMENTAL IMPACTS	
Vehicle miles traveled reduction	133,789 miles
CO_2 reduction	62.6467 tons
NO_x reduction	0.0096 tons
PM_{10} reduction	0.0059 tons
SO_x reduction	0.0059 tons
VOC reduction	0.0059 tons
CYCLING AND PEDESTRIAN HEALTH	
Reduction in health-related deaths	1.2 deaths
ECONOMIC IMPACTS	
% change in property tax base	0.5%
$ change in property tax revenue	$165,704

The overall benefits and costs of the Sandwich project—calculated using the BCS tool for property tax revenues and reductions in pollutants, along with Environmental Protection Agency (EPA)-estimated values of the social costs of CO_2 and criteria pollutants (IWG, 2021; EPA, 2021)—are presented below.

BENEFITS AND COSTS OF A COMPLETE STREETS PROJECT IN SANDWICH, MASSACHUSETTS

BENEFIT/COST CATEGORY	AMOUNT
Increased property tax revenue	$165,704
Reduced NO_x, SO_x, and VOCs	$75–169
Reduced CO_2	$3,571
Total project cost	($2,400,000)
Massachusetts Complete Streets funding	$400,000
Total	**($1,830,603)**

EQUITY

Complete Streets policies can lead to a variety of outcomes that strengthen equity and reduce burdens on vulnerable populations. The Federal Highway Administration regards Complete Streets as a strategy to improve equity due to potential benefits related to creating a "fair, safe, accessible, and healthy transportation network." A few potential benefits include:

- **Enhanced economic opportunity.** Complete Streets policies may lead to increased employment and higher property values (Cox et al., 2015), which could be a large benefit to many communities.
- **Improved transportation options.** Many communities have limited access to personal vehicles and rely on public transportation systems. A Complete Streets program could help present additional (and safe) transportation options, such as new walking and bicycle paths. Notably, Complete Streets programs help create a more interconnected transportation network by creating first- and last-mile connections to transit stops (Cox et al., 2015), which can be a critical resource for communities that rely on public transportation.
- **Reduced vehicular emission exposure.** Complete Streets programs have been shown to increase walking and bicycling trips (Cox et al., 2015), which can lead to a reduction in GHG emissions and pollution. Many environmental justice and vulnerable communities are disproportionately exposed to vehicle emissions (U.S. Federal Highway Administration, 2022); therefore, reductions in emissions could be especially impactful.

Optimizing Equity During Implementation

Prioritizing low-income communities, environmental justice populations, and vulnerable communities when siting Complete Streets projects will help maximize potential benefits for these populations, ensuring equitable distribution of outcomes for all.

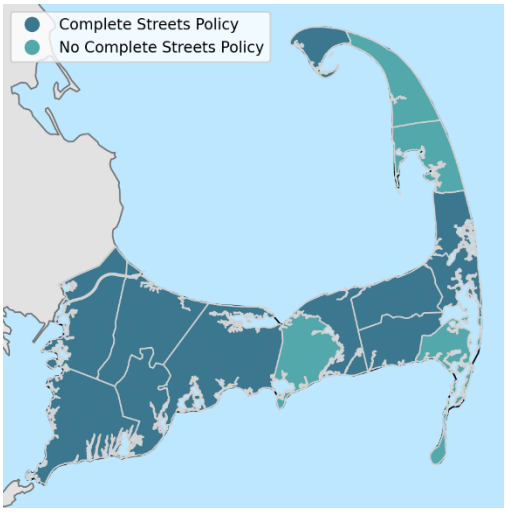
STATE OF PRACTICE

General State of Practice

The adoption of Complete Streets policies in the U.S. has increased from nine jurisdictions in 2000 to over 1,600 by 2022. These policies help decision-makers shape practices for street design, and are the first step in the process of creating a network that connects more people to destinations safely and efficiently (Smart Growth America, 2023).

Cape Cod Context

Several municipalities on the Cape participate in the Massachusetts Department of Transportation (MassDOT) Complete Streets Funding Program, which requires passage of a Complete Streets policy and development of a prioritization plan. As of March 2023, 11 towns have adopted policies and four projects have received awards through the program.



MASSDOT FUNDING PROGRAM AWARDS

DATE	TOWN	PROJECT	TOTAL PROJECT COST	AWARD AMOUNT
March 2018	Sandwich	Install Sandy Neck Road sidewalk	$448,000	$200,000
May 2022	Sandwich	Resurface the intersection at Forestdale Road and Meetinghouse Road to add bicycle lanes, reconstruct sidewalks, and add countdown crosswalk signals.	$2,400,000*	$400,000
October 2022	Eastham	Build a shared-use path along the northern side of Samoset Road to the Cape Cod Rail Trail. Realign the intersection at Samoset Road and Depot Road to create a conventional T-intersection and install a rectangular rapid flashing beacon at the Cape Cod Rail Trail crossing.		$500,000
October 2022	Falmouth	Install new ADA-compliant sidewalks on the Dillingham Avenue extension from Hamlin Avenue to the Lawrence School.	$225,000*	$156,202

*current estimate

CASE STUDY: SANDWICH, MA

In 2016, the Town of Sandwich embarked on the development of a Complete Streets policy and a prioritization plan. Both were approved in 2017. The prioritization plan ranked 31 projects, which ranged in cost from $3,000 to over $7 million (2017 values). Several projects have been completed and others are well underway, including sidewalk construction, re-striping shoulders of existing streets to accommodate bicyclists, creation of a bicycle route using signage and pavement markings, crossing improvements with rectangular rapid flashing beacon systems near a skate park and town offices, and a 4-mile-long shared-use path. Collaboration with and support from the town's Bikeways and Pedestrian Committee was instrumental in program development and continues to aid implementation. Securing grant funding from a range of programs, including for design and construction, has been critical to successful progress in implementation. Similar to other Cape towns, alterations to streets in the historic areas face unique challenges related to the preservation of the historic and scenic character of the streets and sidewalks.

IMPLEMENTATION

The following steps are required for MassDOT's Complete Streets Funding Program. Policies will address a broader set of transportation projects than MassDOT's funding will support, ultimately becoming incorporated into standard processes.

1. **Develop a policy.** Develop a municipal Complete Streets policy for adoption as a bylaw, ordinance, or administrative policy by the municipality's highest elected body. (A model policy is available from the Cape Cod Commission.)
2. **Formulate a plan.** Formulate a prioritization plan through a community-driven process representing a diversity of stakeholders to identify and rank all potential projects for approval by MassDOT. Support for the planning process is available from MassDOT with no cost to municipalities.
3. **Implement projects.** Prepare project design and budget documents to support funding applications and bidding. MassDOT funding is available for municipal roadways, new construction, reconstruction, some types of rehabilitation, standalone projects, or elements of larger projects, and must be approved by MassDOT.

REQUIRED EXPERTISE

Internal: Town engineer, town planner, Department of Public Works (DPW) staff

External: Traffic and civil engineering consulting firm

Resources that may help a municipality implement Complete Streets are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
MassDOT Complete Streets Funding Program	Addresses critical gaps in transportation networks by giving Massachusetts municipalities tools and funding to advance Complete Streets.
State Transportation Improvement Program (STIP)	A combined effort between MassDOT and many state agencies that work together to design and build highways and transit projects.
Shared Streets and Space Grant Program	Provides funding to municipalities and public transit authorities to quickly make improvements to plazas, sidewalks, curbs, streets, bus stops, parking areas, and other public spaces in support of public health, safe mobility, and strengthened commerce.
MassTrails Grants	Provides matching grants to communities, public entities, and nonprofit organizations to plan, design, create, and maintain a diverse network of trails, trail systems, and trail experiences.
Municipal Americans with Disabilities Act Grant	Supports capital improvements dedicated to improving access for persons with disabilities.
Massachusetts Safe Routes to School Program	Works to increase safe biking and walking among elementary, middle, and high school students by using a collaborative, community-focused approach that bridges the gap between health and transportation.
ADDITIONAL INFORMATION	
Complete Streets/Living Streets: A Design Manual for Cape Cod	A guidebook focused on incorporating Complete Streets elements in Cape roadways in a context-sensitive way.
National Complete Streets Coalition	A program of Smart Growth America, the coalition is a nonprofit, nonpartisan alliance of public interest organizations and transportation professionals committed to developing and implementing Complete Streets policies and practices.
Benefits of Complete Streets Tool	Designed to measure the benefits of building activity-friendly routes to everyday destinations through Complete Streets.

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Additional climate change information and resources can be found at capecodcommission.org/climate.

Transportation

CLIMATE ACTION FACT SHEET

Electrify municipal fleets

ACCELERATE ELECTRIFICATION OF MUNICIPAL VEHICLES

Description and purpose of strategy: Cape towns can lead by example by electrifying municipal fleets, which account for 25% of CO_2 emissions from local government operations. Feasibility considerations include typical use patterns in relation to vehicle range. Charging infrastructure requirements will depend on usage and parking locations. Procurement policies may be modified to reflect consideration and prioritization of electric and/or hybrid vehicles.

Content of fact sheet: Overview of the costs and benefits of municipal electric vehicle (EV) adoption. Includes expected economic and environmental costs, equity considerations, a New Bedford, Massachusetts case study, and the steps to EV adoption for municipalities.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☐ Higher property values
- ☐ Increased resilience
- ☐ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☐ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Those closest to the sources of tailpipe emissions will see the greatest benefits from municipal vehicle electrification. In many cases, these are environmental justice and vulnerable communities living in higher-traffic areas.

Financial benefits: While following this strategy typically raises up-front costs, the strategy will often save money over time, and incentives can reduce those high initial costs.

Non-market benefits: Improvements in health from reduced pollutants and reduced maintenance will reduce inoperable time compared to internal combustion engine vehicles (ICEVs).

GHG reductions: EVs produce fewer emissions, so GHG reductions depend on the number of internal combustion engine vehicles (ICEVs) that are replaced by EVs. This strategy could be impactful for municipal GHG reduction.

Ease of implementation: This strategy is scalable. Municipalities can start replacing vehicles as older ones are retired and could be factored into a 5-year capital plan where vehicle replacements are anticipated.

BENEFIT COST ANALYSIS

The following example shows the costs and benefits of replacing a gasoline-powered passenger transport (PT), light-duty truck, police vehicle, and school bus with a comparable electric model. The analysis accounts for the vehicle costs and annual operational costs, such as those for maintenance and fuel. Fuel prices are particularly susceptible to variation; to show how they might change the overall cost of the vehicle, the example below incorporates a sensitivity analysis using fuel prices, as of February 2023, adjusted by 25% to get a range of fuel costs. The sensitivity analysis results are shown in parentheses.

This analysis illustrates the potential financial, health, and environmental benefits of electrifying different types of municipal vehicles. Note that many incentives are available to offset the EV costs shown, including $7,500 incentives for purchasing new vehicles from the Massachusetts Vehicle Incentive Program (MassEVIP). These are discussed below in the "Implementation" section.

TOTAL COST OF OWNERSHIP ANALYSIS

VEHICLE	VEHICLE TYPE	ENGINE TYPE	MSRP	ANNUAL FUEL COST	ANNUAL MAINTENANCE COSTS	TOTAL COST OVER VEHICLE LIFESPAN*
Ford Mustang Mach-E	Police	EV	$45,995	$645 ($484–$806)	$406	$56,509 ($54,896–$58,121)
Ford Explorer	Police	ICEV	$36,760	$1.663 ($1,248–$2,079)	$800	$61,390 ($57,232–$65,549)
Chevrolet Bolt	PT	EV	$26,500	$547 ($410–$684)	$406	$36,037 ($34,668–$37,405)
Toyota Camry	PT	ICEV	$26,220	$1,403 ($1,053–$1,754)	$800	$48,251 ($44,743–$51,760)
Ford F150 Lightning	Light-duty truck	EV	$55,974	$958 ($718–$1,197)	$406	$69,615 ($67,221–$72,009)
Ford F150	Light-duty truck	ICEV	$34,445	$2,041 ($1,531–$2,552)	$800	$62,856 ($57,752–$67,959)
School bus, Type C	School bus	EV	$319,041	$986 ($739–$1,232)	$5,444	$447,638 ($442,710–$452,567)
School bus, Type C	School bus	ICEV	$134,979	$4,775 ($3,581–$5,969)	$11,136	$453,191 ($429,317–$477,065)

* All vehicles were assumed to have a lifespan of 10 years, except school buses, which have a lifespan of 20 years.
**All values are in 2022 USD.

While the total costs suggest that EVs can compete with ICEVs, incentives will help make EVs more affordable. Switching to EVs has many additional benefits: for example, EVs do not emit criteria pollutants from burning fuel. The table below shows the avoided emissions of pollutants for each vehicle type. It displays the avoided pollution, in pounds and social benefit, from switching a single vehicle from an ICEV to an EV for the vehicle's lifespan.

AVOIDED EMISSIONS FROM EV ADOPTION

VEHICLE TYPE	POLLUTANT	AVOIDED EMISSIONS (POUNDS)	SOCIAL BENEFIT (2022 USD)	TOTAL VALUE OVER VEHICLE LIFETIME
Police	CO_2e	91,692.26	$2,371	$3,276
	NO_x	11.76	$103	
	PM	2.77	$780	
	SO_2	0.61	$22	
PT	CO_2e	77,365.35	$2,001	$2,764
	NO_x	9.93	$87	
	PM	2.34	$658	
	SO_2	0.51	$19	
Light-duty truck	CO_2e	112,531.41	$2,910	$4,020
	NO_x	14.44	$126	
	PM	3.40	$957	
	SO_2	0.74	$27	
School bus	CO_2e	627,437.75	$16,225	$31,459
	NO_x	1,384.01	$12,063	
	PM	10.99	$3,095	
	SO_2	2.09	$77	

In addition to the quantifiable benefits, electrification of vehicle fleets can have positive impacts on jobs and the economy from the construction of charging infrastructure and municipal budget savings. Meanwhile, the future will see increasing availability of relevant new technologies such as vehicle-to-grid (V2G) power. V2G allows electricity to flow in either direction between the vehicle and the grid. This means vehicles can be used for demand response and frequency regulation: EVs can be used to stabilize the grid, further reduce power grid reliance on fossil fuels, and reduce air pollution (Noel and McCormack, 2014). V2G is not commonly available now but that is expected to change into the future.

EQUITY

Transportation is responsible for a substantial proportion of emissions on Cape Cod. Switching gasoline-powered vehicles to EVs would result in reduced emissions and air pollution throughout the county. Potential equity benefits include:

- **Reduced emissions in environmental justice communities.** Those living closest to the source of emissions will see the largest benefits as the municipal fleet switches to EVs. The use of municipal EVs may benefit environmental justice communities who have historically been disproportionately burdened by vehicle emissions and air pollution by reducing community-wide emissions.
- **Increase access to charging stations.** Municipalities will need to update and improve charging stations. Making this infrastructure more widely available across the region is essential for equitable access to personal EV utilization.

Optimizing Equity During Implementation

Those closest to the sources of tailpipe emissions will benefit the most from municipal vehicle electrification. These might be low-income families living in higher-traffic areas. Research has found that air pollution burdens often disproportionately affect low-income communities and communities of color (Demetillo et al., 2021).

Beyond reduced emissions, municipal vehicle electrification may not have many other direct equity benefits, but there are potential secondary benefits that could accrue over time. For instance, transitioning to municipal EVs could force towns to consider and make improvements to their EV charging infrastructure. Low-income populations often have less access to EV charging stations (American Cities Climate Challenge, 2021) and could benefit from installation of new EV charging stations, particularly if they are near multi-unit residences. Further, municipalities could make their municipal charging stations available to the public when they are not in use, increasing availability.

Along with potential benefits, a municipal electric fleet program poses very few risks. However, given the potential economic costs of transitioning the municipal fleet to EVs, municipalities need to ensure that they are not investing in this action at the expense of other transportation-related social services that many communities rely on, such as a more robust public transportation network.

STATE OF PRACTICE

General State of Practice

EVs are rapidly increasing their market share. In 2021 there were nearly 1.5 million EVs registered nationally and over 30,000 EVs registered in Massachusetts, up from 3,600 in 2016 (Alternative Fuels Data Center, n.d.). There are now over 50,000 EV-charging locations, with over 140,000 chargers, nationally (Alternative Fuels Data Center, 2023).

Many municipalities are electrifying their fleets throughout the country. New York City operates 2,260 EVs and plug-in hybrid vehicles and plans to have 100% non-emergency EVs by 2035. The city also plans to reduce vehicle emissions by 50% by 2025.

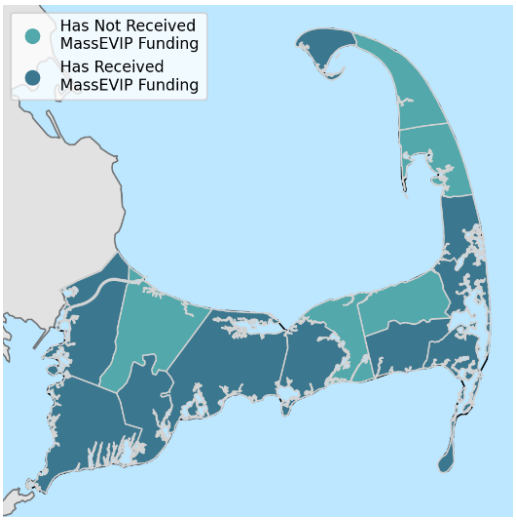
President Biden's Executive Order 14057, signed in December 2021, sets goals of carbon-free electricity generation and use in the federal government. These include 100% carbon-free electricity on a net annual basis by 2035, 100% zero-emission vehicle acquisitions by 2035, and 100% zero-emission light-duty vehicle acquisitions by 2027, among other goals.

The National Electric Vehicle Infrastructure (NEVI) Formula Program from the U.S. Department of Transportation will fund up to 80% of eligible project costs for obtaining and installing EV charging stations, operating and maintaining them, and sharing data from them.

Cape Cod Context

Municipalities in Barnstable County have taken advantage of the MassEVIP program, acquiring incentives for 17 EVs, three plug-in hybrid vehicles, and eight charging stations, totaling over $165,000. The MassEVIP program has provided incentives for 350 EVs, and 98 charging stations, totaling over $3.6 million for Massachusetts.

Massachusetts was recently awarded nearly $30 million in clean school bus funding from the federal Clean School Bus Program. The state will use the funds to purchase 76 full electric school buses (EPA, n.d.), one of which was purchased by Upper Cape Cod Regional Technical School.



CASE STUDY: NEW BEDFORD, MA

New Bedford has a population of 95,032 (as of 2016) and an area of 20 square miles. The town began working with MassEVIP in 2015 to start replacing older fleet vehicles. The town leased 23 Nissan Leafs to replace about 30% of its passenger vehicle fleet and installed 25 additional vehicle charging stations to add to the eight it already had. (Six of the 25 chargers are available to the public.) To date, the town has received $229,000 in incentives from the MassEVIP program. It has saved an estimated $17,329 in gasoline costs and avoided 149,567 pounds of emissions over three years from 176,329 miles traveled. Going forward, the town plans to acquire additional charging stations and EVs.

Photo: MassDEP

IMPLEMENTATION

Below are actions a municipality can take to convert its fleet to EVs. Each action can help a municipality move toward an all-electric fleet, though no single one can achieve that goal on its own.

REQUIRED EXPERTISE

Internal: Selectboards; Department of Public Works (DPW) staff, police, and fire staff; Purchasing and finance staff

- **Take part in a statewide contract for vehicle technology.** The Massachusetts Department of Energy Resources (DOER) has partnered with the Metropolitan Area Planning Council and the Operational Services Division to create a statewide contract for vehicle technology. This is a program that highlights advanced vehicle technology that is best for certain fleets.
- **Buy fuel-efficient vehicles to meet Green Communities criteria.** DOER is working with municipalities to promote vehicle energy use. Municipalities designated as Green Communities must adhere to Criterion 4—which includes rules for buying fuel-efficient vehicles—among other criteria.
- **Join a purchasing cooperative.** State contracts could simplify EV purchasing for smaller municipalities, or municipalities could use Sourcewell, a purchasing cooperative led by Minnesota.
- **Pursue grants for EV purchasing.** MassEVIP is a grant program that supports purchase of EVs by municipalities. Towns can apply online and read case studies of other towns that have completed projects.
- **Join a workplace charging infrastructure program.** MassEVIP also has a workplace and fleet charging infrastructure program that provides incentives to fleet operators to procure and install level 1 and 2 EV charging stations.
- **Follow additional requirements.** Some municipalities have adopted policies to promote fleet electrification. For example, Cambridge, Massachusetts, requires its new vehicles to meet the standards set forth by a local Green Fleet Policy. Under this policy, a municipal department seeking to buy a new vehicle must first compare three options by fuel efficiency and emissions using the Environmental Protection Agency (EPA) Green Vehicle Guide.

The following resources may assist with electrifying municipal fleets.

FINANCIAL AND TECHNICAL SUPPORT	
MassEVIP Fleets Incentives	Provides incentives for public entities to buy or lease EVs with a maximum gross vehicle weight rating up to 10,000 pounds. Maximum funding amounts depend on vehicle type and means of acquisition.
Massachusetts Offers Rebates for Eletric Vehicles (MOR-EV)	Supplies rebates for purchased or leased passenger vehicles that are battery electric or use fuel cells and cost less than $55,000.
MOR-EV Trucks	Offers rebates for public and private purchases or leasing of qualified new vehicles whose gross weight exceeds 8,500 pounds.
U.S. EPA Clean School Bus Program	Offers rebates to replace existing school buses with zero-emission and low-emission models.
MassCEC ACTBUS	Provides deployment technical assistance and advisory services intended to complement the EPA Clean School Bus Program.
MassEVIP Charging Incentives	Provides incentives for fleet operators and employers for Level 1 and Level 2 charging stations.
ADDITIONAL INFORMATION	
Electrifying Transportation in Municipalities	Policy toolkit on EV deployment and adoption at the local level, published by the Electrification Coalition in 2021.
U.S. EPA Green Vehicle Guide	Guide to vehicle technology and its relation to fuel efficiency and emissions.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

Transportation

CLIMATE ACTION FACT SHEET

Adapt infrastructure for resilience

PREPARE LOW-LYING INFRASTRUCTURE FOR FLOODING AND SEA LEVEL RISE

Description and purpose of strategy: Without preventative measures, sea level rise and flooding from climate change are expected to inundate roads and infrastructure throughout Cape Cod. Municipalities should consider elevating, relocating, or even abandoning some resources. While these proposals are costly, the most costly option would be doing nothing to prepare for sea level rise. Investing in infrastructure can increase resilience and property values, as well as lower the risks of physical or economic losses.

Content of fact sheet: Overview of the costs and benefits of infrastructure adaptation, with qualitative descriptions of the costs and benefits for several prominent strategies. Includes a description of the process of relocating a parking facility in Orleans, tools to evaluate the anticipated degree and location of flooding, and resources for more detailed planning.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☐ Greenhouse gas (GHG) emissions reductions or sequestration
- ☐ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☐ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☑ Less damage to infrastructure
- ☑ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Focusing infrastructure adaptation in areas with vulnerable populations and avoiding potential impacts of rising property values can help maximize potential benefits and ensure equitable distribution of outcomes.

Financial benefits: While infrastructure adaptation can require substantial investment, these projects are typically justified by preventing damage from sea level rise. Costs vary by the strategy implemented.

Non-market benefits: Resilience to disasters and the ability to evacuate during storm surges and flooding are major benefits of infrastructure adaptation. Protecting shorelines can have important ecosystem benefits.

GHG reductions: Construction is a large source of GHG emissions, particularly from the production of concrete and asphalt.

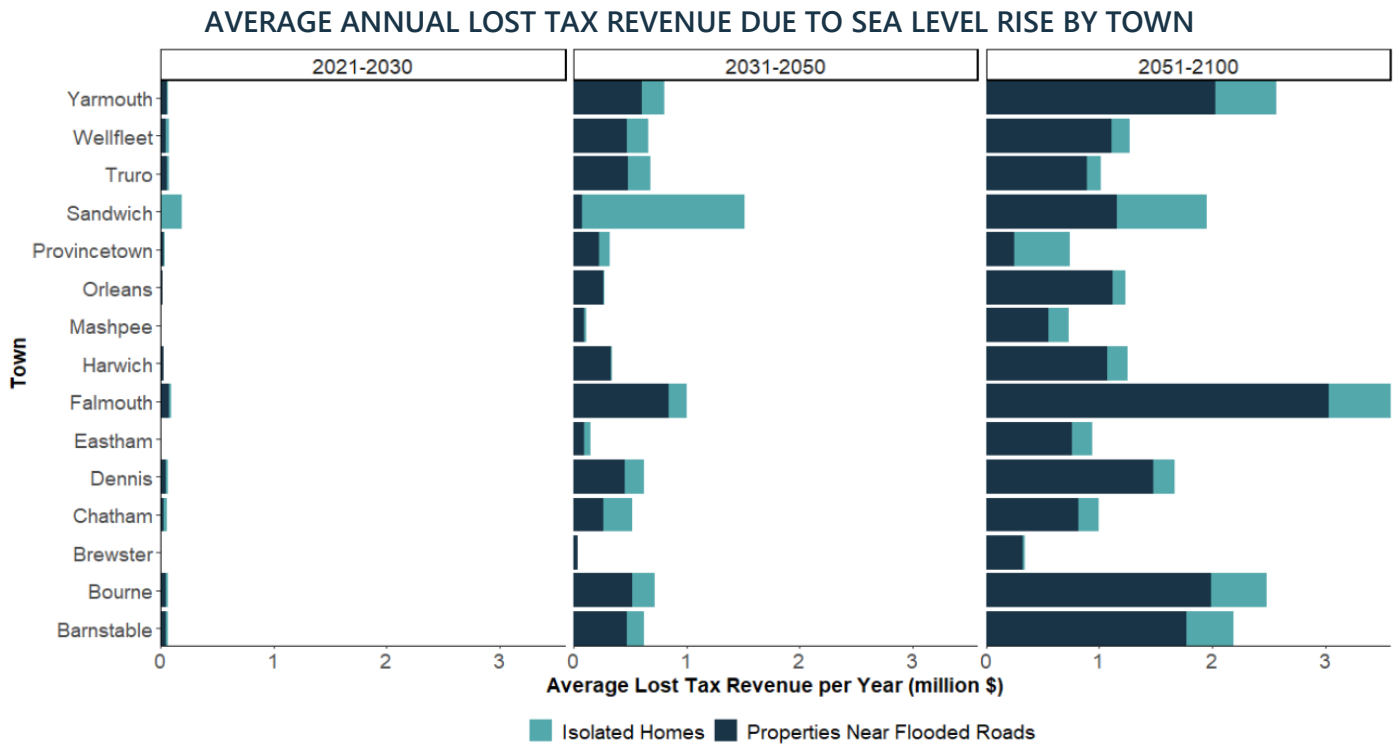
Ease of implementation: Site-level study is necessary to find the best implementation strategy for each infrastructure project. While resources are available to prepare these assessments, significant planning and permitting work is required.

BENEFIT COST ANALYSIS

Infrastructure adaptation projects can have large benefits by preventing damage from flooding or sea level rise.

Roads

The magnitude of benefits depends on the cost of doing nothing, or the expected damage absent any improvements to existing infrastructure. Doing nothing will be an expensive option for municipalities—as sea level rises and roads become unusable, municipalities will lose tax revenue from isolated homes and properties near flooded roads. The figure below shows the estimated lost annual tax revenue due to flooded roads through the end of the century (Cape Cod Commission, 2021). In total, Cape Cod is projected to lose approximately $290 million in tax revenue due to flooded roads by 2100. Sea level rise can also cause direct damage to roadways, which can result in traffic congestion (Fant et al., 2021). Non-monetary damage would also be significant. For example, flooded roads, particularly during storms or significant coastal flooding events, could hinder emergency response and evacuation and potentially lead to loss of life.



Source: Cape Cod Commission, 2021

Over 212 miles of roads on Cape Cod are projected to be flooded by 2100. Municipalities can use the low-lying roads tool to learn when and where flooding is projected. When flooding is projected during the typical useful life of a road (around 30 years), municipalities should conduct detailed analyses to find the appropriate adaptation plan. There are four general strategies to prepare roads for flooding and sea level rise: elevate, relocate, abandon, or protect. The costs and benefits of each strategy depend on many local factors, such as the degree of sea level rise, the population that depends on a given road, and the condition of land and property surrounding a road. Producing the asphalt and concrete required for new road construction is a considerable source of GHG emissions, although new production methods may lower the emissions intensity (Woodall, 2021). When implementing road improvements, municipalities should also promote alternative transit, including Complete Streets.

The following table may help assess which methods are best for roads in a given location by summarizing where methods are most suitable and providing some details about each strategy.

ADAPTATION OPTIONS FOR LOW-LYING ROADS

STRATEGY	RECOMMENDED USE	DETAILS
ELEVATE	Locations where environmental impacts to sensitive resource areas are minimal and other options are not cost-effective	Costs can vary dramatically but are substantially higher than typical road construction. The least expensive option is modifying the thickness of existing roads, although this is not feasible if a large degree of sea level rise is anticipated, if roads are used to drain water from neighboring properties, or if there are clearance restrictions. Overall, estimated costs per mile for an average road range from $1–$14 million.
RELOCATE	Roads at low elevations relative to surrounding features	Municipalities can find a suitable location for the existing road on higher-lying land and reconstruct that road at a higher elevation. The site of the current resource can be used as a living barrier or open space following demolition. The cost of relocation depends on the value of the land municipalities need to purchase. While there are not examples of relocating Cape Cod roads for sea level rise, costs and challenges may be similar to those from relocating parking lots in Brewster, Provincetown, and Orleans.
ABANDON	Repetitive loss areas with few year-round residents	The municipality must purchase and demolish all houses serviced by the targeted road, abandon road segments, and ensure proper disposal of any potential hazardous materials. This option incurs high monetary costs (purchasing private property, lost property tax revenue) and non-monetary costs (personal, cultural, and historic value of land). The monetary cost depends on the value of neighboring land. Pending legislation could provide funding and support for voluntary property buyouts.
PROTECT	Areas without existing natural buffers, and where storm surges are a greater concern than sea level rise	While some human-made strategies are also available, the most cost-effective protective approaches appear to be nature-based solutions such as building living shorelines and preserving coastal wetlands (Costanza, 2021). Buffers do not prevent inundation of roads below sea level, but they can be effective at reducing flood risk and coastal erosion during storms. Research estimates that the average acre of wetland worldwide prevents over $27,000 per year in storm-related damage (Costanza et al., 2021).

Other Infrastructure

Sea level rise will also impact a variety of other key infrastructure components, including bridges and culverts; electric, gas, sewer, and water utilities; and ports. Municipalities can use the Cape Cod Commission's sea level rise viewer to identify critical facilities that would be impacted by sea level rise. The same general strategies above can be applied to other infrastructure components, with some exceptions. For bridges and culverts, efforts to upgrade or relocate facilities must be done in conjunction with road planning. A 2015 study found that upgrading culverts for increased water flow was on average 38% less expensive than replacing and maintaining culverts without upgrading them. For some sites (such as wastewater disposal sites), abandoning a facility may require additional expenses to properly dispose of or store hazardous materials. To protect water infrastructure from sea level rise, research suggests constructing intrusion barriers to prevent saltwater from entering freshwater reserves; rerouting pipes inland, using non-corrosive materials, and/or scheduling more frequent maintenance for pipes where saltwater leads to accelerated corrosion; and elevating key electrical equipment in treatment facilities to prevent service interruption during floods (Chalek 2020).

EQUITY

With careful implementation, infrastructure adaptation can be a tool for equitable climate adaptation. Infrastructure projects may have a variety of economic and non-monetary benefits for communities. A few potential benefits include:

- **Decreased exposure to hazards:** Infrastructure adaptation will decrease exposure of communities to risks from coastal hazards and flooding on low-lying roads.
- **Improved transportation quality:** Infrastructure adaptation can improve quality of transportation, including safer transportation options and fewer transportation delays for communities due to improved roads and infrastructure. These improvements can enhance access to critical services such as healthcare or emergency services.
- **Potential economic opportunities:** Infrastructure projects will lead to opportunities and jobs in construction related to road retrofitting and relocation, as well as replacement of culverts and bridges.

Optimizing Equity During Implementation

To maximize benefits to environmental justice and vulnerable populations, the planning process for infrastructure adaptation should incorporate community feedback, focus on non-monetary benefits of proposed projects, and aim to minimize gentrification impacts from improved infrastructure. While soliciting community feedback, municipalities should provide materials in multiple languages or provide translation services to include the many Cape Cod residents whose primary language is not English (MassGIS 2022).

Non-monetary benefits of proposed projects are important for towns to consider. Decisions based solely on lost property tax revenue might systematically disadvantage low-income residents. Other non-monetary factors to consider include access to emergency services or evacuation routes, roads used for bus routes, number of full-year residents impacted, and number of vulnerable residents impacted. Infrastructure investments can increase property value and rents, adding financial pressure to low-income residents. Municipalities should design adaptation strategies so local residents benefit from opportunities related to construction projects and are protected from displacement (Dorazio 2022).

Costs of infrastructure projects are largely borne by the tax base (through state or federal grants) and local municipalities. If tax increases are required to fund infrastructure projects, municipalities should consider modified fee structures for local infrastructure costs borne by residents. Examples could include a room occupancy excise tax (a tax targeting hotel rooms and other visitor accommodations) or a property tax on second homes.

STATE OF PRACTICE

General State of Practice

While many coastal regions in the U.S. recognize the importance of infrastructure adaptation for sea level rise, few have begun the costly process of preparing critical infrastructure. Many coastal regions have implemented vulnerability assessments to find regions that require infrastructure adaptation investments (e.g., San Francisco, New Hampshire, Puget Sound), and some regions have already begun implementing plans to prepare for sea level rise. For example, Florida has begun elevating roads in Miami Beach and is planning to elevate roads on the Florida Keys (Harris and Ariza, 2021). In addition, a New Jersey program is buying out properties in high-risk flood zones and investing in coastal resilience projects. Infrastructure planning on Cape Cod should learn from these examples, particularly if designing a buyout program, but the practice of infrastructure adaptation is still emerging and implementation may require strategies not tested elsewhere.

Cape Cod Context

Municipalities on Cape Cod recognize the immediate threat of sea level rise for their communities, and several towns have begun extensive planning or implementation of projects to prepare for this threat. Relocation projects for parking lots are either completed or in progress in Brewster (completed 2016), Provincetown (completed 2019), and Orleans (in progress). Lessons learned from these projects include the importance of community engagement. For instance, the project in Brewster encountered several difficulties in building community support for the intended project, leading to substantial project delays.

Municipalities have already begun planning the extensive road investments required to keep pace with the rising sea level. The Town of Eastham conducted a study in 2020 to identify infrastructure adaptation strategies to prepare for sea level rise. The report included a vulnerability assessment for four key roads, found a range of potential adaptation strategies to address sea level rise, and included community feedback. The report presented timelines for implementation and general permitting requirements, and it identified preliminary costs of alternatives. The Cape Cod Commission is developing similar assessments throughout Cape Cod. As of March 2023, these efforts to produce assessments throughout Cape Cod and to implement adaptation strategies in Eastham are ongoing. The low-lying roads project includes vulnerability assessment, community engagement, project selection, and conceptual roadway design for each municipality.

CASE STUDY: NAUSET BEACH, ORLEANS, MA

Sea level rise and coastal erosion have long threatened the current parking lot and sewer lines at Nauset Beach, Orleans. Nauset Beach moved westward at a rate of 12 feet per year between 1990 and 2015 (Zuckoff, 2022). In 2010, the Town of Orleans acquired a parcel of land uphill of the existing site to prepare for a managed retreat of facilities near the coast. In 2021, the town was awarded a Massachusetts Office of Coastal Zone Management (CZM) Coastal Resilience Grant for design and permitting of the parking lot removal. In a 2021 election, voters approved the project to relocate the parking facility, and in 2022, the town was awarded a CZM Coastal Resilience Grant to help fund the project. The new lot is expected to open by Memorial Day 2023, and to last for decades longer than the current site.

IMPLEMENTATION

The steps below are required to implement infrastructure adaptation of roads and other vulnerable infrastructure resources. With relatively little historical precedent for the necessary projects, infrastructure adaptation may require more intensive design and planning than other strategies. Grant funding is available for all stages of implementation from state and federal agencies.

1. **Assess site vulnerability.** Assess the vulnerability of existing sites to projected sea level rise. Environmental scientists should help assess the risks to existing sites.
2. **Identify priority roads or infrastructure projects.** This planning should consider non-monetary impacts from infrastructure adaptation projects such as access to emergency services, evacuation routes, and public transit. Planning should engage diverse community stakeholders.
3. **Design potential solutions.** Design potential solutions for each project, considering elevation, relocation, abandonment, and protection. Solutions should attempt to minimize financial burdens and the displacement of socially vulnerable populations.

REQUIRED EXPERTISE

Internal: Town planner, grant writer, GIS analysis, department of public works staff, emergency services staff

External: Transportation engineer, environmental scientist

4. **Select a project solution.** The selection process should incorporate feedback from the impacted community.
5. **Implement the proposed construction project.** This stage should engage local companies and individuals. When possible, it should also engage contracting companies that are women or minority owned.

The following resources may assist with planning and funding infrastructure adaptation projects.

FINANCIAL AND TECHNICAL SUPPORT	
Cape Cod Commission Sea Level Rise Viewer	Planning tool to visualize the extent of sea level rise and identify critical infrastructure that would be affected.
Cape Cod Commission Low Lying Roads Project	Planning tool to identify roads at risk from sea level rise, and sample project solutions for a range of adaptation strategies. Includes town-level visualizations and reports. To view resources for each town, use the town buttons at the bottom of the webpage to access individual low-lying road viewers.
Cape Cod Commission Managed Retreat Tool	An education and communication tool to present options related to coastal resiliency. Summarizes multiple adaptation plans and includes examples of outreach best practices to develop communications and outreach plans.
Massachusetts Coastal Resilience Grant Program	Provides funding for a range of coastal resilience projects, including vulnerability assessments, public outreach, proactive planning, redesigns or retrofits, and shoreline restoration.
Massachusetts Dam and Seawall Repair or Removal Program	Provides support for repairing or removing dams, levees, seawalls, and other forms of flood control, particularly when the project would benefit public safety, a key economic center, or ecological services.
FEMA Hazard Mitigation Grant Program and Flood Mitigation Assistance Grants	Two federal grant programs that municipalities can use to provide funding for projects that reduce or eliminate the risk of repetitive flood damage. The Flood Mitigation Assistance Grants are limited to buildings insured by the National Flood Insurance Program, but both programs can help fund managed retreat.
Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program	A federal program that provides resources to projects that protect and restore watersheds. Elevation projects may be eligible under flood prevention or watershed protection. Projects must demonstrate agricultural benefits, including benefits to rural communities. Sandwich, Massachusetts, earned support from this program to improve water quality at Town Neck Beach.
ADDITIONAL INFORMATION	
CZM Port and Harbor Planning Publications	Collected publications and resources from CZM on how to plan resilient ports and harbors, including technical assistance to receive CZM support for harbor resilience projects.
Act Establishing a Massachusetts Flood Risk Protection Program	Legislation in Massachusetts state legislature that, if approved, could provide additional funding and support for flood risk protection programs including, voluntary property buyouts.
Environmental Protection Agency (EPA) Resilient Strategies Guide for Water Utilities	Helps water utilities identify potential adaptation strategies based on expected climate vulnerabilities, including potential sea level rise and storm surge scenarios.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

Transportation

CLIMATE ACTION FACT SHEET

Reduce vehicle miles traveled

REDUCE PRIVATE VEHICLE TRAVEL AND ENCOURAGE ALTERNATIVE MODES OF TRANSPORTATION

Description and purpose of strategy: This fact sheet will help municipalities understand vehicle miles travels (VMT) reduction strategies, including the economic and equity implications, best practices, and the state of practice. This fact sheet incorporates work-from-home policies and virtual workshop support as well strategies for collaboration with other entities to improve broadband access and encourage the use of public transit. This fact sheet also discusses how zoning strategies such as multifamily zoning and concentrated development in activity centers can be part of the solution.

Content of fact sheet: An overview of the costs and benefits of VMT reduction strategies, including encouraging virtual work, expanding broadband access, and expanding alternate forms of transportation.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☑ Increased recreation
- ☐ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☐ Higher property values
- ☐ Increased resilience
- ☑ Job and economic growth

COSTS

- ☐ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Strategies to reduce potential economic burdens—including expanding vulnerable populations' access to broadband, public transit systems, and active transport systems—could help maximize potential benefits to these populations and ensure equitable distribution of outcomes.

Financial benefits: VMT reduction projects and programs can be cost-effective compared to conventional transportation projects, depending on local context and project characteristics.

Non-market benefits: Improvements in health from reduced pollutants and increased recreational opportunities are major benefits of some VMT projects.

GHG reductions: Reducing VMT often results in GHG emissions reductions.

Ease of implementation: Developing VMT reduction programs and policies provides support for a wide range of transportation projects and business practices. Community engagement should ensure that projects are designed to maximize equity benefits.

BENEFIT COST ANALYSIS

Projects and programs designed to reduce VMT can vary widely depending on the nature of the work, which presents a challenge for estimating the benefits and costs of VMT reduction initiatives. Programs supporting VMT reduction can have many beneficial effects, including lower accident rates, reduced traffic congestion, increased physical activity (and associated health outcomes) from pedestrian and bicycle programs and projects, improved air quality, an improved sense of place, travel time savings, reduced travel expenses, and amenities such as attractive streetscapes and sidewalk cafes and retail establishments.

Major costs are associated with programs supporting VMT reduction, such as expanding and improving broadband access, expanding and improving access to public transit systems, and creating or improving active forms of transportation such as walking or bicycling. Costs could also include expenses for planning and re-zoning efforts. However, benefits associated with VMT reduction programs and projects continue to be accrued for many years following implementation.

Reductions in VMT are important to achieving decarbonization targets. One Massachusetts report estimates that a 1% reduction in the statewide growth rate of VMT from 2015 to 2030 would result in combined economic savings of $2.3 billion annually, made up of transportation cost savings, reduced automobile collisions, and reduced vehicle and road repair costs (Baxandall & Olivieri, 2015). Another report prepared for the Commonwealth of Massachusetts (The Cadmus Group and Evolved Energy Research, 2020) estimates that pursuing VMT reduction transit policies (including enacting congestion charges, encouraging active transportation, expanding public transit, and implementing travel demand management policies) and community densification policies (increasing the proportion of households located in mixed-use areas) could reduce growth in daily VMT by over 30% in Massachusetts between 2015 and 2050.

However, VMT reductions are limited in opportunity. The effect of housing densification policies is limited because expected new development is usually small compared to the existing built environment. Other policy interventions, such as travel demand management and expanded public transit infrastructure, may need to be substantial to reduce VMT significantly. Costs associated with such substantial policy interventions may be significant and, in some cases, cost prohibitive. VMT reduction policies should be implemented alongside other policy interventions aimed at reducing GHG emissions.

Encouraging work-from-home policies

During the COVID-19 pandemic, many workplaces temporarily ceased operations or shifted from traditional office work policies to work-from-home policies. In U.S. areas with stay-at-home orders, estimates indicate that average daily travel distance declined from 5 to 1 miles (Riggs, 2020) and traffic reductions ranged from 10 to 75 percent (ITE, 2020). Post-COVID, about three-quarters of all U.S. companies are adopting hybrid or work-from-home models permanently (Tsipursky, 2023). Research suggests that workers who work from home still travel by vehicle at a reduced rate despite lifting of stay at home orders (Riggs, 2020), resulting in reduced transportation emissions. In 2017, researchers estimated that work-from-home employees reduced their travel by 2,000 personal vehicle miles (Magellan Advisors, 2022). The table below shows estimates of avoided costs from VMT reduction. According to these figures, reducing VMT by 2,000 vehicle miles could result in average avoided transportation and emissions costs of approximately $573 for each work-from-home employee, using the average cost of U.S. retail gasoline in February 2023 (EIA, 2023) and average U.S. vehicle emissions rates per vehicle for light-duty vehicles using gasoline (Bureau of Transportation Statistics, 2023).

AVOIDED COSTS FROM VMT REDUCTION ($/VEHICLE MILE)

CATEGORY	VALUES
Avoided Transportation Costs	
Congestion cost	$0.08
Pavement maintenance cost	$0.003
Noise pollution cost	$0.001
Accident cost	$0.04
Fuel cost	$0.153
Avoided Emissions Costs	
NOX	$0.0008
PM	$0.0085
CO2	$0.0002
TOTAL	$0.2865

Note: Values adjusted to 2023 values. Calculations assume gas mileage for light duty vehicles of 22.9 miles/gallon.
Sources: EPA COBRA (2023), Bureau of Transportation Statistics (2020)

Businesses with hybrid or work-from-home policies benefit from better company branding, lower turnover rates, reduced carbon footprints, and lower overhead costs (Davies, 2020). Cost savings associated with these benefits vary by company, but often amount to tens of thousands of dollars in savings per year. However, businesses must also consider technical and communication challenges associated with work-from-home policy implementation, which may require costly investments in areas such as technological systems, development of cybersecurity policies, and employee training on security policies and cybercommunication. Additionally, work-from-home policies may be impossible or impractical for many industries on Cape Cod where in-person work is critical to operations, including major local industries like construction, hospitality, and tourism. For industries where in-person work is essential, other strategies should be pursued to reduce VMT from commuting, such as improving or subsidizing public transit systems, encouraging active transportation, or promoting ride-sharing opportunities.

Virtual workshop support

Hosting and organizing workshops can be expensive and logistically challenging. Virtual workshops reduce expenses by eliminating the need to purchase office supplies, secure a location for the workshop, and travel to the workshop (Dennison, 2023). Despite the benefits of virtual workshops, some individuals may be deterred from hosting their workshop online due to the technological challenges involved. Providing support for virtual workshops may encourage businesses and individuals to transition to virtual workshops, resulting in reduced VMT and carbon emissions from travel.

Improving broadband access

Broadband access helps individuals access important online services and is crucial to supporting work-from-home policies and virtual workshops. Improving broadband access allows individuals to reduce VMT by reducing travel needs. Individuals can use broadband access to complete tasks and acquire amenities that may previously have required travel. For example, individuals can use broadband to access healthcare services through telehealth, enroll in online fitness or educational programs, and even check out books and media from libraries. Additionally, broadband users can engage in work-from-home policies and virtual workshops, as previously discussed, which can reduce VMT by eliminating the need to commute to work or travel to workshops. Even with increased broadband access, actual reductions in VMT and GHG emissions depend on changes in employer policies and practices as well as consumer adoption of telecommuting or other activities that substitute for vehicular travel (Magellan Advisors, 2022).

Despite the benefits associated with broadband access, improving availability is costly. One California study estimates that it costs over $300,000 to fully deploy one mile of broadband conduit as a standalone project (Magellan Advisors, 2022). Cost savings are achievable by installing conduit as part of a transportation project, which reduces the need for trench digging and decreases the cost to deploy broadband conduit to approximately $54,000 per mile (Magellan Advisors, 2022).

Improving public transit systems

Cape Cod provides its residents and visitors access to multiple forms of public transit, including bus lines, rail lines, ferries, and multimodal transit (John A. Volpe National Transportation Systems Center, 2011). Access to public transit systems is shown to significantly reduce traffic congestion, increase community access to services, create jobs and stimulate local economies, improve healthcare access while reducing costs, reduce individuals' transportation costs, reduce accidents, and reduce GHG emissions (Ferrell, 2015). One report prepared for the Commonwealth of Massachusetts (The Cadmus Group and Evolved Energy Research, 2020) estimates that pursuing VMT reduction transit policies (including congestion charges, encouragement of active transportation, expanding public transit, and implementing travel demand management policies) could reduce growth in daily VMT by over 30% in Massachusetts. Additionally, there is evidence that switching from a car to public transportation when commuting to work increases activity levels, which may result in improved health outcomes (Morabia et al., 2010). The benefits of public transit systems often outweigh the costs. Public transit systems pay for themselves in congestion relief alone in mid- to large-sized urban areas (Ferrell, 2015). Even in rural areas, certain types of public transit are often cost-effective. While some benefit cost analyses on public transit systems in rural U.S. communities find the costs of public transit slightly outweigh the benefits, other studies have found the benefits outweigh the costs, at times significantly (Ferrell, 2015).

Increased public transit service frequency and coverage, improvements to user experience (such as bus stop improvements), and other system improvements could encourage additional transit ridership. Additional GHG emissions reductions could be realized by transitioning from a fleet of fossil-fueled vehicles to zero-emission vehicles. The transition to zero-emissions vehicles is the currently at the Cape Cod Regional Transportation Authority (CCRTA) and is reflected in the CCRTA 10-Year Strategic Plan and 5-Year Capital Spending Plan, which provides substantial funding resources for the planned migration from fossil fuel vehicles to electric vehicles, supporting EV infrastructure and technician training.

Encouraging active transportation

Active transportation includes all activities individuals can partake in to physically transport themselves, including walking, running, bicycling, rollerblading, and more. Benefits of active transportation include improved public fitness and health, transportation cost savings, reduced traffic congestion, increased traffic safety, energy conservation, and pollutant reductions (Litman, 2023). Projects and programs to encourage active transport as an alternative to travel in a personal vehicle include creating bicycle lanes, expanding access to sidewalks, creating trail systems (including walking trails), and more. Costs of implementing programs and projects to encourage active transportation include equipment expenses (e.g., shoes, bikes), time costs because of slower travel, and development costs. The scale of costs and benefits will vary depending on the nature of the project or program.

Multifamily zoning and concentrating community development

Multifamily zoning provisions can enhance housing affordability, encourage more revenue-balanced community growth, improve land use, and accommodate a greater diversity of personal and community needs (Massachusetts Housing Partnership, 2023). By allowing denser, more compact and mixed-use communities, residents can shop, live, and access important services through means other than personal vehicles, such as through biking or walking (Cape Cod Commission, 2023). Locating multifamily housing near public transit systems further reduces reliance on private vehicles, thus reducing VMT, by providing residents access to destinations beyond walking or cycling distance (Massachusetts Executive Office of Housing and Economic Development, 2023).

EQUITY

A few potential equity benefits for VMT reduction strategies for vulnerable populations include:

- **Reduced vehicular emission exposure.** Reducing VMT is likely to lead to reductions in fossil fuel use and thus reduced GHG emissions and pollution. Many vulnerable populations are exposed to vehicle emissions at disproportionate levels (U.S. Federal Highway Administration, 2022). Therefore, reductions in vehicular emissions could result in benefits from improved air quality for these populations.
- **Enhanced economic opportunity.** Many communities have limited access to personal vehicles and therefore rely on public transportation systems. Encouraging alternatives to private vehicle transportation such as public transportation, walking paths, and bicyclist paths could present additional (and safer) transportation options for all.
- **Improved access to services and reduced travel costs.** Increased multifamily development in activity centers could help residents access needed services (e.g., food, healthcare), reducing travel time and transportation-related costs of accessing those services.
- **Health and physical benefits.** There is a strong relationship between family income and physical activity, with low-income families reporting the lowest levels of physical activity (Armstrong et al., 2018; U.S. Department of Health and Human Services, 1996). There are often financial and transportation-related barriers to accessing health care and fitness centers. VMT reduction strategies can encourage use of pedestrian and bicycle trails, which can lead to improved physical activity levels and health outcomes.

Optimizing Equity During Implementation

Despite some of the benefits discussed above, VMT reduction strategies may also negatively impact equity efforts. For example, strategies that rely on tax increases for funding could place disproportionate financial burdens on low-income communities. Rural communities may also face disproportionate challenges given longer commutes. communities located in remote areas Additionally, benefits to quality of life resulting from VMT reduction strategies could potentially lead to gentrification and further the housing crisis.

VMT reduction strategies requiring digital skills and resources may be more difficult to access for vulnerable communities. Strategies will need to address the digital divide—that is, the lack of affordable internet access; affordable devices appropriate for an individual's civic, social, and employment needs; and the skills necessary to engage digitally (Cape Cod Commission, 2023). Digitally focused VMT reduction strategies should assist communities with understanding digital access limitations and adoption challenges to digital equity to bridge the digital divide.

CASE STUDY: IMPACTS OF RESIDENTIAL DEVELOPMENTS IN EASTERN MA

Between 2000–2005 in eastern Massachusetts, nine residential developments were constructed in suburban areas with varying built environment characteristics such as density, location, job accessibility, and neighborhood building age. In 2011, Massachusetts Institute of Technology (MIT) published a case study on how built environment characteristics in these developments affect VMT. Findings suggest that developments with high density, high land use mix, proximity to major roads, and moderate job accessibility result in the lowest VMT per residents (Xia, 2011).

Photo: Brad Hutchinson Real Estate, Inc., n.d.

STATE OF PRACTICE

General State of the Practice

Reducing VMT is an official goal of U.S. government policy (U.S. Department of Transportation, 2014). In the U.S. Department of Transportation's Fiscal Year 2022–2026 Strategic Plan, officials list supporting options to reduce trips and encourage active means of transportation, such as walking and bicycling, as a departmental strategy for advancing a sustainable transportation system.

Cape Cod Context

According to the 2021 Cape Cod Climate Action Plan, the average daily VMT on Cape Cod is over 8 million miles. Cape Cod's per capita VMT rate is significantly higher (30-40%) than the rest of Massachusetts. Cape Cod is working to invest in infrastructure and development patterns that support VMT reduction. The Cape Cod Commission regularly updates a Regional Policy Plan that articulates a growth policy for the region focused on growth in activity centers, with concentrations of community amenities (e.g., schools, hospitals, community centers) and business activities. The Regional Policy Plan encourages compact development patterns that reduce residents' distance from services and support alternative means of transportation such as walking and bicycling.

IMPLEMENTATION

The specific actions that can be taken to implement VMT reduction programs and projects will vary according to the specifications of the work. Below are some options to reduce VMTs on Cape Cod:

- **Support local organizations in implementing work-from-home policies.** Develop resources to support organizations transitioning from in-person to work-from-home policies. Ensure that the municipality has clear and reasonable work-from-home policies. Consider developing online resources and written resources to distribute to Cape Cod organizations. Consider designating one or more personnel to assist Cape Cod organizations with transitions to work-from-home policies.

REQUIRED EXPERTISE

Internal: Town planner, grant writer

External: Transportation engineer, network engineer

- **Expand broadband access strategically.** Incorporate broadband conduit deployment into planned transportation projects in remaining areas with limited access to broadband.
- **Support local organizations and agencies in switching from in-person to virtual workshops.** Develop resources to support organizations and agencies in hosting virtual workshops. Consider developing online resources and written resources for distribution to Cape Cod organizations interested in hosting virtual workshops. Consider designating one or more personnel to assist Cape Cod organizations and agencies with implementing virtual workshops.
- **Improve and expand public transit systems.** Work with the Cape Cod Regional Transit Authority to improve access to public transit systems by incorporating additional public transit stops, expanding routes, implementing public campaigns to encourage the use of public transit systems, providing clear signage and schedules for public transit, extending the hours of public transit operation, and increasing the frequency of public transit stops.
- **Encourage active transportation.** Encourage active transportation by expanding trail systems, implementing complete streets, encouraging compact communities, creating bicycle lanes, and increasing access to sidewalks. Consider expanding multifamily zoning in appropriate areas and focusing development in activity centers.

- **Encourage dense community development.** Allow new multifamily residential developments with alternative site patterns and/or a variety of housing types. Overlay multifamily zoning with mixed-use developments to improve walkable access to goods and services. Establish zones where multifamily housing is allowed by right. Provide density bonuses or other forms of zoning relief in exchange for including some affordable housing units.
- **Develop an organization to lead VMT reduction strategy development on the Cape.** Implement a Cape Cod transportation management association to coordinate VMT reduction approaches and leverage pooled resources to support initiatives.

Resources that may assist with implementing VMT reduction programs and projects are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
MassTrails Grants	Provides matching grants to communities, public entities, and nonprofit organizations to plan, design, create, and maintain a diverse network of trails, trail systems, and trails experiences.
National Telecommunications and Information Administration State and Local Implementation Grant Program	Provides funding to assist state, local, and tribal government entities as they plan for the nationwide public safety broadband network.
Municipal Americans with Disabilities Act Grant	Supports capital improvements specifically dedicated to improving access for persons with disabilities.
Massachusetts Safe Routes to School Program	Works to increase safe biking and walking among elementary, middle, and high school students by using a collaborative, community-focused approach that bridges the gap between health and transportation.
Municipal Digital Equity Planning Services	Assists municipalities in assessing the digital divide in their community and finding solutions towns can further through other state and local efforts.
ADDITIONAL INFORMATION	
Federal Communications Commission National Broadband Map	Map of broadband access nationally that is useful in identifying areas of limited broadband access.
Making the Shift: How TMAs in Massachusetts Leverage Private Sector Resources to Achieve State Goals and Public Benefits	Explores the impacts that Transportation Management Associations (TMAs) are yielding throughout the Commonwealth and how these impacts can be strengthened to achieve greater public benefits and cost-effectiveness. Useful in developing and implementing a Transportation Management Association for Cape Cod.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

CLIMATE ACTION FACT SHEET

Transportation

Promote residential adoption of electric vehicles

STRATEGIES TO ENCOURAGE RESIDENTS TO CONVERT PERSONAL VEHICLES TO ELECTRIC

Description and purpose of strategy: This fact sheet will help municipalities understand the economic and equity implications, best practices, and state of practice of encouraging adoption of electric vehicles (EVs) for residents and Cape visitors. This includes insights about the return-on-investment of EV adoption, adding public and private EV chargers, encouraging EV rentals, and updating zoning to encourage EV spaces.

Content of fact sheet: Overview of the costs and benefits to individuals in Barnstable County switching from internal combustion engine vehicles to EVs, overview of the current state of EVs in Massachusetts and the county, and information on the current incentives for switching to EVs.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☐ Higher property values
- ☐ Increased resilience
- ☐ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☐ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Strategies to reduce potential economic burdens, such as ensuring accessibility to charging, could help maximize potential benefits to underserved populations and contribute to equitable distribution of outcomes.

Financial benefits: Encouraging adoption of EV technology, together with affordable public transit, can be cost-effective for EV adopters and reduce vehicle emissions.

Non-market benefits: Improvements in health from reduced local criteria air pollutants like NO_x, SO_x, and $PM_{2.5}$ and reduced use of fossil fuels are major benefits of increased EV adoption.

GHG reductions: Replacing internal combustion vehicles with EVs can reduce the amount of fossil fuels needed while also eliminating tailpipe emission.

Ease of implementation: Supporting increased adoption of EVs will require parking policy reform, zoning updates, and infrastructure investments in public charging stations. Vehicle owners may also need to invest in residential charging, though there are often incentives from utility.

BENEFIT COST ANALYSIS

Switching to EVs, particularly sedans, can be cost-effective while reducing emissions from vehicles.

EVs cost about half as much to maintain as internal combustion engine vehicles (ICEVs): $0.031 per mile for EVs compared to $0.061 per mile for ICEVs (Burnham et al., 2021). They also have lower fuel costs, especially when charged at home. Both reduced fuel and maintenance costs increase the benefits of driving an EV over time, so the more miles consumers drive their vehicles, the more financial benefits they will see. EVs also use fewer moving parts and often have better warranties, many offering eight years/100,000 miles (McKinsey, 2016). Finally, much of the additional cost for EVs is for batteries—but battery costs decreased from $1,000/kilowatt hour (kWh) in 2010 to $227/kWh in 2016 (McKinsey, 2016). They decreased for several more years before increasing in 2022, to $152/kWh, for the first time in a decade (Bloomberg, 2022). Due to supply chain issues during COVID-19 battery prices may have seen a short-term increase but may again experience a decreasing trend as supply increases and technology advances. The owner of a Chevrolet Bolt (an EV) will save over $12,000 over 10 years compared to a conventional Toyota Camry based on the up-front cost, as well as the annual fuel and maintenance costs.

Meanwhile, the emissions benefit of switching a single-passenger transit vehicle from gasoline-powered to electric-powered is over 77,000 pounds of carbon dioxide equivalent emissions, nearly 10 pounds of NO_x, over 2 pounds of PM, and over 0.5 pounds of SO_2. This reduces the societal cost of emissions by over $3,500 per vehicle over 10 years.

An important cost factor is the number of chargers needed to sustain EVs in an area. The table below shows the results of an analysis that used the EVI-Pro Lite tool to determine the number and type of chargers needed to support EVs in Barnstable County, based on the estimated number of light-duty EVs on the road in the county between 2021 and 2050. The tool estimated the number of workplace level 2 chargers, public level 2 chargers, and public direct current (DC) fast chargers needed, while taking into consideration the proportion of individuals who have access to home chargers. For two scenarios—the sustained policy (SP) scenario and an aggressive electrification (SER1) scenario—the table shows the year of each scenario, the number of EVs, and the number of each type of charger needed to sustain the estimated EVs in the county.

CHARGERS NECESSARY TO SUSTAIN EVS IN BARNSTABLE COUNTY

YEAR (SCENARIO)	LIGHT-DUTY EVS	WORKPLACE LEVEL 2	PUBLIC LEVEL 2	DC FAST
2030 (SP)	13,998	358	230	40
2040 (SP)	67,596	1,698	1,002	126
2050 (SP)	117,766	2,953	1,725	206
2030 (SER1)	69,269	1,740	1,026	128
2040 (SER1)	167,507	4,196	2,441	286
2050 (SER1)	214,025	5,359	3,110	360

SP = sustained policy, SER1 = aggressive electrification

In the SER1 scenario, the cost of chargers in Barnstable County in 2030 would total $10,781,000 for all 2,894 chargers. As the number of chargers increases to 6,923 in 2040 and 8,829 in 2050, the costs would rise to $25,252,000 and $32,104,000, respectively. The SER1 scenario reduces transportation emissions, resulting in a reduction of 0.78 million metric tons (MMT) of CO_2 in Barnstable County by 2030. This increases to 3.43 MMT by 2040 and 6.21 MMT by 2050.

While public chargers are necessary to fuel vehicles while traveling, home chargers are cost-effective, providing electricity at utility rates compared to public chargers that may charge additional fees. Utilities in Massachusetts currently offer incentives for purchasing and installing residential chargers (see the table of resources under "Implementation" below). Public chargers will often charge an access fee (a flat rate for a charging session), a station- or time-based fee (a certain cost per amount of time spent charging), and/or an energy fee (the cost of the energy) (Cape Cod Commission, n.d.).

In addition to reducing annual costs on fuel and maintenance, a shift to EVs would boost jobs in the automobile sector as well as create jobs installing charging stations in Barnstable County. An analysis by the Economic Policy Institute (EPI) found that 150,000 jobs would be created if the country moved to 50% EVs by 2030. Nationally, based on existing statistics, Black workers and those without four-year college degrees are likely to see the greatest benefit from these jobs (EPI, 2021). Additionally, the Institute for Energy Economic and Financial Analysis (IEEFA) found switching to EVs was a large driver in solar investments, thereby creating additional solar energy jobs (IEEFA, 2019).

EQUITY

Switching vehicles in Barnstable County can reduce emissions in the area most responsible for them: transportation. The up-front cost of EVs is steadily decreasing, and they are becoming more affordable with the addition of tax credits and incentives. Further, EVs cost much less for maintenance and fuel than gasoline-powered vehicles, especially when charged at home. The following are items to consider when creating programs to encourage residential EV adoption:

- **Financial accessibility.** EVs often cost more up-front than gasoline-powered vehicles, but their operation costs are much lower. Including incentives and tax credits can drastically bring down the cost of new vehicles and reduce overall vehicle ownership costs.
- **Geographic accessibility of charging.** It is important to ensure that chargers are equitably spread geographically and that they are easily accessible in lower-income areas. Funding programs such as the National Electric Vehicle Infrastructure (NEVI) Program require that a portion of funds be allocated to vulnerable communities.
- **Providing incentives for used vehicles.** Ensuring that incentives are not exclusive is essential to creating equity in the EV market. The Biden administration included tax credits for buying used EVs in the Inflation Reduction Act. Additionally, the Green Energy Consumers Alliance, a Boston-based nonprofit, helps educate consumers about the EV market and can help them find and purchase new and used EVs.

Optimizing Equity for Implementation

Ensuring benefits and costs are fairly distributed through the community is essential for equitable outcomes of EV adoption programs. Key concerns relating to EV supply and charging infrastructure include a project's affordability, accessibility, reliability, location, safety, and economic benefits. The U.S. Department of Transportation has compiled resources and recommendations for incorporating equity into EV adoption strategies. Key recommendations include supporting meaningful community engagement, conducting an outcome-focused community needs assessment, investing in transit and affordable mobility services (as part of a broader strategy for low-carbon mobility), and dedicating funding to address needs of traditionally underserved populations.

Nevertheless, there are significant barriers to EV adoption for vulnerable communities in terms of affordability and accessibility. In recognition of barriers and history of communities exposed to high-traffic areas, the NEVI Formula Program requires that 40% of charging funds be used in disadvantaged communities as identified in the Justice40 Initiative. Additionally, electric utilities in Massachusetts have proposed to offer rebates for the cost of charging infrastructure as well as the labor to install them. The rebates would be given out on a sliding scale, with low-income residents qualifying for higher rebates (Green Energy Consumers Alliance, 2023). These rebates will amount to nearly $400 million over the next 5 years throughout Massachusetts.

Examples of equity considerations in siting EV supply equipment were documented in a recent white paper by the American Council for an Energy-Efficient Economy. The Cape Cod Commission (CCC) developed a model municipal EV bylaw meant to encourage EV charging infrastructure and awareness of EV options. This bylaw includes EV-ready parking space calculations for single and multifamily homes.

Historically, low-income communities and communities of color are most exposed to pollution from high-traffic roads (Demetillo et al., 2021). Reducing emissions from gasoline-powered vehicles would improve air quality in high-traffic corridors. Special consideration for rural areas and EV infrastructure needs is essential.

Meaningful community engagement to identify local barriers to adoption, charging, and maintenance that acknowledges historical and cultural trauma and dynamics can help generate restorative solutions. Working with local trusted partners, leveraging data, and involving the community throughout plan development can improve program success and equity. Once charging sites are identified, collecting data on their utilization, reliability, and pricing is essential. The National Renewable Energy Laboratory has published a guide to energy justice relevant to transportation projects with more information.

STATE OF PRACTICE

General State of Practice

EVs are growing in popularity and becoming more affordable as battery prices decrease. Sales of plug-in EVs (including battery EVs and plug-in hybrid EVs) nearly doubled from 2020 to 2021 (U.S. Department of Energy, 2022). The federal government just instituted the first incentives to buy used EVs in the form of a tax credit. Additionally, several states—including Massachusetts—have either adopted or have begun rulemaking to adopt the Advanced Clean Cars II regulations, which require all new light-duty vehicles sold in the state to be zero-emission vehicles by 2035.

Cape Cod Context

As of early 2023, there are a total of 160 public charging stations in Barnstable County, including 136 level 2 chargers and 24 DC fast chargers (EERE, 2023). As shown in the "Benefit Cost Analysis" section above, more charging stations will need to be installed to keep up with the demand of the current trajectory of EV adoption. Transportation accounts for 55% of GHG emissions in the county and 42% in the state (Cape Cod Commission, 2021). This means that EV adoption will have a large impact on total emissions.

IMPLEMENTATION

While there is a social shift toward EV adoption, local government should take the following actions to increase the rate of adoption, ensure thoughtful infrastructure planning, and achieve strategic benefits. The actions include municipal actions, incentives, and advocacy (Friedman et al., 2021).

- **Municipality adoption of EVs.** Leading by example can show the residents of Barnstable County that EVs are reliable and affordable. This step involves purchasing EVs as well as purchasing and installing the charging infrastructure to fuel the municipal fleet.

REQUIRED EXPERTISE

Internal: Zoning boards can update codes to make them EV-friendly

External: Utilities can work with government to install chargers

CASE STUDY: ACTON, MA

Eastern Research Group analyzed the number and costs of public EV chargers to match demand at different proportions of EV ownership in Acton. With current EV ownership (1.6%), the town only needed eight public chargers. If the proportion of EVs were to increase to 20%, the town would need to install 78 more chargers (72 level 2 and two public DC fast chargers) at a cost of $400,000. At 50% EV ownership, the town would need 109 workplace chargers (level 2), 88 public level 2 chargers, and 17 public DC chargers. At 100% EVs, it would need 218 workplace chargers, 176 public level 2 chargers, and 34 public DC fast chargers, at a total cost of just over $2 million.

- **Expanding charging infrastructure.** One of the main deterrents of EV adoption is range anxiety. Regions can address this by installing adequate charging infrastructure. This involves a mix of workplace and public level 2 chargers and public DC fast chargers. Installing chargers in on-street parking spaces can increase visibility, encouraging use. In addition to public charging, increasing ease of installing residential or multi-unit dwelling chargers can further incentivize EV adoption. In its model bylaw, the CCC created three levels of recommendations to encourage EV charging infrastructure.
- **Establish EV-friendly zoning requirements.** Installing EV charging infrastructure can be complicated for residential, workplace, and local governments. Amending regulations so that installing charging infrastructure is easier and creating EV-friendly zoning requirements will support adoption. Governments and business owners can designate certain parking spots to be EV-only to allow as many EVs to charge as possible. One part of the CCC's model bylaw is encouragement for EV-ready parking spaces to meet the anticipated needs of EV-owning residents. The bylaw includes calculations to figure out the necessary number of EV-ready parking spaces in single-family and multifamily homes.
- **Incentivize EV purchases.** EVs still cost more to buy than ICEVs. Providing tax credits or rebates can encourage EV purchases. Local government can also help residents navigate the state or national programs available to them, as well as offering discounted EV parking or charging additional fees for ICEV purchases.
- **EV advocacy.** EVs have changed drastically since their inception, and there are still misconceptions and unknowns for residents. Local governments can play a role in educating residents through online material, public forums, and presentations. Additionally, they can adopt climate and health goals that involve EV adoption and explain how they will be achieved. Finally, municipalities can host/support EV showcase events to promote the technology.

There are many incentives for governments, workplaces, and residents to help defray costs and make EV adoption easier.

FINANCIAL AND TECHNICAL SUPPORT	
Siting Electric Vehicle Charging Stations on Cape Cod	Planning tool from the Cape Cod Commission to assist in identifying locations that could support EV charging infrastructure.
Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) Program	Massachusetts program that provides a rebate for EV leases or purchases, up to $3,500.
Federal EV Tax Credit	Describes a federal tax credit, up to $7,500, for new plug-in EV or fuel cell EV purchases. There are qualifications: for example, SUVs, vans, and pickup trucks must cost under $80,000 and other vehicles must cost under $50,000.
Massachusetts EV Incentive Program (MassEVIP) Workplace and Fleet EV Charging Station Grants	Provides grants to non-residential establishments for 80% of the cost, up to $50,000, to buy and install level 2 charging stations. Provides grants for 60% of the cost, up to $50,000, for level 1 and 2 charging stations installed on educational campuses and at multi-unit dwellings.
Eversource Incentives	An example of the incentives various utility companies offer for buying and installing chargers in residential, workplace, and fleet locations.
Green Energy Consumers Alliance	Nonprofit that seeks to educate individuals and help them move to EVs. Offers an EV shopping tool that lets you test drive vehicles and take advantage of incentives.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

CLIMATE ACTION FACT SHEET

Preservation and protection of open space

REDUCE EMISSIONS BY INCREASING PROTECTED OPEN SPACE, PARKS, AND TREE CANOPY

Natural Resources & Working Lands

Description and purpose of strategy: Natural lands consist of forests, grasslands, agricultural areas, wetlands, and recreational lands such as parks. These spaces are important parts of a community and ecosystem, providing environmental and economic benefits. They give people an opportunity to interact with the outdoors, which is linked to better physical and mental health outcomes. In addition, they offer ecosystem services such as carbon sequestration and water filtration and represent a significant opportunity to reduce greenhouse gas (GHG) emissions. Preserving open spaces, parks, and forestland, are an important part of climate mitigation.

Content of fact sheet: An evaluation of the financial and non-market benefits of green spaces such as parks and forests. Includes an investigation of how these areas are acquired, enhanced, and maintained—which is important for equity and environmental outcomes. See the fact sheets on wetlands and agriculture for more information.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☐ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property values
- ☐ Increased resilience
- ☐ Job and economic growth

COSTS

- ☐ Higher capital costs
- ☑ Higher maintenance costs
- ☐ Higher operational costs
- ☐ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Creating and preserving parks and other green space can provide access to outdoor resources for all communities. Improved air quality can lead to improved health outcomes, and trees can also reduce urban heat island effects, which often disproportionately affect vulnerable communities.

Financial benefits: Green space preservation can increase property values and provide economic opportunities through the value residents place on open space and recreation. However, land acquisition can also be costly, so financial outcomes are largely dependent on the project.

Non-market benefits: Improvements in physical health from increased recreational opportunities are an important benefit of green spaces. Additionally, access to green spaces has been linked to improved mental health outcomes.

GHG reductions: Preserving green spaces leads to GHG reductions through increased carbon sequestration and decreased development.

Ease of implementation: Cape Cod can ensure protection of its green spaces by developing and implementing Open Space and Recreation Plans and enacting policies that allocate resources to conserving lands and improving parks.

BENEFIT COST ANALYSIS

Land conservation creates financial and non-market benefits by providing recreational opportunities and ecosystem services. People are willing to pay for access to green spaces for outdoor activities, even if they are not charged to do so. The value of green spaces can be estimated based on what individuals are willing to pay, though estimates can vary based on methodology and geography. Data from Oregon State University's Recreational Use Values Database reveal the following willingness to pay values for certain activities in the Commonwealth of Massachusetts:

VALUE OF RECREATION FOR SELECTED ACTIVITIES

ACTIVITY	BENEFIT ESTIMATE (PERSON PER DAY)
Backpacking	$23
Beachgoing*	$45
Camping	$25
Freshwater fishing	$39
Hiking	$91
Waterfowl hunting	$29
Picnicking	$13
Wildlife viewing	$31
General recreation	$31
Other recreation	$42

* Due to a lack of Massachusetts-specific data from Oregon State, the beach user-day value is taken from *Economic Impacts of Climate Change on Cape Cod* (Cape Cod Commission, 2021).

In addition to the recreational use residents get from green spaces, forests and other natural lands perform various ecosystem services that provide economic and environmental benefits, such as carbon sequestration, improved air quality, improved water quality, and avoided runoff. Avoided runoff is important to quantify because it represents pollutants and stormwater that do not have to be managed or filtered in any other way. According to the U.S. Forest Service's i-Tree landscape assessment tools, Barnstable County's trees sequester $16 million worth of carbon annually and save roughly $9 million in avoided runoff costs. In addition to sequestering carbon below ground, trees store carbon above ground as biomass, adding to their potential to act a carbon sink.

ECONOMIC BENEFITS FROM TREE COVER IN BARNSTABLE COUNTY

CANOPY ACRES	CARBON SEQUESTRATION ($/YEAR)	CARBON SEQUESTRATION (TONS/YEAR)	AVOIDED RUNOFF ($/YEAR)	VALUE PER CANOPY ACRE ($/YEAR)
114,359	$16,809,046	88,581	$9,059,264	$67,236.49

Along with preserving existing parks and forestlands, identifying and acquiring new land for protection is important to increase Barnstable County's carbon sequestration potential. Acquiring open spaces both removes vulnerable land from the market and protects it in the long term. Land acquisition can take the form of donations from willing landowners or purchase of private land. Conservation land trusts, groups that own land or often manage land on behalf of the landowner, play a key role in land acquisition and preservation because private lands may be too expensive to purchase outright. To help defray the costs of land, towns can apply for grants from the Massachusetts Division of Conservation Services or federal conservation programs. Additionally, towns can allocate funds from the Community Preservation Act to acquire open space, as the Harwich Conservation Trust recently did to help purchase 85 acres.

One strategy to augment existing parks and public green spaces is tree plantings that maximize ecosystem services of land. i-Tree can be used to estimate the benefits of planting trees in a certain geography. Among other things, i-Tree estimates the financial benefits of avoided runoff, the financial benefit of CO_2 emissions avoided due to reductions in energy uses from tree shading and increased insulation, and the value of the project's carbon sequestration based on the social cost of carbon. (The Understanding i-Tree report offers a complete breakdown of i-Tree's methodology). For example, the table below shows select lifetime benefits from an initiative to plant 50 maple trees within 20 feet of buildings in the Town of Barnstable.

ILLUSTRATION OF I-TREE USES FOR PROJECT PLANNING

TREE TYPE	NUMBER	LIFETIME CO_2 AVOIDED VALUE	LIFETIME CO_2 SEQUESTERED VALUE	LIFETIME AVOIDED RUNOFF VALUE
Maple	50	$2,652	$1,547	$224

In addition to land acquisition costs, municipality-specific maintenance costs should be considered when preserving green spaces. A municipality can generate per-acre cost estimates by reviewing its recreation and natural resources budgets and comparing them to the numbers of acres it maintains.

EQUITY

Equity must be a top consideration when preserving and acquiring green spaces on Cape Cod. Access to green spaces, as well as proximity to hazardous environmental conditions, is uneven among communities of differing race and class. According to a report from the Trust for Public Land, parks across the U.S. in majority non-white neighborhoods are half as large and serve five times as many people as parks in majority white neighborhoods. Studies have shown race and class to be a predictor of pollution exposure and access to green spaces, which is why preserving and creating green spaces in all communities is important. This is an especially important consideration of late, as public outdoor spaces have acted as important gathering spots during the COVID-19 pandemic. Some equity benefits and considerations are as follows:

- **Better health outcomes for adjacent communities.** Studies have shown conserved land has positive impacts on physical health by improving air and water quality. Access to parks is also associated with higher rates of physical activity. Additionally, exposure to nature has been shown to have mental health benefits, as highlighted in a report from the Massachusetts Land Trust Coalition that notes nature's ability to reduce symptoms of post-traumatic stress disorder, reduce childhood obesity, and reduce mortality.
- **Temperature reductions in urban spaces.** Trees near residences and municipal buildings reduce summertime temperatures. For instance, in Worcester the removal of 30,000 mature trees due to insect damage resulted in an increased peak temperature of 1 to 6 degrees Celsius. Ensuring preservation of existing green spaces and installation of new ones—particularly in areas with high proportions of vulnerable communities—could help reduce instances of extreme heat in the summer.
- **Job and educational opportunities stemming from preserving natural lands.** As illustrated above, there are many economic benefits from land conservation. Jobs and labor are necessary to preserve and create green spaces, creating economic opportunity in areas that focus on conservation. In addition, access to the outdoors provides opportunities for outdoor education and recreational programs.

Optimizing Equity During Implementation

An important consideration while preserving green spaces is that they can increase property values, making housing less affordable. This has been called the Green Space Paradox: residents who have not had access to green space are also the most likely to be displaced by the creation of new green spaces. Research has shown that the location and function of

parks are a strong predictor of gentrification. Decision-makers must take action to ensure parks are accessible to all and to create safeguards from increased housing prices for low-income communities. Job opportunities relating to green spaces must be accessible to all communities, so municipalities should invest in incentives and targeted training opportunities for vulnerable populations. Municipalities should make note of environmental justice populations, considering and prioritizing them while making decisions related to tree planting, park creation, and forest preservation.

STATE OF PRACTICE

General State of Practice

The State of Massachusetts has included natural carbon sequestration in its 2050 Decarbonization Roadmap and published an associated land sector technical report. Massachusetts forests have the capacity to sequester 7% of the Commonwealth's annual emissions and represent a powerful opportunity to remove carbon from the atmosphere. In the decarbonization roadmap, Massachusetts calls for increasing natural carbon stocks through afforestation, reforestation, forest management, and natural ecosystem restoration. Other publications such as the Massachusetts Land Trust Coalition's How Conserving Open Space Provides Economic Benefits to Massachusetts Communities and the Massachusetts Healthy Soils Action Plan highlight the potential for land conservation to generate benefits greater than the costs. Initiatives stemming from municipal climate action plans and statewide strategies are emerging as key components of GHG reduction—for example, the San Jose Natural and Working Lands Strategy, which creates plans to expand parks, recreation, regenerative agriculture, and high-density neighborhoods.

Cape Cod Context

The Cape Cod Commission completed a GHG emissions inventory for 2017, in which it estimated sequestration potential on Cape Cod to be 340,582 $MTCO_2e$ per year, or 9% of the Cape's total emissions. In addition, the Cape Cod Climate Change Collaborative has identified conservation and land use as key in GHG reductions. The 2018 Cape Cod Regional Policy Plan sets additional goals for conservation and estimates that, as of 2012, about 40% of the Cape's assessed acres were protected. However, the Regional Policy Plan also notes that Cape Cod lost more than 2,300 acres of forest cover between 2001 and 2011, with the majority being replaced by development. It is of critical importance that open spaces on Cape Cod be preserved, and that development be done with environmental considerations in mind.

CASE STUDY: HARWICH, MA

In December 2022, the Harwich Conservation Trust finished a fundraising effort that brought in $3 million for a project to preserve 85 acres in the Six Ponds Special District. This area, the largest undeveloped tract on the Lower Cape, includes pine-oak forest, walking trails, and multiple recharge zones for freshwater resources. The effort was made possible by the landowner, as well as funding from the Massachusetts Department of Conservation, the Community Preservation Act, individual donations, and the Harwich Town Finance Committee. The land is important for water quality in the nearby area and provides recreation opportunities for residents and visitors. This project is a great illustration of municipalities working with residents and land trusts to preserve land, and can be viewed as a template for future endeavors.

- **Develop or update land inventories.** Land inventories are important for a municipality to understand its capacity to meet current and future needs. They should include developed and undeveloped land. In addition to planning, a land inventory can help assess the current benefits from different lands.
- **Create or update Open Space and Recreation Plans (OSRPs) with existing guidance from mass.gov.** OSRPs can include land inventories but are broader in scope. They help communities plan open space projects and are a required part of eligibility for state open space funding.

REQUIRED EXPERTISE

Internal: Town planner, recreation department, local conservation board, tree warden

External: Subject matter experts, affected communities, local land trusts

- **Secure funding and incentives to preserve forested areas.** Funding can come from many sources at the state and local levels. Municipalities can work with land trusts to pursue opportunities such as the Local Acquisitions for Natural Diversity grant program or funds from the Community Preservation Act.

Resources that may assist with preserving green spaces are listed below.

FINANCIAL AND TECHNICAL SUPPORT	
Division of Conservation Services Grants	Grant programs for conserving and acquiring open spaces.
Parkland Acquisitions and Renovations for Communities (PARC) Grant Program	Grant program that awards funding to cities and towns to acquire and develop land for outdoor recreation.
MassTrails Grants	Explanation of the MassTrails program and where to apply for grants to build trails.
Managing for Forest Carbon	Massachusetts Department of Conservation and Recreation report that describes carbon management strategies.
How Conserving Open Space Provides Economic Benefits to Massachusetts Communities	MassLand report with content that can inform what areas of Cape Cod to target for preservation and what benefits might result.
i-Tree	U.S. Forest Service tool that estimates the benefit and GHG reduction associated with forested and natural lands. Also allows the user to input projects with specific numbers of trees, area, and locations to estimate the benefits of proposed green space projects.
Open Space and Recreation Planner's Workbook	Commonwealth guide to creating OSRPs.
Recreation Use Database	Database from Oregon State University.
The Value of Land Conservation	MassLand toolkit for landowners and land trusts about the value of land conservation.
List of Land Trusts	MassLand list of all land trusts in Massachusetts; features several on Cape Cod.

ADDITIONAL INFORMATION	
The Cape's Natural Resources—What's at Stake?	Report from the Association to Preserve Cape Cod with information about the Cape's natural resources.
Nature-Based Solutions for Climate Change Mitigation	United Nations (UN) guidance and information on climate change mitigation, with a strong component of land conservation.
Natural and Working Lands Element: Climate Smart San José	Example of a natural and working lands strategy
New Jersey Natural and Working Lands Strategy	Example of a natural and working lands strategy.
Fiscal Impacts of Land Use in Massachusetts	Document showing the fiscal impacts of land use in four Massachusetts communities.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Protect, preserve, and restore wetlands and buffer areas

Natural Resources & Working Lands

PROTECT EXISTING WETLANDS FROM CONVERSION, PRESERVE WETLAND FUNCTIONS, AND RESTORE DEGRADED WETLANDS TO THEIR NATURAL STATE

Description and purpose of strategy: Wetlands serve important environmental and economic functions. They naturally sequester carbon, provide an essential habitat for wildlife, deliver water quality benefits, and offer protection from flooding and storm surge. Cape Cod's wetlands also provide a variety of recreational opportunities. The protection, preservation, and restoration of wetlands is a prominent strategy for both combating climate change and protecting communities from climate impacts.

Content of fact sheet: Overview of the economic and equity implications of protecting, preserving, and restoring wetlands, including the current state of the practice, a case study from Wellfleet, and steps for implementation.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☐ Health improvement from reduced pollutants
- ☑ Increased recreation
- ☐ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☑ Less damage to infrastructure
- ☐ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☑ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Wetlands protection, preservation, and restoration could improve economic opportunities by creating new jobs and protecting the livelihoods of local businesses that rely on the health of coastal and lowland ecosystems. Decreased exposure to risk from coastal hazards can also reduce personal and economic losses, which can be particularly burdensome for vulnerable communities.

Financial benefits: The capital costs associated with wetlands protection, preservation, and restoration typically outweigh the direct financial benefits. The cost per unit of carbon sequestered is high relative to the costs for other mitigation options.

Non-market benefits: There are many non-market benefits associated with wetlands protection, preservation, and restoration, including carbon sequestration, climate resilience, sedimentation and erosion control, water quality, groundwater recharge, wildlife preservation, and recreation. They may outweigh the high up-front costs.

GHG reductions: Healthy wetlands are effective carbon sinks, absorbing and sequestering more carbon per unit area than terrestrial forests. Although wetlands are collectively responsible for roughly one-third of global methane emissions, saline coastal wetlands produce negligible methane emissions. Restoring the natural tidal exchange to impounded coastal wetlands can reduce methane emissions.

Ease of implementation: Implementation approaches may vary significantly based on the type of project and wetland, ranging from passing regulations for wetlands protection and landward migration to launching construction projects to restore degraded wetlands.

BENEFIT COST ANALYSIS

The capital costs incurred by a municipality for a wetlands project are typically higher than the direct economic benefits. However, there are many indirect, or "non-market," benefits associated with wetlands protection, preservation, and restoration that accumulate over time and are often difficult to quantify.

Benefits

- **Direct economic benefits:** Wetlands projects—particularly restoration projects—can yield direct economic benefits to residents in the form of temporary job creation.
- **Climate mitigation benefits:** Wetlands can absorb and sequester impressive quantities of carbon per unit area compared with other ecosystems, storing most of it in sediments rather than vegetative biomass. Estimates suggest that Massachusetts' wetlands store six times more soil organic carbon per acre than forests (EEA, 2022). Because wetlands maintain anoxic conditions for extended periods, they can continue to sequester carbon for thousands of years, creating thick layers of organic matter. Conversely, when wetlands are drained or soil is degraded, rapid soil carbon loss can occur, and large quantities of GHG that took centuries or millennia to store can be released in a few decades. While estimates of long-term carbon burial capacity in wetland sediments are highly variable, research (Mcleod et al., 2011) suggests the following rates:
    - Salt marshes: 73 to 6,900 kilograms of carbon per acre per year
    - Seagrasses: 180 to 770 kilograms of carbon per acre per year

  While wetlands are collectively responsible for roughly one-third of global methane emissions, emissions rates vary significantly across wetland types and conditions. Saltwater wetlands produce negligible methane emissions due to regular inundation with sulfate-rich seawater. Recent studies conducted in Wellfleet and Falmouth by the Woods Hole Coastal and Marine Science Center suggests that restoring natural tidal exchange to impounded saltwater wetlands can significantly reduce methane emissions (Sanders-DeMott et al., 2022).
- **Climate resilience benefits:** Wetlands can act as buffers against storm surge and sea level rise. While difficult to quantify, benefits can be significant; one study suggests that U.S. saltwater wetlands provide more than $3,000 per acre on average per year in storm protection (Moomaw et al., 2018). During Hurricane Sandy alone, tidal marshes prevented an estimated $625 million in storm damage (Narayan et al. 2017). Wetlands also provide sedimentation and erosion control.
- **Water quality benefits:** Wetlands can recharge groundwater and improve water quality by removing pollutants from surface waters.
- **Commercial benefits:** Restoring wetlands strengthens ecosystems and promotes biological diversity. Many industries—including commercial fishing and cranberry production—derive benefits or generate products that are dependent on wetlands.
- **Recreation benefits:** Wetlands provide many recreational benefits including recreational fishing, swimming, boating, hiking, bird watching, and photography. The overall economic impact of recreational fishing in the U.S. is estimated at over $100 billion, and wetlands play a crucial role in the life cycle of up to 90% of fish caught recreationally (EPA, 2006).

Costs

- **Capital costs:** The costs of wetlands restoration can vary widely depending on the size and complexity of the site. Salt marsh restoration projects across the U.S. vary in cost between $3,300 and $15,550 per acre (Cape Cod Commission, 2021). The Massachusetts Division of Ecological Restoration estimates that freshwater wetlands cost $20,000 per acre to restore (EEA, 2022). The economic costs of restoring wetlands per unit of carbon sequestered are high relative to costs for other mitigation strategies. A study commissioned by the State of Maine found that

restoring salt marshes and eelgrass cost well over $1,000 per metric ton of CO_2 sequestered. However, these options become much more cost-effective when they are sited to maximize other ecosystem services, such as flood protection (State of Maine, 2020).

The following table presents the results of a recent cost-benefit analysis conducted for two priority wetlands restoration sites in Barnstable County: Parkers River in Yarmouth and Pamet River in Truro.

COSTS AND BENEFITS OF CAPE COD RESTORATION PROJECTS (IN THOUSANDS OF 2020$)

SITE	ACRES	RESTORATION COST	DIRECT ECONOMIC BENEFIT	CARBON SEQUESTRATION BENEFIT*	NITROGEN REMOVAL BENEFIT	FISHERIES BENEFIT	BENEFIT COST RATIO 2021–2030	BENEFIT COST RATIO 2021–2050
Parkers River	60	$1,050	$422	$4.0–7.0/year	$148–267/year	$14.2/year	2.0–3.2	5.2–8.3
Pamet River	158	$3,170	—	$10.7–18.4/year	$390–705/year	$37.4/year	1.4–2.4	4.2–7.2

* The carbon sequestration benefit was calculated in terms of the social cost of carbon at 2030.
Source: Cape Cod Commission, (2021).

EQUITY

The protection, preservation, and restoration of wetlands can result in a variety of outcomes that strengthen equity and reduce burdens on vulnerable populations. Potential benefits include:

- **Enhanced economic opportunity.** Wetlands conservation may protect or improve livelihoods for populations throughout coastal communities that rely on the health of marine ecosystems for economic security (e.g., fishing, restaurants, other businesses that sell marine products). Temporary job creation from the "restoration economy" could benefit those who are unemployed or under-employed, particularly if accessible training and job programs are developed in parallel.
- **Decreased risk from climate hazards.** Impacts from climate hazards such as flooding and storm surge are often particularly burdensome for underserved and under-resourced communities and can result in considerable economic losses and damage. Wetlands serve as an important bulwark against climate hazards; they can act as buffers from flooding and storm surge, absorb stormwater, and provide shoreline stabilization.

Optimizing Equity During Implementation

Along with the benefits mentioned above, wetland conservation can have equity-related impacts on communities. For instance, it will be important to consider equity in the citing of any wetland projects to avoid displacement. In addition, planners should consider potential long-term project impacts to adjacent communities, including any indirect impacts to property values and taxes that could stem from community improvements.

CASE STUDY: HERRING RIVER, WELLFLEET, MA

In 2023, the Town of Wellfleet and the Cape Cod National Seashore broke ground on the Herring River Restoration Project—the largest tidal restoration project in New England. The project aims to restore healthy estuarine function to over 800 acres of former salt marsh. Expected benefits include improved water quality, habitat restoration, and substantial climate benefits resulting from decreased methane production. The project is largely funded by grants from the U.S. Department of Agriculture Natural Resource Conservation Service and the Massachusetts Department of Fish and Game's Division of Ecological Restoration.

Photo: Chequessett Neck Road bridge and tidal gates, Mary Ann Bragg/Provincetown Banner

STATE OF PRACTICE

General State of Practice

There is an estimated 590,000 acres of wetlands in Massachusetts, representing 14% of the state's land area. An estimated 82% of these wetlands are freshwater; the rest are salt marshes and coastal resource areas such as beaches, dunes, and tidal flats. Between 1990 and 2017, wetlands in Massachusetts had an estimated net gain of 4,188 acres for freshwater wetlands and 737 acres for coastal wetlands. Although human activity was responsible for 1,548 acres of wetland resource loss and 2,733 acres of wetland resource gain during this period, the greatest overall increase to wetland resources was due to natural causes, primarily beaver activity (MassDEP, 2019).

Wetlands can be lost due to natural stressors (e.g., erosion, droughts, coastal storms, sea level rise) or more commonly due to human intervention (e.g., filling, draining). Efforts to prevent wetlands losses can either be regulatory or voluntary and are directed primarily by programs. The Massachusetts Department of Environmental Protection (MassDEP) oversees the administration of the Wetlands Protection Act (Massachusetts General Laws Chapter 131 § 40), which protects wetlands and other resource areas such as riverfront area, salt ponds, and fish runs. The Massachusetts Office of Coastal Zone Management (CZM) oversees the protection of coastal resources including salt marshes, eelgrass, and other habitats.

Cape Cod Context

Wetlands—including freshwater wetlands, salt marshes, intertidal areas, and other coastal resources such as beaches and dunes—represent 1 out of every 4 acres on Cape Cod. Recognizing their importance: the Cape Cod Regional Policy Plan established the Wetlands Resources Goal: "protect, preserve, or restore the quality and natural values and functions of inland and coastal wetlands and their buffers." The Goal includes objectives to protect wetlands and their buffers from vegetation and grade changes, protect wetlands from changes in hydrology, protect wetlands from stormwater discharges, and promote the restoration of degraded wetland resource areas. With narrow exceptions, development on Cape Cod must not alter the vegetation, grade, or hydrology of wetland resources or their 100-foot buffer areas.

IMPLEMENTATION

The following are recommended actions for planning and implementing wetlands projects. Specific approaches may vary based on the type of project (protection, preservation, restoration) and wetland type and function (freshwater/saltwater, tidal/non-tidal, etc.).

1. **Understand the potential.** Understand the natural potential of watersheds—including the historical range of conditions—and the ongoing causes of degradation.
2. **Incorporate wetlands into Open Space and Recreation Plans (OSPRs).** Consider including wetlands and actions for wetlands protection in municipal OSPRs.

REQUIRED EXPERTISE

Internal: Town planner, conservation commission, grant writer

External: Wetland scientist

3. **Secure funding.** Apply for grants to restore wetlands, such as the Environmental Protection Agency (EPA) Wetland Program Development Grants and other federal and state grants.
4. **Draft or modify bylaws and regulations.** Look for opportunities to incorporate local bylaws and regulations for wetlands protection and landward migration (i.e., the movement of coastal wetlands landward into adjacent ecosystems in response to environmental changes).
5. **Prioritize projects.** Focus on projects that are feasible, self-sustainable, and rely on natural fixes.
6. **Track progress.** Monitor restoration progress over time, document results, and modify practices as necessary.

Resources that may assist with implementation of wetlands conservation are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
MassDEP Grants and Financial Assistance: Watersheds and Water Quality	Grant programs focused on nonpoint source pollution, management, planning, and stormwater.
CZM Coastal Resilience Grant Program	Information on Massachusetts CZM grants to advance local efforts to address coastal flooding, erosion, and sea level rise.
CZM Coastal Habitat and Water Quality Grants	Information on the Coastal Habitat and Water Quality Grants, which provide financial resources for projects that assess and treat stormwater impacts and support comprehensive habitat restoration planning activities.
Massachusetts Division of Ecological Restoration (DER) Wetlands Restoration	Information on the Massachusetts DER wetlands restoration program.
Federal Funding for Wetlands	Information on EPA and other federal agency sources of funding that can be used to support state and tribal programs as well as voluntary restoration.
Cape Cod Regional Policy Plan Wetlands Technical Bulletin	Provides technical guidance on how wetlands projects can meet the goals and objectives of the Wetlands Resources Goal set by the Cape Cod Commission's 2018 Regional Policy Plan.
2018 Regional Policy Plan Data Viewer	Interactive GIS data organized according to the Cape Cod Regional Policy Plan Technical Bulletins.
Cape Cod Coastal Planner	A communication and decision support tool to educate users on the climate change hazards impacting Cape Cod's coastline, the adaptation strategies available to address them, and implications for local infrastructure and ecosystems.

ADDITIONAL INFORMATION	
Model Coastal Resiliency Bylaw	A model coastal resiliency bylaw developed by the Cape Cod Commission, which identifies strategies to mitigate and adapt to coastal changes.
Nashua River Communities Resilient Lands Management Project	A project implemented by the Towns of Clinton and Bolton, Massachusetts, to develop place-based land use and land management strategies that can enhance the potential of forests, open spaces, and wetlands. Contains recommendations for wetlands regulations.
Massachusetts Association of Conservation Commissions	A Massachusetts nonprofit 501(c)(3) organization dedicated to protecting wetlands, open space, and biological diversity through education and advocacy.
2021 Cape Cod Pond and Lake Atlas	An update to the 2003 Cape Cod Pond and Lake Atlas; examines the Cape's freshwater bodies, include pond ecology, water quality, threats, and strategies to restore pond health.
Cape Cod Freshwater Initiative	A science-based, information-driven planning process to engage stakeholders and enable action to protect and restore Cape Cod's freshwater resources.
Cape Cod Natural Resources Assessment	A report developed by the Association to Preserve Cape Cod that documents and maps the current status of sensitive natural resource areas on Cape Cod and documents unprotected areas that remain at risk from development.
Principles of Wetland Restoration	A list of principles developed by EPA's Office of Wetlands, Oceans and Watersheds that have been critical to the success of a wide range of aquatic resource restoration projects.
Economic Benefits of Wetlands	Fact sheet developed by EPA summarizing the national and local economic benefits of wetlands.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Support sustainable and resilient working lands

ZONING, REGULATION, AND LAND MANAGEMENT FOR AGRICULTURAL LAND PRESERVATION AND SUSTAINABLE PRACTICES

Natural Resources & Working Lands

Description and purpose of strategy: Making working lands sustainable and resilient can reduce greenhouse gas (GHG) emissions by reducing transportation of food, providing for compatible solar electricity generation, and reducing land management needs.

Content of fact sheet: Overview of actions municipalities can take to support agricultural land preservation and sustainable management practices, including zoning to preserve and promote agricultural use of land with prime agricultural soils and dual use of agricultural land for solar electricity generation, support for right to farm bylaws, engagement in efforts to preserve land in agricultural use, adoption of sustainable land management practices on town owned land, and support for local agriculture.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☐ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☑ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Workers may benefit from the creation of more sustainable jobs. Minimized fertilizer use and reduced emissions may benefit vulnerable communities, which tend to be most affected by watershed and air pollution.

Financial benefits: Municipalities can save on provision of community services by preserving farmland as an alternative to residential development. Adoption of dual-use "agrivoltaics" can provide significant financial benefits to producers through available incentives.

Non-market benefits: Solar electricity generation on agricultural land provides health benefits through reduced emissions of CO_2 and criteria pollutants.

GHG reductions: Agricultural land preservation, dual-use "agrivoltaics," sustainable land management practices, and supporting local agriculture can all help reduce CO_2 emissions.

Ease of implementation: Successful implementation of sustainable and resilient working lands actions requires an understanding of the characteristics of the land base and alignment with potential public and private partners.

BENEFIT COST ANALYSIS

Zoning

Municipalities can support the preservation, potential expansion, and sustainable use of productive agricultural lands through zoning to achieve two goals: preserve land with prime agricultural soils and facilitate adoption of dual-use agricultural production and electricity production from solar photovoltaic panels occurring together on the same piece of land that allows the continued use of the land for agriculture.

Land with prime agricultural soils can be zoned to discourage alternative uses, especially residential development, and the benefits of keeping land out of development would include lower costs of community services, increased property values for neighboring properties related to proximity to open space, and if converted to active and sustainable agricultural use, reduced chemical inputs and emissions related to transportation of food, and employment benefits of the farming operation.

The benefits of zoning for dual-use "agrivoltaics" include cost savings for the producer, reduced GHG emissions, reduced criteria pollutant emissions, and associated health benefits. By making agricultural operations more viable, adoption of agrivoltaics can preserve the already limited farmland on the Cape. The table below presents the value of health benefits from reduced pollutants, total project cost, and the value of incentives from the SMART program for a 10,000-watt photovoltaic system (approximately 440–475 square feet) over 20 years.

BENEFITS AND COSTS OF 10,000-WATT PHOTOVOLTAIC SYSTEM

BENEFIT/COST CATEGORY	AMOUNT
Reduced NO_x, SO_x and VOCs	$1,820–$4,120
Reduced CO_2	$11,974
Total project cost	($30,600)
Incentives	$63,008
Total	**$46,202–$48,502**

The range of values for reduced criteria pollutants reflects low and high estimates in EPA's Co-Benefits Risk Assessment (COBRA) tool.

Right to Farm

Right to farm bylaws protect and encourage the growth and development of farm-related businesses by protecting farmers and farm operators against nuisance lawsuits related to complaints about odor, flies, dust, noise from field work, spraying of farm chemicals, and slow-moving farm machinery on local roads. The benefits are similar to agricultural zoning protections if land is converted to active agricultural use.

Agricultural Land Preservation

Government farmland preservation programs and private land trusts work to ensure that land currently in agricultural use continues to be available for farming. In addition to zoning, municipalities may play a role in facilitating agricultural land preservation in partnership with federal, state, and private efforts to purchase development easements, transfer development rights, or outright purchase parcels identified as important to retaining a community's agricultural heritage. Agricultural lands can remove carbon dioxide from the atmosphere if managed with appropriate practices.

Stewardship of Town-Owned Land

Towns can lead by example by adopting management strategies that reduce GHG emissions and increase resilience on town-owned land. Strategies include integrated pest management, adoption of stress-tolerant plant varieties, and noxious weed eradication on town-owned land. Integrated pest management can decrease management time and chemical use by diversifying pest control practices, and carefully selecting and timing the use of pesticides to maximize their impact. Judicious use of fertilizer can reduce potential impacts on water resources. Using stress-tolerant (e.g., drought-resistant) plant varieties can also reduce management time, need for inputs, and the need to reestablish plantings that suffer during extreme weather events. Identifying and eradicating noxious weeds can limit damage to public health, agriculture, recreation, wildlife, or property. For example, noxious weeds may displace or slow canopy development of native pine species if uncontrolled.

Supporting Local Agriculture

Towns can also support local agriculture by making town-owned land available for farming and hosting farmers markets and community-supported agriculture (CSA) pickup locations. All of these actions can help foster the local agricultural economy, reducing food transportation and associated GHG emissions.

EQUITY

The potential equity-related benefits of supporting sustainable and resilient working lands include:

- **Employment**. Promoting local agriculture can help protect (through farmland preservation and more sustainable farmland practices) and generate jobs and economic opportunities for farm workers at various levels. Changes in farming practices and farmland preservation could help create local and sustainable job opportunities.
- **Food security**. More sustainable and regenerative agriculture practices could help increase food and nutritional security for local communities.
- **Improved health and safety**. The use of regenerative farming practices could improve the health and safety of local communities and workers by reducing exposure to chemicals and pesticides.
- **Reduced pollution**. Minimized fertilizer use could help decrease watershed and air pollution, which tend to disproportionately affect vulnerable communities.

Optimizing Equity During Implementation

- There will be a need to consider who benefits most from any implemented strategies. For example, if farm owners benefit from strategies that help their farms are workers also benefiting?
- Will zoning changes to protect farmland create any burdens for low-income populations through indirect means such as increased property taxes or housing costs? If so, municipalities should consider solutions to address the increased financial burden.

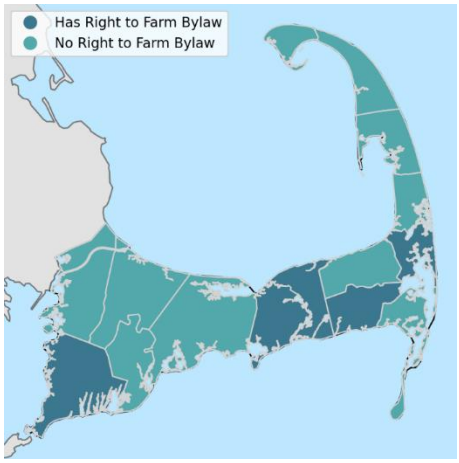
STATE OF PRACTICE

General State of Practice

Right to farm laws were developed in the 1970s in response to rapid suburbanization of agricultural areas. Massachusetts passed one of the first right to farm laws in the country in 1979. Towns can strengthen the protections of the state law by passing right to farm bylaws; as of 2017, 140 Massachusetts towns had adopted such bylaws.

While not a new concept, dual-use solar is expanding rapidly. The U.S. Department of Energy's InSPIRE project tracks adoption of agrivoltaics, showing 325 projects across 32 states in the U.S. as of early 2023. In Massachusetts, there are eight projects encompassing almost 19 acres of solar arrays. Specific location details were unavailable.

Cape Cod Context



Agriculture is a relatively small industry on the Cape—with 6,564 acres in farms in 2017—but it is a significant part of the area's history and cultural feel. Cranberries are the number one crop in terms of area, and nurseries and greenhouses lead total sales. Efforts to protect and support local agriculture are well established on the Cape. As of 2017, five Cape Cod towns had right to farm bylaws: Dennis, Falmouth, Harwich, Orleans, and Yarmouth. These bylaws recognize the value of agriculture and outline expectations for living near a farm (noise, odors, dust, and fumes). Several farmers markets run regularly during the summer months across the Cape, and four CSA farms are located on the Cape. In addition, many Cape towns have community gardens.

CASE STUDY: TONY ANDREWS FARM, FALMOUTH, MA

In 2018, the Town of Falmouth and The 300 Committee Land Trust acquired Tony Andrews Farm and adjacent lands overlooking the Coonamessett River in order to continue the century-old farming tradition. The acquisition was the result of a coordinated effort involving the Falmouth Community Preservation Committee, the Falmouth Conservation Commission, the Compact of Cape Cod Conservation Trusts, and the Massachusetts Land and Conservation Partnership grant programs. The 46-acre farm is now protected in perpetuity and will continue to be a working farm, growing strawberries, sweet corn, vegetables, and flowers.

Photo: Courtesy of Tony Andrews Farm

LEADING BY EXAMPLE TO REDUCE RESIDENTIAL USE OF PESTICIDES AND FERTILIZER

The largest user category for both pesticide and fertilizer products on Cape Cod is residential use, accounting for 81% of pesticide use and 69% of fertilizer use, applied either by property owners or commercial applicators. Cape towns can lead by example by adopting best management practices (BMPs) that residential land owners can also follow. The Cape Cod Commission has supported the development of residential BMPs for reducing pesticides and fertilizers that include:

- Knowledge development
- Limiting the size of managed areas
- Alternative landscapes and native species selection
- Smart grass selection
- Smart soil preparation and management
- Smart mowing
- Smart waste management and composting
- Pest identification
- Monitoring pests
- Mechanical pest controls
- Biological pest controls
- Chemical control

These BMPs provide guidance for municipal maintenance managers seeking to transition to more sustainable land management practices.

IMPLEMENTATION

The following steps can help guide municipalities that wish to pursue actions to support sustainable and resilient working lands.

- **Locate prime farmland.** Use MassMapper below to evaluate the suitability of zoning in relation to the presence of prime farmland soils.
- **Identify opportunities.** Using the results of mapping, identify opportunities for agricultural zoning, potential preservation through easements or acquisition (considering proximity to socially vulnerable communities), and agrivoltaics.
- **Adopt a right to farm bylaw.** Review the *Model Right to Farm By-Law* as an example for potential adoption.
- **Protect farmland.** Engage potential partners to consider options for agricultural land preservation through government or privately supported programs.
- **Incorporate sustainable practices into land management.** Develop a plan for adopting sustainable land management practices on town-owned land.
- **Facilitate local agriculture markets.** Contact local farmers and farmer organizations to gauge interest in cultivating town-owned land, establishing a new farmers market, or coordinating a CSA pickup location.

REQUIRED EXPERTISE

Internal: Town planner, maintenance managers, agricultural commission, community preservation committee, open space committee

External: Land trusts, private donors

Resources that may assist with implementation of sustainable and resilient working lands actions are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
Model Right to Farm By-Law	Encourages the pursuit of agriculture, promotes agriculture-based economic opportunities, and protects farmlands within a town by allowing agricultural uses and related activities to function with minimal conflict with abutters and town agencies.

Agricultural Preservation Restriction (APR) Program Details	Provides information about requirements, resources, policies, and guidelines from the Massachusetts Department of Agricultural Resources' APR program.
Agricultural Conservation Easement Program (ACEP)	Helps landowners, land trusts, and other entities protect, restore, and enhance wetlands or protect working farms and ranches through conservation easements.
Division of Conservation Services Grant Programs	Offers grant programs to cities and towns for the acquisition of conservation and recreation land, as well as the development and renovation of parks.
Solar Massachusetts Renewable Target (SMART)	Offers incentives for residential and commercial solar projects throughout Massachusetts.

ADDITIONAL INFORMATION

MassMapper	An interactive map for Massachusetts that can be used to identify land with prime agricultural soils.
Dual-Use: Agriculture and Solar Photovoltaics	UMass Clean Energy Extension fact sheet designed to help farmers navigate the SMART program.
American Farmland Trust-New England Regional Office	Resources to help farmers protect their land, produce a healthier environment, and build successful communities.
Invasive Plants	Overview of invasive plants in Massachusetts, with links to additional resources on identifying and managing invasives.
Cape Cod Cooperative Extension	Hosts a variety of programs to improve the health and well-being of youth, families, and communities; conserve and enhance natural and marine resources, and strengthen agriculture and food systems on Cape Cod.
UMass Extension Integrated Pest Management	Source of regional management guides and newsletters that help farmers, horticulturalists, green industry professionals, and home gardeners manage pests using integrated pest management principles.
Massachusetts Farmland Action Plan	Addresses the farmland needs and goals of the Commonwealth including but not limited to increasing farmland conservation, addressing farmland access (including urban farmland), food security, and the long-term economic and environmental viability of farms across all regions of the Commonwealth of Massachusetts.
Resilient Lands Initiative	An initiative whose vision is to protect and improve the quality of life for residents of every Massachusetts community through land conservation and stewardship initiatives that conserve and enhance the health of the forests, farms, and soils.
Healthy Soils Action Plan	A plan to protect, restore, and better steward soils across the Commonwealth.

This fact sheet was prepared for the Cape Cod Commission by Eastern Research Group Inc. with Economic Adjustment Assistance funding from the U.S. Department of Commerce, Economic Development Administration.

Additional climate change information and resources can be found at capecodcommission.org/climate.

CLIMATE ACTION FACT SHEET

Community

Improve public understanding of climate change

INCREASE UNDERSTANDING AND KNOWLEDGE OF CLIMATE CHANGE IMPACTS, PROGRAMS, AND ADVOCACY ACTIONS

Description and purpose of strategy: Municipal education and advocacy can improve community knowledge of climate risks, mitigation, and adaptation solutions. Education can help encourage residents to adopt strategies and other risk-reducing behaviors, while advocacy can help change laws at the local, state or federal level that support climate adaptation and mitigation.

Content of fact sheet: Summary of best practices for municipal climate change education and advocacy; a case study on how Outer Cape Energize conducted successful outreach; and information on the process and resources available for advancing municipal education and advocacy, including recommendations on how to reach out to diverse audiences.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☑ Increased recreation
- ☐ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☑ Less damage to infrastructure
- ☑ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Communicating how climate change is impacting the local environment and economy could empower communities to take actions to be more resilient.

Financial benefits: Education and advocacy efforts are indirect by nature and require significant time and resources, but they can have considerable and wide-ranging benefits.

Non-market benefits: Improvements in health from reduced pollutants are benefits of several climate actions promoted by education and advocacy.

GHG reductions: Education and advocacy is a supporting strategy for emissions reductions and while there are no direct emissions reductions, it can indirectly reduce GHG impacts.

Ease of implementation: A lack of staff and resource capacity is often a barrier for implementing education and advocacy programs. However, partnering with local organizations and working with volunteers can allow municipalities to streamline initiatives, reduce their individual workload, and reach a wider audience.

BENEFIT COST ANALYSIS

Education and advocacy yield several long-term outcomes, but the diversity in types of projects and local contexts makes quantifying the benefits of education and advocacy programs challenging. Many outreach and education campaigns are collaborations between volunteers, nonprofits, and municipal organizations. Some efforts focus on raising awareness of climate impacts and vulnerability, while other efforts are tied to specific programs, such as Solarize Mass. Programs that pair targeted education with outreach have led to progress throughout the Commonwealth. For example, the Arlington and Winchester HeatSmart Mass campaign, which utilized volunteers to conduct outreach on the program's financial savings and environmental benefits, resulted in 224 signed contracts for installation of clean heating systems like air source heat pumps. These installations result in more efficient homes, reduced CO_2 emissions, and long-term financial savings on heating and energy bills.

The potential benefits of education and advocacy efforts are indirect by nature, as these efforts aim to influence the decisions and actions of others. Education and outreach activities are an important component of many of the strategies highlighted throughout these fact sheets, as summarized below.

BENEFITS OF EDUCATION AND OUTREACH ACTIVITIES

STRATEGY	EDUCATION/OUTREACH ACTIVITY	POTENTIAL BENEFITS
Reduce vehicle miles traveled	• Support local organizations in implementing work from home policies • Support local organizations and agencies in switching from in-person to virtual workshops • Encourage active transportation	• Reduced emissions of GHG and criteria pollutants • Health improvements • Increased recreation • Job and economic growth
Promote residential adoption of electric vehicles (EVs)	• EV advocacy	• Reduced emissions of GHG and criteria pollutants • Health improvements • Lower maintenance/operational costs
Generate and increase the use of safe, reliable and clean electricity	• Encourage community solar through public outreach	• Reduced emissions of GHG and criteria pollutants
Strive toward net zero energy buildings: New non-municipal buildings	• Educate the community about benefits of the Specialized Building Code • Advertise training resources	• Reduced emissions of GHG and criteria pollutants • Health improvements • Lower maintenance/operational costs • Higher property value • Increased resilience • Job and economic growth
Strive toward net zero energy buildings: Existing non-municipal buildings	• Engage the community • Provide assistance	• Reduced emissions of GHG and criteria pollutants • Health improvements • Lower maintenance/operational costs • Environmental enhancement/protection • Increased resilience • Job and economic growth
Promote waste reduction and waste diversion from landfills	• Promote participation in compost collection • Promote community recycling programs	• Reduced emissions of GHG and criteria pollutants • Health improvements • Lower maintenance/operational costs • Environmental enhancement/protection • Higher property value • Job and economic growth
Retrofitting and relocation of vulnerable buildings	• Community outreach	• Reduced damage to infrastructure • Higher property value • Increased resilience • Job and economic growth

EQUITY

Education and advocacy have the potential to empower communities by increasing understanding of how climate change is impacting their environment and economy. This knowledge can encourage people to take actions that reduce their own climate risk and influence decision-making at the local, state, and federal level. Potential equity benefits from education and advocacy include:

- **Increased awareness of ways to reduce climate risk.** Improved understanding of climate risks and adaptation and mitigation solutions could benefit communities by increasing awareness of personal and community strategies that individuals and households can take to reduce risk and decrease vulnerability, resulting in more individual, household, and local community resilience.
- **More sustainable behaviors.** Improved behavior change could lead to more sustainable behaviors (e.g., decreased vehicle usage), which could lead to improved air quality and decreased pollution into the future.

Optimizing Equity During Implementation

When designing an education or outreach program, municipalities should integrate equity considerations throughout the process. Important components of an equitable communications strategy include:

- Using clear and straightforward language to communicate climate change information and impacts
- Utilizing diverse outreach platforms
- Leveraging written and oral translation services for residents whose second language is English or who speak languages other than English.
- Reducing barriers to engagement by ensuring that materials are accessible to individuals with disabilities.

Engagement efforts should consider:

- Providing multiple ways for the audience to provide feedback.
- Scheduling activities with cultural considerations, such as religious holidays, in mind.
- Meeting people where they are physically at within the community in spaces where they are most comfortable. This can be achieved by partnering with trusted community organizations.
- Designing engagements that are centered around communities to empower individuals and build capacity.

Municipalities will need to have a thorough understanding of the demographics and needs of their community to ensure that outreach and engagement is responsive to all populations. For any public meetings, it will also be useful to consider strategies to ensure vulnerable communities are able to attend. For example, this could include transportation vouchers, childcare at the events, having events in a variety of locations and at a variety of times, or providing food at events. Municipalities should consider integrating outreach with existing community events to meet residents where they are at and collaborating with local groups that have built trusted relationships within the community and who are representative of the community's diverse constituency.

STATE OF PRACTICE

General State of the Practice

Climate change education and advocacy is conducted by most municipalities throughout Massachusetts, though the extent and type of education and advocacy vary. For the 335 municipalities participating in the Municipal Vulnerability Preparedness (MVP) program, each municipality was required to host community resilience building workshops. Education and advocacy take time and resources, which are often limited at the municipal level. In a 2021 survey of Massachusetts

municipalities, a frequently reported barrier to resilience strategies was a lack of resources needed to rally broad community support (Vicarelli et al., 2021). This lack of resources has resulted in most municipal-level outreach and education taking place through volunteers, partnerships with nonprofits and other institutions, and the utilization of several networks. This type of collaborative education is common throughout the Commonwealth. For example, 85 municipalities in Massachusetts participated in the Solarize Mass program, where municipalities partnered with volunteers to conduct grassroots outreach and education on installing renewable solar energy. Education efforts vary by community, but they included developing a program website, writing articles in local papers, mailings, online raffles with prizes from local businesses, and outreach at town meetings.

There are many environmental groups working to implement climate action and promote climate policies within the Commonwealth. For example, the Massachusetts Climate Action Network (MCAN) supports 49 local chapters working at the municipal level, including the Cape Cod Climate Action Network (CC CAN). MCAN facilitates municipal-level action while also advocating at the state and regional level for policies that support municipalities in taking climate action. Within the CC CAN, there are five climate action networks formed at the town level by local citizens.

Cape Cod Context

All 15 municipalities within Cape Cod have completed some level of climate vulnerability outreach with their MVP planning grant. Nine of the 15 municipalities have committees dedicated to energy, climate action, or coastal resiliency (or a combination thereof) that are also charged with public education and outreach. Many of these committees focus on increasing alternative energy use, energy conservation, and energy efficiency. Each municipality varies in the level of education and outreach they have conducted so far, but most partner with nonprofits and other organizations in their educational campaigns. Some towns have expanded their work to focus more on climate impacts and vulnerabilities (especially flooding). For example, the Town of Sandwich Energy Committee is currently conducting a survey on coastal resiliency to inform flood management. The Town of Orleans promotes climate change workshops and resources on its website. See the table below for more examples of education and advocacy projects. Several towns are part of organizations or collaborations to further their energy goals. For example, Cape Light Compact represents 20 towns in Barnstable and Dukes counties to promote consumer advocacy and education on energy efficiency and renewable energy supply. Towns on the Outer Cape formed Outer Cape Energize to promote solar installations, as detailed in the case study below.

There are several groups active on Cape Cod that work with municipalities and individuals to further climate education, action, and advocacy. The Cape Cod Climate Change Collaborative works with public and private stakeholders across the Cape and Islands to foster connections, educate, and advocate for decarbonization and climate adaptation actions. Self-Reliance provides education on energy efficiency and renewable energy throughout the Cape to consumers, industry, businesses, and municipalities. These groups provide resources, training, and support for climate and energy education that can be leveraged to support town efforts.

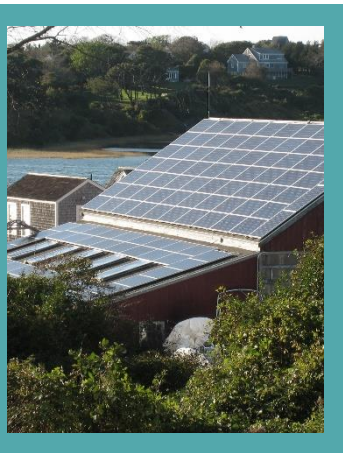
EXAMPLE EDUCATION AND ADVOCACY PROJECTS ON CAPE COD

PROJECT	PARTNERS	DESCRIPTION
Electric Vehicle Expo	Recharge Massachusetts, Cape Cod Commission, Cape Cod Regional Transit Authority, and Cape Cod Climate Change Collaborative	This test drive event is an open and free event designed to increase understanding and adoption of EVs. Individuals can test drive an EV, chat with EV owners, learn from regional organizations about plans for public charging and EV adoption, and learn about the local, state, and federal incentives for purchasing an EV.
Climate Action Workshops	Wellfleet Energy and Climate Action Committee, Wellfleet Public Library	These workshops comprised a three-part program to promote better energy practices through electrifying homes and modes of transportation, converting to renewable electricity, and improving energy conservation.

Climate Ambassadors Program	Cape Cod Commission	This program selects students in grades 9–12 to develop their understanding of climate change, how to best communicate about it, and what actions can be taken to bring about change. Students complete the program with a small demonstration project on how they can have a personal impact on climate change.
Energy Cafe	Cape Light Compact, National Grid, Mass Save, volunteers from the faith community	Energy cafes are discussions run by volunteers and hosted at various faith-based institutions on Cape Cod. These conversations share information about energy efficiency benefits and upgrade opportunities. Participants are invited to sign up for no-cost home energy assessments.
Candidates Climate Forum	Chatham Climate Action Network	This forum covered a range of topics related to climate change with candidates for Chatham's Select Board.
Take Care Cape Cod	CARE for the Cape & Islands	This campaign educates visitors and year-round residents about the role all of us have in preserving Cape Cod's unique environment. Other environmental stewardship projects offered by Care for the Cape and Islands include Cape Crusaders and annual Care Days.

CASE STUDY: OUTER CAPE ENERGIZE

Starting in 2018, the energy committees of Provincetown, Truro, Wellfleet, and Eastham formed Outer Cape Energize to increase the use of solar electricity, reduce carbon emissions, and increase energy conservation on the Outer Cape. Under their Solarize Mass program funded by the Massachusetts Clean Energy Center, the group sponsored a series of public outreach meetings and collaborated with volunteers to conduct an educational campaign on how citizens can reduce their environmental impact and save money in the process. Outer Cape Energize partnered with ACE Solar to offer preferred pricing for solar systems installed through the program. By the end of 2018, 120 Outer Cape households purchased solar arrays through Solarize Mass, amounting to over 833 kW of photovoltaic capacity (Outer Cape Energize, n.d).



IMPLEMENTATION

The Cape Cod Climate Action Plan Communications Framework recommends the following steps to implement an effective communication program:

1. **Set goals and objectives.** Define goals based on what the outreach should achieve and set measurable objectives to support reaching those goals. Consider strengths and weaknesses of previous efforts, and opportunities to influence stakeholders.
2. **Identify key audiences and collaborators.** Different groups of people will respond to messages in different ways. Consider who the key audience segments are and identify organizations that could help reach each group.
3. **Develop key messages.** Messages should be tailored to each target audience segment and use simple, clear, and consistent language. Key messages may revolve around increasing climate awareness or focus on individual, local, and regional change.

REQUIRED EXPERTISE

Internal: Communications specialist

External: Nonprofit community organizations

4. **Select outreach strategies.** Determine the best communication channels to achieving the outreach goals and reaching target audiences. Prioritize channels that the target audiences use frequently and make sure core messaging remains consistent across communication platforms.
5. **Determine milestones and timelines.** Set a timeline for implementing each tactic in the outreach plan. Consider your organization's goals and incorporate major milestones into the timeline, such as town meetings, stakeholder engagement events, or target dates for climate action achievements.
6. **Define and measure success.** Using the goals and objectives set in step one, determine what your measure of success will be and how to measure it. Evaluate the success of the outreach periodically and adapt messaging and tactics as needed.

Equity should be considered in each step of the process. Finding collaborators and building partnerships can help municipalities reach a wider audience, increase their capabilities, and be more efficient with available resources. As mentioned in the examples described above, forming partnerships with nonprofits/community organizations and their leadership is instrumental in effective education and advocacy work on Cape Cod.

Resources that may help identify collaborators, and design and implement effective climate change communications are listed below.

TECHNICAL SUPPORT	
Climate Action Plan: Cape Cod Communications Framework	Framework and resources to support municipal and regional government, non-governmental organizations, nonprofits, and others to communicate climate impacts and increase engagement and individual actions on reducing climate risk.
Self-Reliance	Nonprofit based on Cape Cod that provides energy education and advocacy resources.
Cape Light Compact	Energy services organization that advocates for clean energy and provides resources, case studies, and examples of education and advocacy work.
Cape Cod Climate Change Collaborative	Nonprofit that builds networks and relationships to support local action on climate change. Provides resource library, a list of their partners, and information on how to get involved with their network.
C40 Cities Climate Action Planning Communications Toolkit	Resources on developing communications campaigns, telling stories to inspire change, using social media, and planning, targeting, and measuring a campaign. Also provides guidance on engaging your audience with graphics.
FINANCIAL SUPPORT	
Coastal Resilience Grant Program	Grants for coastal municipality projects that increase coastal resiliency, including public outreach to increase community understanding of climate change impacts, build partnerships, and promote local adaptation efforts.
Urban and Community Forestry Challenge Grants	Grants for municipalities and nonprofits working to improve urban and community tree resources, including programs that build advocacy and action organizations and improve public awareness or support for community tree care and/or urban forestry.
Our Town Grants Program	Grants for partnership between a local government and nonprofit organization to integrate arts, culture, and design into efforts that strengthen communities by improving local economic, physical, or social outcomes, including projects on energy and the environment.

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Additional climate change information and resources can be found at capecodcommission.org/climate.

CAPE COD COMMISSION

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